



MODERN PEDIATRIC DENTISTRY

Vinay Kumar Srivastava



Foreword Anil Kohli

JAYPEE

Modern Pediatric Dentistry

Modern Pediatric Dentistry

Vinay Kumar Srivastava

Professor and Head
Department of Pedodontics and Preventive Dentistry
Saraswati Dental College
Lucknow, UP, India

Foreword

Anil Kohli



JAYPEE BROTHERS MEDICAL PUBLISHERS (P) LTD

New Delhi • St Louis • Panama City • London

Published by

Jitendar P Vij

Jaypee Brothers Medical Publishers (P) Ltd

Corporate Office

4838/24, Ansari Road, Daryaganj, **New Delhi** 110 002, India

Phone: +91-11-43574357, Fax: +91-11-43574314

Registered Office

B-3, EMCA House, 23/23B Ansari Road, Daryaganj, **New Delhi** 110 002, India

Phones: +91-11-23272143, +91-11-23272703, +91-11-23282021, +91-11-23245672

Rel: +91-11-32558559, Fax: +91-11-23276490, +91-11-23245683

e-mail: jaypee@jaypeebrothers.com, Website: www.jaypeebrothers.com

Offices in India

- **Ahmedabad**, Phone: Rel: +91-79-32988717, e-mail: ahmedabad@jaypeebrothers.com
- **Bengaluru**, Phone: Rel: +91-80-32714073, e-mail: bangalore@jaypeebrothers.com
- **Chennai**, Phone: Rel: +91-44-32972089, e-mail: chennai@jaypeebrothers.com
- **Hyderabad**, Phone: Rel: +91-40-32940929, e-mail: hyderabad@jaypeebrothers.com
- **Kochi**, Phone: +91-484-2395740, e-mail: kochi@jaypeebrothers.com
- **Kolkata**, Phone: +91-33-22276415, e-mail: kolkata@jaypeebrothers.com
- **Lucknow**, Phone: +91-522-3040554, e-mail: lucknow@jaypeebrothers.com
- **Mumbai**, Phone: Rel: +91-22-32926896, e-mail: mumbai@jaypeebrothers.com
- **Nagpur**, Phone: Rel: +91-712-3245220, e-mail: nagpur@jaypeebrothers.com

Overseas Offices

- **North America Office, USA**, Ph: 001-636-6279734
e-mail: jaypee@jaypeebrothers.com, anjulav@jaypeebrothers.com
- **Central America Office, Panama City, Panama**, Ph: 001-507-317-0160
e-mail: cservice@jphmedical.com, Website: www.jphmedical.com
- **Europe Office, UK**, Ph: +44 (0) 2031708910
e-mail: info@jpmedpub.com

Modern Pediatric Dentistry

© 2011, Vinay Kumar Srivastava

All rights reserved. No part of this publication should be reproduced, stored in a retrieval system, or transmitted in any form or by any means: electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the author and the publisher.

This book has been published in good faith that the material provided by author is original. Every effort is made to ensure accuracy of material, but the publisher, printer and author will not be held responsible for any inadvertent error(s). In case of any dispute, all legal matters are to be settled under Delhi jurisdiction only.

First Edition: 2011

ISBN 978-93-5025-189-8

Typeset at JPBMP typesetting unit

Printed at

Dedicated to
My family members for their unconditional love,
support and long-term sacrifices

Foreword

I am glad to write the foreword for the textbook titled *Modern Pediatric Dentistry* by Dr Vinay Kumar Srivastava, Professor and Head, Department of Pedodontics and Preventive Dentistry, SDC, Lucknow, UP, India. The contents of the book are based as per the guidelines of Dental Council of India. This book has fulfilled the need for illustrated, concise and comprehensive educational materials for undergraduates and postgraduates in the subject of pediatric dentistry.

I would like to congratulate the author for writing such a good textbook. It has the potentials of becoming a milestone in the upgradation of knowledge in the subject of pediatric dentistry.

I wish him good success in all his endeavors.

Anil Kohli

Padam Bhushan (Hony) Brigadier

President

Dental Council of India

Preface

The purpose of mastering a difficult subject is accomplished only by successfully conveying the knowledge to others. The key attribute of a good textbook is its ability to explain things so interestingly that students are able to understand and appreciate it. Dentistry and teaching of dentistry are undergoing profound changes continuously. Rapid progress has recently been made in the fields of adhesive dental materials, advances in instrument, microbiology, physiology, preventive dentistry as well as genetics and forensic science. It is for us as teachers to convey the recent inventions and discoveries in the fields of pediatric dentistry to the students.

This book is intended for students who are pursuing careers in pediatric dental health. My aim is to present a straightforward, uncomplicated approach to the subject both for the pupils and their teachers. I had three main objectives for preparing this book:

1. To bring the book up-to-date in both depth and scope, so that it may reflect recent discoveries and advances in the fields of pediatric dentistry.
2. To present the matter with appropriate explanations and functional examples so that it can be more accessible to a larger group of students.
3. To make the book fully career-oriented, to fulfill the needs of every undergraduate and postgraduate students.

It was a joy for me to write this book. Over years of teaching I have found that students learn best from short, focused chapters. Students learn more when presented with concise illustrated educational material. I would say that along with the vast knowledge that the book covers, it is an affordable book for keen and eager students. Emphasis has been placed on clarity and importance of mastering fundamentals.

I have made a sincere effort to minimize all sorts of errors including textual, grammatical and clinical. Even then, some minor errors may have been incorporated inadvertently. I request you to overlook all those errors that may be regarded as insignificant and I would humbly accept your corrections for the significant one for the benefit of students and others.

Vinay Kumar Srivastava

Acknowledgments

At the very outset, I bow my head to Almighty who blessed me with his worthy blessing, bestowed me with his kind grace, provided me necessary strength, courage and good health to reach this stage and made it possible for me to bring out this manuscript into book form titled *Modern Pediatric Dentistry*. I am thankful to my parents and grandparents, whose unforgettable sacrifices and choicest blessings have provided me the opportunity to be educated.

I am deeply indebted to my revered teacher and pathfinder specially Professor JN Jaiswal, Professor Sobha Tandon, Professor Sarkar, and Professor Satish Chandra who have very dexterously guided me through the difficult and painstaking path of successfully completing this endeavor.

My sincere thanks to my PG students specially Dr Somya, Dr Ankur, Dr Nitin, Dr Tazeen, Dr Rajat, Dr Saima, Dr Sansriti and Dr Kirti who were always ready to help me in my moments of need.

I shall always remember the co-fraternity (Pedodontist) of my dear colleague, Professor IK Pandit, Professor Sameer Dutta, Professor Mousami, Professor Rani Somani, Professor Usha Mohan Das, Professor Bharat Bhushan, Professor Nikhil Srivastava, Professor Dr MK Jindal (AMU), Associate Professor Abhay, Dr Rana (Shubarti, Meerut), Associate Professor Neerja, Dr Monica, Dr Abhay Mani (BBD, LKO). Associate Professor Somya Navit, Dr Gyanendra, Associate Professor AG Nigam, Associate Professor Afroz (Carrier dental LKO), Dr SB Pustakey, Dr Anshul, Dr RK Chak, Dr Seema Choudhary, Dr Suleman Abbas, Dr Sarika Garg, Dr Seema Sohel, and all the Pedodontists of India and abroad who were always ready to help me in my moments of need.

I am deeply indebted to my wife Ekta Srivastava for her unflinching support, patience and prayers, which were a great incentive in reaching this place and completing this work.

I ought not to fail to mention my thanks to management of SDC Lucknow who have always emboldened me and boosted my morale, and to all my friends specially Professor RK Dubey (AMU), Professor TP Chaturvedi (BHU), Dr HC Baranwal and Captain PK Srivastava (Army corps). Last but not the least, I would like to thank all those who directly or indirectly helped me to complete this manuscript in time.

Contents

1. Scope and Importance of Pediatric Dentistry 1

- Definition 1
- Brief History of Pedodontics in India 1
 - Scope of Pedodontics 1
 - Vastness of Pedodontics 2
 - Procedures and Pictures 2
 - Importance of Pedodontics 3
- Challenges for Pediatric Dentistry in 21st Century 3

2. Infection Control in Pediatric Dental Clinic 4

- Introduction 4
 - Infection Control: Precaution and History 4
- Sterilization of Endodontic Instrument 4
- Autoclave 4
 - Sterilization of Gutta-percha 5
 - Sterilization of Silver Cone 5
 - Sterilization of Glass Slab or Dappen Dishes 5
 - Sterilization by Formalin Gas Chamber 5
 - Laser Beam Sterilization 6
 - Infection Control to the Dental Staff 6
 - Infection Control to the Patient 6
 - Infection Control in Diabetic Dental Patient 6
- Disinfection of Operatory
- Surface and Dental Appliances 6
- Careful Handling of Biopsy Specimen 7
- Infections Control Through Hospital Waste Disposal 8
 - Classification of Waste 8
 - Collection of Waste 9
 - Waste Disposal 9
 - Microwaves Sterilization 9
 - Incineration 9
 - Facility Option 12

- Single in House Facility 12
- Joint Facilities Serving Several Hospitals 12
- Delegating the Task to an Independent Collection Service 12
- Waste Treatment 12
- Combustion Chamber (Low Temperature Carbonization) 12
- Reheating Chamber 13
- Heat Exchangers 13
- Advantages of Incineration 13
- Waste Minimization Options 13
- Source Reduction 13
- Recycling and Reclamation 14
- Conclusion 14

3. Set-up of Pediatric Dental Clinic 15

- Introduction 15
 - How to Communicate with the Child in Dental Operatory 18
 - Record Keeping 18
 - Health Education Room 18
 - Modification of Clinic for Disabled Child 19
 - Dental Office Access 19

4. Child Examination, Diagnosis and Treatment Planning 20

- Aim and Objective of Childs
- Orofacial Examination 20
 - Introduction to the Pediatric Dentistry 20
 - Risk Assessment and Orofacial Examination 20
 - Prevention 20
 - Steps of the Examination 20
 - Interview and Counseling 22
 - The Child's Position During Dental Treatment 22
 - Case History 22
 - Vital Statistics 23
 - Parental of Caretaker History 23

Prenatal and Natal History	23
Postnatal and Infancy History	23
Clinical Examination of Child	25
General Survey of Child	25
Child-language Development	26
Motor Aphasia	26
Delayed Speech	26
Repetitive Speech or Stuttering	26
Articulatory Speech	26
Hands	27
Temperature of Body	27
Examination of Head and Neck	27
Oral Mucosa	30
Examination of Tongue and Sublingual Space	31
Examination of Palate	31
Pharynx and Tonsil's Examination	31
Examination of Dentition	31
Uniform Dental Recording	32
Other Diagnostic Aids	33
Indication for Radiograph in Children and Adolescence	33
Pulp Vitality Test	33
Electric Pulp Testing	33
Thermal Testing	34
Laser Doppler Flowmetry	34
Pulse Oximetry in Evaluation of Pulp Vitality	34
Fiberoptic Transillumination Test for Teeth	34
Study Casts	34
Laboratory Investigation	35
Photographs	35
Advance Diagnostic Aids	35
Diagnosis	37
Collection of Important Information	37
Evaluation of Patient Record	37
Making the Diagnosis	37
Treatment Planning	37
Revisions of a Treatment Plan	38
Position of Dental Team and Patient Around the Dental Chair	38
Lighting of the Operative Field	39

5. Dental Radiology for Child and Adolescent 40

Definition	40
Radiographic Techniques in Dentistry	41
Intraoral Radiography	41
Paralleling Technique	41
Bisecting Angle Technique	41
Bitewing Technique	42
Occlusal Radiographic Technique	42
Periapical Radiographic Technique	43
Panoramic Radiography	43
Buccal Object Rule	44
Skull Projection	44
TMJ Projection	46
Hazards of Radiation	46
Effect on Cells	46
Precautions	46

6. Normal Child Development 49

Introduction	49
Clinical Significance of Developmental Theories	49
Practical Implication of Temperamental Development	51

7. Behavior Management of Children 55

Childhood Development	55
Tell, Show, do Technique (TSD Technique)	60
Conclusion	63

8. Nutritional Considerations for Children and Adolescents 64

Introduction	64
Dietetics	64
Classification of Foods	64
Proteins	65
Functions of Proteins in the Body	65
Sources of Proteins	65
Fats	65
Fatty Acids	65
Source	65

Functions	65
Carbohydrate	66
Dietary Fiber	66
Functions of fiber	66
Advantage	66
Disadvantage	66
Nutritional Requirements	66
Basic Concepts	66
Recommended Daily Allowance (RDA)	66
Balanced Diet	66

9. Eruption of Teeth, its Disturbances and their Management..... 69

Teething Process	69
Signs and Symptoms of Teething	69
Local Signs	69
Systemic Signs	69
Teething and Associated Problems	69
Management of Teething	69
Local Treatment	69
Systemic Medicament	70
Eruption Cyst	70
Treatment	70
Submerged Tooth (Infraocclusion)	70
Mechanism of Submergence	70
Treatment	70
Diagnosis of Ectopic Eruption	71
Treatment	71
Methods	71
Kesling or Self Locking Separating Spring	71
Delayed Eruption of Permanent Teeth	72
Incisors	72
Canines	72
Premolars	72
Molar	72
Impaction and Delayed Eruption of Maxillary Permanent Canines	72
Treatment	72
Anomalies of Tooth Form	73
Management of Double Teeth	73
Peg Shaped Lateral Incisors	73
Treatment	73
Tooth within a Tooth (Dens in Dente)	73
Management of Dens in Dente	73

Talon Cusp	74
Problems Associated with Talon Cusp	74
Treatment	74
Dilaceration	74
Treatment	74
Anomalies of Tooth Number	74
Development of Supernumerary Tooth	74
Treatment	75
Anodontia	75
Treatment	75
Anomalies of Tooth Structure	75
Enamel Hypoplasia	75
Etiology of Hypoplasia of Enamel	75
In Primary Teeth	76
In Permanent Teeth	76
Problem Associated with Hypoplasia and Hypomineralization of Enamel	76
Treatment	76
For Permanent Hypoplastic and Hypomineralized Incisors	77
For Hypoplastic Canine and Premolars	77
Dentinogenesis Imperfecta	77
Treatment	77
Staining of Teeth	77
Intrinsic Staining (Mottled Enamel or Tetracycline Staining)	78
Management of Staining	78
Technique: Etching and Abrading (Crool and Cavanaugh, 1986)	78
Technique: Etching and Bleaching (Boksman and Jordan, 1983)	78
Technique: Etching, Bleaching and Abrading (Chandra and Chawla, 1975)	78
A Newer Concept: Removal of Dental Fluorosis Strains	78

10. Development of Dentition 80

Prenatal Effect on Facial Development	80
Embryonic Development	80
Late Fetal Development	80
Gum Pad	81
Eruption of the Primary Teeth	81
Eruption of Permanent Teeth	82
Space Relationship in Replacement of the Deciduous Incisors	83

Space Relationships in Replacement of
Deciduous Canine and Molars 83
Non Spaced Primary Dentition 84

11. Growth and Development of Nasomaxillary Complex and Mandible..... 85

Theories of Growth Control 85
Growth of Maxilla 85
Rotation of Maxilla 86
Mandible 86
Timing of Growth in Width,
Length and Height 87
Jaws Rotation During Growth 87
Mandibular Rotation 88

12. Use of Preventive and Interceptive Orthodontics in Pediatric Dentistry.... 89

Concepts of Preventive Orthodontics 89
Use of Preventive Orthodontics 89
Growth and Development 89
Etiology 90
Case History, Examinations and Records 90
Oral Examination 90
Study Model 91
Photograph 91
Radiograph 91
Classification 91
Methods of Crossbite Correction 92
Clinical Preventive Procedure 93
Summary 94

13. Space Maintainers 95

Introduction 95
Definition 95
Class I 95
Class II 95
An Ideal Requirement of Space Maintainer 96
Removable Space Maintainer 96
Indications 96
Contraindications of Removable
Space Maintainer 96
Technique and Fabrication 96
Complete Denture 97
Removable Distal Shoe Space Maintainer 97

Fixed Space Maintainer 97
Advantage of Fixed Space Maintainer 97
Disadvantage of Fixed Space Maintainer 97
Crown and Loop Space Maintainer 97
Indications 98
Technique and Fabrication 98
Band and Loop Space Maintainer 98
Lingual Holding Arch Space Maintainers 99
Indications 99
Technique and Fabrication 99
Nance Holding Arch (Maxillary) 99
Fabrication 100
Placement 100
Distal Shoe Space Maintainer (Fixed Type) 100
Indications and Contraindication 100
Technique and Fabrication 100
Placement 101
Band and Bar Type Space Maintainer 101
Esthetic Anterior Space Maintainer 101
Gerber Space Maintainer 101
Mayne Space Maintainer 101
Advantage 102
Disadvantage 102

14. Pediatric Oral Habits 103

Digit Sucking 103
Etiology 103
Psychoanalytic Theory 103
Behavioral Theory 104
Clinical Feature of Digit Sucking 104
Corrective Appliances 104
Mouth Breathing 104
Clinical Feature 105
Treatment 105
Tongue Thrust Habit 105
Classification of Tongue Thrust 105
Treatment 106
Appliance Therapy 106
Management of Tongue Thrust 106
Finger Nails Biting Habit 107
Treatment 107
Clinical Feature (Dentoalveolar) 107
Treatment 107

Etiology 107
 Clinical Features 108
 Treatment 108

15. Gingival Health Considerations in Children and Adolescents 109

Normal Periodontium 109
 Effect of Growth and Development on Periodontium 109
 Treatment 111
 Advantages of Electrosurgery 112
 Disadvantages 112
 Advantages of Laser Surgery 112
 Disadvantages of Laser Surgery 113
 Periodontitis and Loss of Tooth in Young Children 112
 Prepubertal Periodontitis 113
 Treatment 114
 Juvenile Periodontitis 114
 Treatment 114

16. Dental Plaque 116

Introduction 116
 Complexity of Plaque Bacteriology 116
 Criteria for Periodontal Pathogenicity of Oral Bacteria 116
 Supragingival Plaque 117
 Development of Supragingival Plaque (Plaque Maturation) 117
 Bacterial Growth and Proliferation within Dental Plaque 118
 Concept of Bacterial Specificity 118
 Oral Flora 118
 Immunologic Response in Gingivitis and Periodontitis 119

17. Dentifrices 121

Composition of Dentifrices 121
 Recent Development in Dentifrices 121
 Types of Dentifrices 122

18. Age Specific Plaque Control 123

Introduction 123
 Positioning 123
 Advantages 123

Disadvantages 124
 Advantages 125
 Disadvantages 125
 Oral Hygiene Aids in Children with Disabilities 126
 Flossing Procedure 128
 Dentifrices (see Chapter Dentifrices) 128

19. Prenatal Oral Health and Oral Health in Pregnancy 129

Introduction 129
 Physiological Changes in the Body of Pregnant Women 129
 Psychological Changes in Pregnancy 129
 Maternal Diet and Nutrition 129
 Prenatal Fluoride 129
 Breastfeeding and Oral Health of Child 130
 Aim and Objective of Prenatal Dental Counseling 130
 Methods 130
 Contents of Counseling 130
 Strategies Associated with Life Stages of Female 131
 Puberty and Adolescence 131
 Treatment 131
 Nutritional Strategies for Adolescent Girl 131
 Principle of Dental Surgery for Adult Women 131
 Nutrition During Pregnancy and Lactation 132
 Menopause and Oral Health 133
 Oral Symptoms of Menopause 133

20. Myofunctional Appliance Therapy 135

Introduction 135
 Definition 135
 Mode of Action 135
 Classification 136
 Advantages of Myofunctional Appliances 136
 Disadvantages of Myofunctional Appliances 136
 Indications 137
 Contraindications 137
 Timing of Treatment 137

Types of Appliances	137
Inclined Plane	137
Indications	138
Contraindications	138
Mode of Action	138
Modifications	138
Indications	139
Contraindications	140
Limitations of Functional Appliances	140
Modifications	140
Harvold Activator	140
Types of Bionators	140
Modifications	141
Function Regulator Appliance (Frankel)	141
Herbst Appliance	141
Twin Bloc	141

21. Cariology and Management 142

Part I: Theories of Caries Etiology	142
Theories of Caries Etiology	142
Acidogenic Theory	142
Proteolysis Theory	142
Proteolysis and Chelation Theory	142
Sucrose – Chelation Theory (Phosphorylating Theory)	143
Autoimmunity Theory	143
Part II: Caries	143
Definition	143
Clinical Classification of Caries	143
Sulfatase Theory	143
Types of Caries	143
Clinical Features	144
Chalky Whitespot Lesion	144
Frank Cavitation	145
Arrested Lesion	145
Origin of Dental Caries	145
Recent Concept of Caries Development	146
Demineralization Process	146
Remineralization	146
Factors Responsible for Dental Caries	146
Primary Factors	146
Tetralogy of Dental Caries (New Birth 1982)	146
The Tooth	146
Role of Oral Microbiota	147

Microbiota of Enamel Caries	147
Microbiota of Root Surface Caries	147
Slavkin Squares Model for	
Environmental Caries Risk Factor	148
Role of Substrate	148
Weight-Watchers Phenomenon	149
Detergent Food	149
Caries Protective Component of Food	149
Secondary Factor of Caries Development	150
Plaque	151

Part III: Caries Susceptibility Vs

Carries Activity	151
Caries Risk Assessment	151
Other Factor Causing Caries	151
Hereditary Factor	151
Systemic Conditions	151
Caries Activity Tests	151
Uses	153
Microbial Test	153
Measurement of Mutans	
Streptococci in Saliva	153
Chair Side Method	153
Measurement	153
Saliva	154
Measurement of Salivary Flow Rate	154
Measurement of Buffering	
Capacity of Saliva	154
Snyder Test	155
Swab Test (Fosdick Calcium Dissolution Test)	155

Part IV: Diagnosis of Dental Caries 155

Visual Examination	155
Cariogram	155
Aids and Dental Caries	155
Tactile Examination	156
By Radiographs (Conventional Method)	156
Electrical Conductance Measurements	156
Fiberoptic Transillumination (FOTI)	156
Digital Imaging Fiberoptic	
Transillumination	157
Quantitative Light Induced	
Fluorescence (QLF)	157
Diagnodent	157
Disadvantage	157

Part V: Rampant Caries and Nursing**Bottle Caries 158**

Definition 158

Etiology 158

Clinical Feature 159

Developmental Stages of Nursing Caries 159

Management of Nursing Caries 161

Parent Counseling 161

Prevention 161

**Part VI: Prevention, Caries Control
and Caries Management 161**

Principles of Preventive Dentistry 161

Role of Pediatric Dentist 161

Role of Hygienist 162

Pediatric Dental Clinic—

A Preventive Program 162

Child's First Dental Visit 163

Postnatal Counseling 163

Diet Counseling 164

A Showroom of Preventive Dentistry 164

Community Activities of

Pediatric Dental Surgeon 164

**Part VII: Use of Pit and Fissure Sealant—
A Preventive Approach 165**

Introduction 165

Type of Fissures 165

Criteria of Ideal Pits and Fissure Sealant 165

Materials Used as Sealant 165

Classification of Resin Fissure Sealant 165

Selection of Teeth for Sealant Application 166

Indications 166

Contraindications 166

Technique of Fissure Sealant Application 166

Part VIII: Caries Management 166

Operative Treatment 167

Free Smooth Surfaces 167

Occlusal Surface 167

Caries vaccine 168

Introduction 168

Why a Vaccine is Needed 168

Strategy 168

Vaccine 168

Function 168

Characteristics of *Streptococcus mutans* 168Mechanism of *Streptococcus mutans*

Adherence to the Tooth Surface 169

Systemic Active Immunization 169

Systemic Passive Immunization 169

22. Fluorides and Dental Health 170

Source of Fluoride Intake 170

Absorption of Fluoride 170

Factors Affecting Fluoride Absorption 170

Mechanism of Fluoride Absorption 170

Fluoride in Blood Plasma 171

Storage of Fluoride in Bone 171

Fluoride in Dental Tissues 172

Mechanism of Action of Fluoride 173

Antimicrobial Action of Fluoride 173

Classification of Fluoride Administration 174

Community Water Fluoridation 175

Advantages of Water Fluoridation 175

School Water Fluoridation 175

Dietary Fluoride Supplements 175

Salt Fluoridation 175

Milk Fluoridation 176

Fluoridated Sugar 176

Fluoride in Beverages 176

Unintentional Ingestion of Fluoride 176

Fluoride Sustained Release Device 176

Topical Fluoride Application 176

Professional Application of

Topical Fluoride 176

Sodium Fluoride Solution

(2% NaF, 9040 ppm, pH 7) 177

Knutson Technique (1948) 177

Stannous Fluoride Solutions

(8% SnF₂, 19360 ppm) 177

Muhler Technique (1957) 177

Acidulated Phosphate Fluoride Solution 178

Brudevold Technique (1963) 178

Other Topical Fluoride Agents 178

Fluoride Varnishes 178

Fluoride Containing Oral Prophylaxis Paste 179

Self Applicable Topical Fluoride 179

Fluoride Toxicity 180

Management of Acute Toxicity of Fluoride 180

Defluoridation (Removal of Fluoride) 181

- Nalgonda Technique 181
- Procedure 181
- Nalgonda Calcined Magnesite Technique or Dual Defluoridation Technique 181
- Prasanti Technology for Defluoridation 181
- Defluoridation by Reverse Osmosis 181
- Adsorption and Ion Exchange Method 181
- Precipitation Method 181

23. Pediatric Restorative Dentistry 183

- Principles of Cavity Preparation 183
- Finn's Modification of Black's
- Classification for Primary Teeth 184
- Class I Preparation for Incipient Caries in a Very Young Child 184
- Conventional Class I Cavity Preparation in Primary Teeth 184
- Class II Cavity in Primary Tooth 184
- Minimal Intervention for Proximal Caries in Primary Teeth 185
- Tunnel Shaped Cavity Preparation 185
- Proximal Slot Preparation 185
- Proximal Approach 185
- Matrix Bands, Retainers and Wedges 185
- Classification of Matrix Band 185
- Spot-Welded Matrix Band 185
- Wedging 186
- Wedges 186
- Consequences of Faulty Wedging 186
- Class III Cavity 186
- Class V Cavity 187
- Esthetic Composite or GIC Restoration for Posterior Primary Teeth 187
- Veneer Restoration in Primary Teeth 187

24. Various Designs of Prefabricated Crown in Pediatric Dentistry 189

- Introduction 189
- Factors Influencing the Design of Crown 189
- Prefabricated Metal Crowns (Gold Ionized, Metal and Stainless Steel Crown Respectively) 190
- Stainless Steel Crown 190
- Indications 190
- Selection of Crowns 191
- Primary Tooth Preparation 192
- Primary Anterior Tooth Preparations 192

- Primary Posterior Tooth Preparation 192
- Stainless Crown Trimming, Contouring, Crimping and Seating 192
- Stainless Steel Crown Modifications 194
- Complications 194
- Esthetic Restoration of Primary Anterior Teeth by 194
- Open Face Steel Crown or Chair Side Veneered 194
- Advantages 194
- Disadvantages 194
- Pre-veneered Stainless Steel Crowns 194
- Advantages 195
- Disadvantage 195
- Indications for Full Coronal Coverage of Incisors 195
- Acid Etched (Strip) Composite Crown 195
- Selection Criteria 195
- Tooth Preparation 195
- Strip Crown Preparation 195
- Etching 196
- Positioning 196
- Advantage 196
- Disadvantages 196
- Polycarbonate Crown 196
- Contraindications 196
- Manipulation of Polycarbonate Crown 196
- Crown Selection 196
- Preparation of Tooth 196
- Crown Adaptation 196
- Cementation 197
- Disadvantages 197
- Preformed Plastic Crowns 197
- Stainless Orthodontic Bands 197
- Castable Glass Ceramic Veneer (Porcelain) 197
- Acrylic Jacket Crown 197

25. Atraumatic Restorative Technique (ART) .. 198

- Introduction to ART 198
- Concept of ART 199
- Aims and Objectives of ART 199
- Advantages of ART 199
- Limitations of ART 199
- Prerequisites for the ART Procedure 200
- Dentist's Posture and Positions during ART 200
- Patient Position 200

Use of Natural or Head	
Lamp Operating Light	201
Essential Instruments and	
Materials for ART Procedure	201
Other Materials Used in ART	202
ART for Posterior Teeth	202
Restoring Multiple Surface	
Cavities using ART	204
ART for Anterior Teeth	205
Evaluation of ART	206
ART in Primary Dentition	206
Other Applications of ART	206
Conclusion	207

26. Endodontic Therapy in Primary and Young Permanent Teeth 209

Primary Root Canal Anatomy	209
Root Canals of Primary Molars	210
Root Canals of Maxillary	
1st Primary Molars	210
Root Canals of Maxillary Second Molars	210
Root Canals of Mandibular	
1st Primary Molars	210
Root Canals of Mandibular	
2nd Primary Molars	210
Pulp Diseases in Primary Teeth	210
Procedure	211
Buckley's Formacresol (Original)	212
1/5 Concentration of Buckley's Formacresol	212
Indication for Pulpotomy in Primary Teeth	212
Contraindication for	
Pulpotomy in Primary Tooth	212
Technique	212
Drawback of Formacresol	212
Gluteraldehyde	212
Calcium Hydroxide	212
Ferric Sulfate	213
Technique	213
Advantage	213
Cell Inductive Agents	213
Pulpectomy in Primary Teeth (RCT)	213
Contraindication for Primary	
Root Canals (Pulpectomy)	213
Access Opening for RCT in Primary Teeth	213

Determination of Working Length	214
Root Canals Cleaning and Shaping	214
Canal Irrigating Agent	214
Obturation	214
Obturation Technique	214
Obturing Materials for	
Primary Root Canals	214
Pulp Treatment for Young Permanent Teeth	215
Permanent Tooth Pulpotomy	215
Procedure	215
Ca (OH) ₂ vs MTA as Pulp Therapy Agent	215
Apexification	215
The Use of Ca(OH) ₂ for Apexification	
Pulpless in Immature Apex	216
Apical Barrier Technique	216
MTA Barrier Technique	216

27. Unconventional Local Anesthesia Techniques for Child and Adolescent 218

Local Anesthetics	218
Composition of Local Anesthetic	219
Mechanism of Action	219
Instrumentation	219
Needles	219
Cartridges	220
Syringe	220
Conventional Cartridge Syringes	220
Single-use Syringes	221
Powered Injectors or Jet Injectors	223
Ideal Properties of Local Anesthetics	223
Indications for Local Anesthesia	223
Advantages of LA vs GA	223
Duration of Application	225
Intraligamentary Injection	225
Duration of Anesthesia	226
Intraseptal Injection	226
Nerve Anesthetized	226
Duration of Anesthesia	227
Duration and Spread of Anesthesia	228
Intrapapillary Techniques	228
Intrapulpal Anesthesia	229
Electronic Dental Anesthesia	232
Mechanism of Action	233
EDA Indications	234

EDA Contraindications 234

EDA Advantages 234

EDA Disadvantages 234

28. Conventional Local Anesthesia Technique 235

Introduction 235

Technique for Maxillary and
Mandibular Nerve Block 235

Method 235

Supraperiosteal (infiltration) Technique for
Maxillary Primary, Permanent Incisors and
Canine 236

Anesthesia for Maxillary
Primary Molars and Premolars 237

Local Anesthesia for Maxillary
Permanent Molars 238

Nasopalatine Nerve Block 238

Greater Palatine Nerve Block 238

Infraorbital Nerve Block 240

Mental Nerve Block 240

29. Conscious Sedation in Children and Adolescents 241

Consideration of Anatomic and Physiologic
Differences between Adult and Child Patient
before Conscious Sedation 241

Criteria of Patient Selection
for Conscious Sedation 242

Intramuscular Sedation 245

Combination of Methods and
Sedative Agents 245

Ideal Feature of Inhalation
Sedation Equipment 246

Other Agents Used for Conscious Sedation 247

Benzodiazepines Group 247

Midazolam 247

Benzodiazepine Antagonist 247

Antihistamines 248

Sedative Hypnotics 248

Narcotics 248

Narcotic Antagonist 248

30. General Anesthesia in Pediatric Dentistry 250

Indications for GA in the

Treatment of Children 250

Operating Room Protocol 250

Properties of Inhalation General Anesthesia 251

Preparation of Child for General Anesthesia 252

31. Commonly Used Drugs in Pediatric Dentistry 254

General Principles of Pediatric Drug Therapy 254

Important Physiological Considerations

Associated with Medications in Children 254

Bioavailability 254

Calculations of Drug Dosage 255

Dosage Forms 255

Calculation of Dosage in Pediatric Patients 255

Use of Weight for Determination of Dosage 255

Using Body Surface Area

for Dosage Calculations 255

32. Dental Injuries and their Management 262

Introduction 262

Etiology 262

Dental History 262

Medical History 262

Examination of Maxillofacial Injuries 263

Tooth Vitality Test 263

Special Tooth Vitality Test 263

Treatment Plan 263

Ellis and Davey Classification of

Tooth Fracture 263

Ellis Class I Fracture and its Management 263

Clinical Feature 264

Management 264

Ellis Class II Fracture and its Management 264

Ellis Class III Fracture and its Management 265

Procedure 265

Restorative Treatment 265

Cemented Pins 265

Self-threaded Pins	266
Friction Lock Pins	266
Ellis Class IV Fracture and its Management	267
Apexification	267
Properties of MTA	267
Advantages	268
Disadvantages	268
Ellis Class V Fracture and its Management	268
Treatment	268
Ellis Class VI Fracture and its Management	268
Investigations and Management	268
Ellis Class VII Fracture and its Management	269
Subluxation and its Management	269
Lateral Displacement and its Management	269
Reimplantation (Replantation)	269
Preparation of the Socket	270
Management of Soft Tissues	270
Ellis Class VIII Fracture and its Management	272
Criteria for Success of Post and Core Restoration	272
Introduction	272
Need for a Post	273
Load Experienced by Endodontically Treated and Restored Tooth	273
Principal of Tooth Preparation	273
Procedure	274
Procedure	275
Primary Tooth Fracture and their Management	275
Crown Fracture	275
Root Fracture	275
Complications of Traumatic Injuries of	276

33. Considerations of Maxillofacial Injuries in Growing Patient 277

Introduction	277
Incidence	277
Etiology	277
Classification of Fracture	277
Important Features Associated with Jaw Fracture in Children	278
Emergency Treatment	278
Guideline for Treating Soft Tissues Injuries (Lackmann, et al 1992)	279

Fracture of the Mandible	279
0 to 2-year-old Child	279
Treatment	279
2 to 4-year-old Child	281
Nasal Fractures	282
Nasoethmoidal Fracture	282
Orbital Fracture	282
Fracture of Zygomatic Arch	282
Caution	282

34. Common Pediatric Oral Pathology and their Management..... 283

Congenital Lesions	283
Ankyloglossia	283
Treatment	283
Palatal Cyst	283
Treatment	283
Alveolar Cyst	283
Treatment	283
Alveolar Lymphangiomas	283
Treatment	283
Median Alveolar Notch	284
Treatment	284
Oral Leukoedema	284
Treatment	284
Hemangiomas	284
Treatment	284
Lymphangiomas	284
Congenital Epulis	284
Treatment	284
Melanotic Neuroectodermal Tumor of Infancy	285
Natal Teeth	285
Commissural Lip Pit	285
Developmental Lesion	285
Geographic Tongue	285
Fissured Tongue	285
Retrocuspid Papilla	285
Treatment	286
Macroglossia	286
Treatment	286
Lingual Thyroid	286
Treatment	286
Fordyce Granules	286

Treatment 286
 Mucocele 286
 Treatment 286
 Odontogenic Cyst 286
 Eruption Cyst and Hematoma 287
 Factitial Injuries 288
 Post Anesthesia Trauma 288
 Bruxism 288
 Smokeless Tobacco 289

35. Common Infectious Lesion of Oral Cavity in Child and Adolescent 290

Viral Infection of Mouth 290
 Prevention and Precautions 290
 Systemic 290
 Topical 290
 Mouthwashes 290
 Herpes Labialis 290
 Herpangina 291
 Intraoral Lesion 291
 Hand, Foot and Mouth Disease 291
 Recurrent Aphthous Ulcers 291
 Human Immunodeficiency Virus 291
 Rubeola 291
 Treatment 292
 Infectious Parotitis (Mumps) 292
 Bacterial Infections 292
 Impetigo 292
 Acute Necrotizing Ulcerative Gingivitis (Vincent Infection) or ANUG 292
 Mycotic Infection 293
 Candidiasis 293
 Neonatal Candidiasis 293
 Treatment 293

36. Management of Dental Problems of Handicapped and Systemically Compromised Children 294

Risk Factors 294
 Advantages 296
 Disadvantage 296
 Indications 297
 Contraindications 297
 Mechanical Devices to

Hold Mouth in Open Condition 297
 Wheelchair Head Rest 298
 Cerebral Palsy Head Support 298
 Specific Management 298
 Medically Compromised Patients 298
 Cardiac Diseases 298
 Congenital Heart Disease (CHD) 298
 Acquired Heart Disease 298
 Management 299
 Coagulation Disorders 299
 Treatment 300
 Complications 300
 Precaution During Dental Treatment 300
 Surgical Complications 301
 Precautions During Dental Management 301
 Respiratory Disorders 301
 Precautions During Dental Management 301
 Precautions During Dental Management 302
 Emergency Treatment 302
 Renal Disorders 302
 Precautions During Dental Management 302
 Hepatic Disorder 302
 Precautions During Dental Management 303
 Endocrine Disorders 303
 Clinical Manifestation 303
 Precautions During Dental Management 303
 Adrenal Insufficiency 304
 Clinical Manifestation 304
 Precautions During Dental Treatment 304
 Convulsive Disorder 304
 Generalized Convulsions 304
 Preventive Measures 304
 Immune Disorder 305
 Leukemia 305
 Precautions During Dental Management 305
 Malabsorptions and Chronic Inflammatory Intestinal Diseases vs Dental Caries 306
 Developmentally Compromised Patients 306
 Down Syndrome (Mongolism, also see Chapter Genetic Counseling) 306
 Management 306
 Neuropsychological Disabilities 306
 Mental Retardation 306
 Oral Manifestation of

Mentally Retarded Patient	306
Management	307
Childhood Autism	307
Oral Manifestation	307
Management	307
Hyperactivity	307
Management	307
Precautions During Dental Management	308
Sensory Disabilities	308
Blindness	308
Treatment Consideration	308
Physical Disabilities	309
Cleft Lip and Palate	309
Precautions During Dental Treatment	309

37. Laser in Dentistry 310

Laser for Hard Tissues (Teeth)	310
Advantages	311
Capabilities and Limitations of Laser	311
Advantages of Laser	312
Laser Safety	312

38. Dentistry for Sport Players 314

Introduction	314
ADA Recommendations for Mouth Guard	314
Types of Mouth Guards	315
Drawbacks	315
Drawbacks	316
Drawbacks	317
Purpose	318

39. Forensic Science for Pedodontist 319

Forensic Dentistry or Odontology (Forensic Odontostomatology)	319
Definition	319
Importance of Forensic Dentistry	319
Armamentarium Required for Examinations of Body	319
Role of Pedodontist in Forensic Science	320
Child Abuse and Neglect	320
Battered Baby Syndrome (Caffey Syndrome)	320
Recognition by the Forensic Pedodontist	321
Probable Factors of Parents	

Responsible for Child Abuse	321
Vectors	321
Treatment of Metal Poisoning	322
Accidental and Non-accidental Oral Trauma	323
McDonald's Classification (J Forensic Sci Soc, 1974)	324
Individual Characteristics	325
Legal Aspect for the Forensic Pedodontist	325
Recent Advances for Collecting Forensic Evidences	325
Methods of Sex Determination	329

40. Genetic Counseling in Dentistry 330

Introduction	330
Role of the Pediatric Dentist in Genetic Counseling	330
The Genetic Counselor	331
The Genetic Consultation	331
At the Genetic Counseling Session	331
Prenatal Screening for Down Syndrome	336
Diagnostic Testing for Trisomy 18	336
Diagnostic Testing for Trisomy 9	336
Diagnostic Testing for Turner's Syndrome	336

41. Advances in Dental Instruments 338

Machined Restoration: CAD/CAM	338
CAD/CAM Technology: An Introduction	338
Stages of Machined Restoration Fabrication	338
Disadvantages of CAD/CAM Systems	339
Stages of Machined Restoration with CAD/CAM	339
Dental Air Abrasion (Microdentistry)	340
Pediatric Dental Uses of Air Abrasion	341
Advantages of CT Scan	343
Dental Uses	343
Apex Locator	343
Advantages	343
Disadvantages	343
Types of Apex Locator	343
Resistance Apex Locator	343
Working of Resistance Type Apex Locator	344
Impedance Apex Locator	344
Frequency Apex Locator	344

Advance Technology	345
Apex Locator vs Radiographs	345
Features	345
Uses	345
Advantages	346
Disadvantages	346
Conclusion	346
Dental Microscope	346
Introduction	346
Uses	346
Advantages	346
Disadvantages	347
Conclusion	347
Intraoral Camera	347
Advantages	347
Disadvantage	347
Conclusion	347
Oximetry	347
Method	347
Indications	347
Other Uses	347

42. Research Methodology and Biostatistics 348

Aim and Objective of Research	348
Types of Research Study	348
Research Design	349
Research Planning	349
Pilot Research Study	349

Program Evaluation	350
Criteria for Research Empirical Studies	350
Review of a Research Study	350
Introduction and Review of Literature	350
Observations and Result	350
Discussion and Interpretation of Results	351
Summary and Conclusion	351
Bibliography and References	351
Keep Few Things in Mind During Selection of a Study	351
Statistics: An Introduction	351
Terms to be Clearly Understood before Beginning of the Research	352

43. Fundamentals of Private Practice in Pediatric Dentistry 354

Introduction	354
Philosophy of Dental Practice	354
Patient Assessment	354
Aim and Objective	354
What is Marketing	354
Selection of a Target Market	354
Fundamentals of Marketing Plan	355
Product	355
Internal Marketing (Internal Promotion)	356
Dental Staff, Policies and Systems	357
Selection Criteria for Dental Personnel	357

Index 359

Scope and Importance of Pediatric Dentistry

Treating children can be one of the most enjoyable aspects of dental practice. A child spontaneity, honesty and sense of humor can provide the dentist a refreshing reprieve from the rigors of a daily routine. Although, the majority of children are well behaved patients. Some have fear or anxieties about dentistry that makes their behavior extremely challenging and often frustrating for a pediatric dentist to manage.

DEFINITION

According to American Academy of Pediatric Dentistry (1999); Pediatric Dentistry is an age defined specialty that provide both primary and comprehensive preventive and therapeutic oral health care for infants and children through adolescence, including those with special health care needs.

BRIEF HISTORY OF PEDODONTICS IN INDIA

- In India, the first Dental College was started in the year 1920 by Dr Rafiuddin Ahmed in Calcutta. Hence, he is also known as “The Grand Old Man of Dentistry”.
- The foundation of Pedodontics was laid down in 1950 in Amritsar, Punjab.
- Pedodontics did not exist as an independent specialty in the initial years of development of Dentistry but was included in the operative Dentistry Paper and later on in the Orthodontics paper.
- In the year 1988, as per DCI rules it got its due importance and was treated as a separate entity.

Scope of Pedodontics

‘The Scope of Pedodontics’ pertinent to the range of activities considered in the practice of Pediatric Dentistry. Proper intake of nutritious diet is essential during growing phase of a child. A child stops eating, if his/her tooth hurts during mastication. Therefore, if caries is detected, the teeth should be immediately restored before any undesirable consequences develop.

In addition to be knowledgeable about the dental needs of the child patient, basics in the pediatric medicine, general and oral pathology, growth and development and child psychology, also need to be known. With the changing trends and the development there has been a tremendous increase in the scope of Pedodontics. Various factors responsible for this change are:

1. *Recognition of a child as patient:* Majority of the parent don’t give importance to decaying or decayed primary tooth of children. They say ‘Ohh’, it’s a milk tooth eventually it’s going to fall off. This attitude of parent has been slowly changing nowadays with the help of print and electronic media and school dental health education program.
2. Public recognition of the dental health for general well being of the child.
3. Recognition of fluoride as the most effective health agent in the prevention of dental caries.
4. Improvement of various aesthetic agents in clinical use. Introduction of the system of the sophisticated plastics, i.e. composite, ionomer cement, pits and fissure sealant. It is also known as invisible or tooth colored filling.
5. Radical changes to control virulent infections in any clinical content or in the dental office.

Pedodontics: Pedodontics and preventive dentistry is a vast subject. Pedodontist acts as an orthodontist, an Oral Surgeon, an endodontist, periodontist, a child psychologist and prosthodontist, etc. at a time.

“Vastness of Pedodontics”

- Preventive Orthodontics
- Endodontic
- Periodontics
- Allied Health Sciences
- Special Care Dentistry
- Forensic Dental Science
- Material Science
- Oral Rehabilitation
- Oral Surgery
- Preventive Dentistry
- Cariology
- Dental Radiology
- Oral Medicine
- Restorative Dentistry
- Immunology
- Neonatology
- Child Psychology.

A significant portion of dental and oral disease is preventable. Oral diseases and conditions can begin at birth and result in pain, infection, tooth loss and other problems for a child. Early intervention may enable to experience optimal oral health and the life long benefits of a healthy mouth.

Procedures and Pictures

- Silver fillings (Fig. 1.1)



Fig. 1.1: Silver amalgam filling (Postoperative)

- Tooth colored fillings (Figs 1.2A and B)



Fig. 1.2A: Anterior tooth fracture (Preoperative)



Fig. 1.2B: Anterior composite resin restoration (Postoperative)

- Endodontic treatment (Root Canal Treatment) (Fig. 1.3)

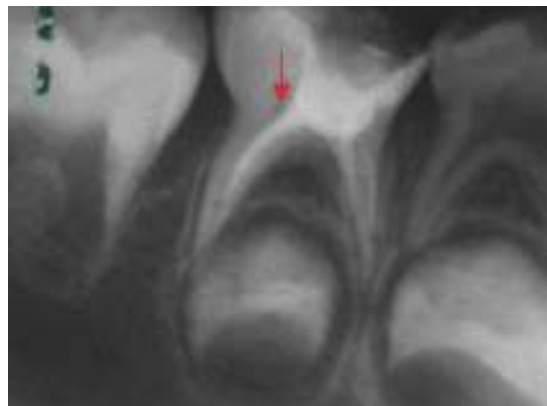


Fig. 1.3: IOPA- X-ray of endodontically treated primary tooth (arrow shows Dycal Obturation)

- Stainless steel crowns (Fig. 1.4)



Fig. 1.4: Stainless steel crown adaptation on right and left lower primary second molar

Importance of Pedodontics

Pediatric dentists work towards the maintenance of the primary teeth until they are naturally lost. This is due to the importance they serve in permitting children to chew properly and therefore maintain good nutrition and health. Its role in speech development and the way it aid permanent teeth by saving space for them (Guiding Path).

“Previously, a Pediatric Dentist is a Dentist treating the teeth of children right from eruption to the ages of 12 to 14 years.” but nowadays, the pediatric age includes (adolescent) up to 19 years and even more in cases of handicapped condition.

The role of the pediatric dentist changes as children enter adolescence. Recognizing the growth importance of appearance and self-image in their clients, pediatric dentists work to ensure that adolescents’ dental needs are met.

In Pedodontics the service provided are as follows:

1. Preventive Dental Care
 - Risk assessment
 - Fluoride treatment
 - Water fluoride analysis.
2. Restorative Dental Care
 - Application of sealants
 - Treatment of dental injuries
 - Cosmetic dentistry: A very fast increase has been observed in this particular branch of dentistry, children have started becoming very conscious about their appearance.
 - Root canal treatment and restorations.

3. Pediatric Oral Surgery
 - Hospital dental care
 - Treatment of emotionally challenged child
 - Treatment of physically challenged child.
4. Preventive Orthodontics
 - Space Maintenance
 - Custom made athletic mouthguards: Can be made for children involving into heavy sports, such as boxing wrestling, martial arts and rugby, etc. where there are more chances of trauma or injury to the tooth.
 - Oral habit control.
5. Behavior Management
 - Treatment of Dental Phobia
6. TMJ Evaluation.
7. Diet counseling: The diet counseling is an important part of the pediatric dentistry to prevent incidence of dental disease or stop disease progression. The black cavity generally appears first on the upper anterior teeth or on the lower posterior teeth.

Black → Cavity → food → pain → swelling
Spot formation lodgment

- The characteristic that differentiates the pediatric dentist from the other dentists is the fact that he/she provides comprehensive health in the total to the patient, prevents the onset of the disease right from the beginning while considering the psychological need of the child patient thus instills a positive attitude to the dental health in future years to come.
- In author opinion the importance of Pedodontics, should be spread at the community level by arranging school program and educating children about healthy teeth and its role and general health.

CHALLENGES FOR PEDIATRIC DENTISTRY IN 21ST CENTURY

There will be six phenomenons that need to be a greater concern in the 21st century. These are as follows:

- Child abuse and neglect
- Children of poverty
- Informed consent and risk management
- Advance technology
- Health care delivery strategies/payment strategies
- Emergence of pediatric dentistry as a worldwide community.

Infection Control in Pediatric Dental Clinic

INTRODUCTION

The dentist and dental staff are always exposed to a wide variety of infectious organisms in the saliva and blood of their patient. These infectious organisms may include viruses like Hepatitis B virus, Herpes simplex, Chickenpox, HIV-I, Cytomegalovirus, etc. Bacteria like *Mycobacterium tuberculosis*, *streptococci* sp., *staphylococci* sp. and fungi like *Candida albicans*. These microorganisms can infect the respiratory tract so it is necessary to use infection control procedure and prevention to avoid the spread of disease.

Infection Control: Precaution and History

1. Before starting any orodental surgical procedure dental surgeon always asks thorough medical history, including question about present and past illness, medication, sudden weight loss, lymph adenopathy, oral soft tissue lesion or other infections.
2. Dental instrument cleaner should wash the reusable instruments in ultrasonic washer and wear heavy mask, gloves, protective clothing and eyewear to protect any puncture injuries and splashing.
3. *Sterilization of instrument*: Sterilize all those reusable orodental instruments that come into contact with oral tissues, saliva or blood. Metal instruments should be sterilized in steam autoclave or dry heat oven. Heat sensitive instruments are sterilized by chemical vapors like ethylene oxide or formalin gas. Heat sensitive instrument may require up to 10 hr. for sterilization in liquid chemical agent. Spore test or chemical indicator test should be weekly done to check the sterility of the instrument or sterilizer.

STERILIZATION OF ENDODONTIC INSTRUMENT

1. After applying rubber dam, isolated tooth should be washed with Povidone-iodine or 99 percent isopropyl alcohol.
2. Burs used for the opening of pulp chamber should be sterilized by autoclave or dry heat or a bur dipped in 99 percent alcohol and then passes over the blue flame of spirit lamp.
3. Endodontic instruments are cleaned with 2" × 2" gauge moistened with H₂O₂ or 99 percent alcohol. Absorbent points, broaches, files, reamers and other root canal instrument should be sterilized immediately before use in glass bead or hot salt sterilizer.

In hot salt sterilizer a table salt mixed with 1 percent Sodium silicoaluminate, magnesium carbonate and sodium carbonate is kept in a cup having temperature of 218° to 246°C and a suitable thermometer kept in salt to check the temperature. Sodium silicoaluminate, magnesium carbonate and sodium carbonate acts as anti-agglutination agent for the endodontic instrument. At this temperature root canal instrument such as broaches, files, reamers may be sterilized in 5 seconds and absorbent point and cotton pellets in 10 seconds.

The salt should be changed weekly or more often depending on the degree of humidity. In glass bead sterilizer (Fig. 2.1) less than 1.0 mm diameter glass beads are used in place of table salt because glass beads does not clog with files or reamer. The temperature ranges between 218°C and 246°C. The hottest part of the glass bead sterilizer is along its outer rim starting at the bottom



Fig. 2.1: Glass bead sterilizers
(Arrow shows cup of glass bead)

layer of salt and temperature is lowest in the center of the surface layer of glass beads that's why it is always advisable that endodontic instrument be immerse at peripheral area of glass bead sterilizer. After sterilization of the endodontic files and reamer, it should be kept in cold disinfectant solution to maintain the sterilization of the instrument.

AUTOClave (FIGS 2.2 AND 2.3)



Fig. 2.2: Modern autoclave machine
(Arrow shows safety valve)

All other instrument like long handle instrument, extraction forceps, cotton gauge piece, tray, cloth, etc. are sterilized by autoclaving procedure. In autoclave, sterilization is accomplished when the instrument are kept at 15 lbs pressure at 120°C for at least 15 minutes.

Sterilization of Gutta-percha

Gutta-percha can be sterilized by immersing it into 5.2 percent sodium hypochlorite for 1 minute then rinse the cone with H_2O_2 . Frank and Pellieu have shown that 5.2 percent sodium hypochlorite is 5 times more effective than sporicidine.

Sterilization of Silver Cone

It can be done by putting cone in hot salt sterilizer for 5 seconds or by passing-silver cone dipped in alcohol over Bunsen burner.

Sterilization of Glass Slab or Dappen Dishes

Glass slab or dampen dishes can be sterilized by swabbing the surface with tincture of thimersal followed by double swabbing with alcohol.

Sterilization by Formalin Gas Chamber

It is recommended that only wet instrument be kept in formalin gas chamber because formalin gas must be in water solution form to enter into the protoplasm of microorganism for effective sterilization. Formalin gas thus, acts as poison for protoplasm.

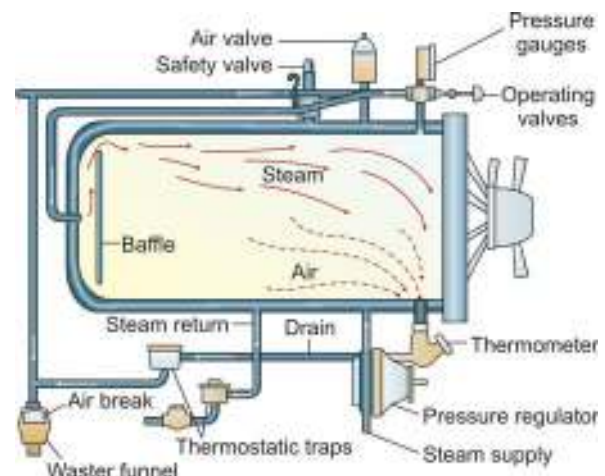


Fig. 2.3: Internal design of modern autoclave

Laser Beam Sterilization

Hooks, et al have found that exposure of infected endodontic instrument for 3 seconds to a laser beam is sufficient to destroy microbiota including spores.

Infection Control to the Dental Staff

1. Chairperson of the dental office should insist that their dental staff to wear gloves during all patient treatment procedure and when touching items contaminated with blood or saliva.
2. Dental staff should wear surgical mask, protective eyeglasses, gowns and use protective cover such as clear plastic wrap to protect operative surface that is difficult to disinfect.
3. During dental procedure, use of rubber dam should be done whenever possible along with high speed evacuation to reduce splatters and aerosols.
4. Dental team should be vaccinated against hepatitis B (including the dentist). Blood test should be done to confirm the response of the vaccination.
5. Antimicrobial surgical hand scrub technique should be performed before gloving for assisting any surgical procedure. Handwashing with antimicrobial or liquid soap is appropriate for examination and nonsurgical procedure.

Infection Control to the Patient

- a. *By draping:* The aim of the draping is to isolate the surgical areas from other part of the body that have not been prepared for surgery and also from non-sterile operating room equipment and surgical staff. The most effective methods of isolating the mouth from the surgical site are by using a clear plastic adhesive barrier to microorganism. The adhesive is pressed tightly around the lower face and lower lip, preventing saliva from flowing into the surgical site.
- b. *By the surgical part preparation:* The purpose of surgical part preparation is to reduce contamination by patient's own normal oral flora and resistant bacteria acquired from the hospital environment. The surgical site cannot be sterilized with this part preparation but the gross cleansing action from center of the surgical site to away from the surgical center, does significantly reduce the incidence of post-

operative infection. A circumoral part-preparation should precede intraoral surgical procedure to prevent transfer of the resistant skin microorganism to the intraoral wound. The skin preparation for surgery should be done for 5 min. The following solutions are used for surgical part preparation.

i. Iodophor compound	] For skin preparation
ii. Hexachlorophene solutions	
iii. Chlorhexidine 0.2 percent solution	] As intraoral surgical part preparation
iv. Phenol-Alcohol mouth rinse	
v. Betadine oral rinse	
c. Infection control by prophylactic and therapeutic medicine (Tables 2.1 to 2.3).	

Infection Control in Diabetic Dental Patient

The diabetic patient requires special precaution before dental procedure. If the dentist detects intraoral sign of undiagnosed or poorly controlled diabetes, a thorough history is indicated. If a patient is suspected of having undiagnosed diabetes the following procedure should be performed.

- i. Consult the Physician
- ii. Lab test recommended
- iii. Rule out acute orofacial infection or severe dental infection and provide emergency care only until diagnosis is established.

Patient with relatively well controlled diabetes usually respond in a manner similar to non-diabetic individual. Prophylactic antibiotic (penicillin group) should be started two days prior to the dental procedure and continued postoperatively for one week in diabetic patient.

DISINFECTION OF OPERATORY SURFACE AND DENTAL APPLIANCES

Clean and disinfect operatory surface (dental chair) between each operated patient by wipe down the surface with absorbent towel and disinfect with 1:10 dilution of house-hold bleach. Clean and disinfect impression and intraoral appliances before handling or adjusting or sending them to the dental laboratory. Appliances should also be cleaned and disinfected when they are received from the dental laboratory and before placement in the mouth.

Table 2.1: Infection control in the dental bacterial endocarditis patient by prophylactic and therapeutic medicine

<i>Situation</i>	<i>agent</i>	<i>regimen</i>
Standard general prophylaxis	Amoxicillin	Adult: 2 g orally one hour before procedure. Children: 50 mg/kg orally one hour before procedure.
When patient unable to take oral medication	Ampicillin	Adult: 2 g IM or IV within 30 min before procedure. Children: 50 mg/kg orally IM or IV within 30 minutes before procedure.
When patient allergic to penicillin	Cephalexine or Cephadroxy	Adult: 2 g orally one hour before procedure. Children: 50 mg/kg orally one hour before procedure.
When patient allergic to penicillin and unable to take oral medication	Azithromycine or clarithromycine	Adult: 500 mg orally one hour before procedure. Children: 15 mg/kg orally one hour before procedure.
	Clindamycine	Adult: 600 mg IV within 30 minutes before procedure. Children: 20 mg/kg IV within 30 minutes before procedure.
	Or cefazoline	Adult: 1 g IM or IV within 30 minutes before procedure. Children: 25 mg/kg IM or IV within 30 minutes before procedure.

Total children dose should not exceed adult dose.

Note: Cephalosporin's should not be used in individuals with immediate type hypersensitivity reaction (Urticaria, Angioedema, or anaphylaxis) to penicillin.

Table 2.2: The newest guideline for endocarditis prevention in dental patient

<i>S.No.</i>	<i>Change from old guidelines</i>
1.	Oral initial dosing has been reduced to 2 g
2.	Follow-up antibiotic dose is no longer recommended
3.	Erythromycin is no longer recommended for penicillin allergic patient.
4.	Clindamycin and other alternatives have been recommended to replace the Erythromycin regimens.
5.	Clearer guidelines for prophylaxis decisions for patient with mitral valve prolapsed have been developed.

Table 2.3: Antibiotic regimes for patient with prosthetic implants

<i>Patient not allergic to penicillin</i>	<i>Cephalexine, cephradine or amoxicillin</i>	<i>2 g orally one hour prior to the procedure</i>
When patient not allergic to penicillin and unable to take oral indications	Cephazolin Or Ampicillin	1 g IM or IV one hour prior to procedure. 2 g IM or IV one hour prior to procedure
When patient allergic to penicillin	Clindamycin	600 mg orally one hour prior to dental procedure.
When patient allergic to penicillin and unable to take orally	Clindamycin	600 mg IV one hour prior to the procedure.

CAREFUL HANDLING OF BIOPSY SPECIMEN

Before transferring the biopsy specimen, it should be placed in a tight-lid container containing 40 percent liquid formalin as a fixing solution and care should be taken not to leak during transport from dental clinic to pathologic laboratory. The volume of the fixative solution should be approximately 20 times more than the volume

of the tissues specimen. The minimum time required for fixation is 8 hours for smaller piece and proportionally the larger tissues take longer.

If the biopsy specimen is too thick, only the peripheral portion of the tissues will be completely infiltrated with fixative solution while the central areas undergoes degenerative changes. So the larger biopsy specimen

should be cut in several sections before being immersed. Care should be taken not to contaminate outer surface of the transferring biopsy container.

The specimen bottle should be properly labeled to indicate whether the tissues specimen is soft tissues or it contains bone. It is a good practice to keep soft tissues and bone specimens in separate marked bottles whenever possible. A brief history should accompany the specimen. This should include the name, age, sex of the patient and the location and gross description of the lesion, its duration, rate of growth or change in growth rate and method used in obtaining the specimen.

INFECTIONS CONTROL THROUGH HOSPITAL WASTE DISPOSAL

Infection control through hospital waste-disposal is an issue that is often ignored by many dental and medical hospitals. In developed countries the quantity of waste produced today has decreased in the hospital sector. The quantity of waste produced per day per bed and per dental chair differs greatly from hospital to another hospital/dental clinic.

Among hospital waste 85 percent are general refuse and 15 percent waste contaminated with infectious agent, i.e. microbiological cultures, blood and blood products, body fluids, isolation waste from patient with communicable diseases pathological specimens and sharps.

Hospital waste is disposed off by selectively separating it into various groups. Group separation made it possible for regulations and laws, for single type of waste; governing their collection, transport, storage, reutilization and final treatment.

Classification of Waste

Waste is classified into following groups:

1. General refuse waste
2. Waste from the medical/dental environment
3. Hazardous waste
4. Radioactive waste
5. Others waste.

General Refuse Waste

Waste that can be treated or recycled. Example:- Household garbage, paper, glass, and textiles, plastic.

Waste from Medical/Dental Environment

Waste that may present a risk of infection in a medical/dental environment but need not be handled as hazardous waste. Ex. Plaster caste, dental caste, bandages, drip bags, disposable clothing and, gutta-percha, etc.

Hazardous Waste

Waste that represents a hazardous in the medical environment and elsewhere and requires special handling Ex. waste that is tainted with hazardous pathogens blood and body fluids of human or animal origin, parts of the bodies, aborted, stillborn of fetus and sharps, reamers files, etc.

Radioactive Waste

It includes any substance regulated and licensed under the Nuclear Regulatory Commission which, should be disposed off in accordance with the rules and regulations of the Nuclear Regulatory Commission.

Other Waste

Other waste occurring in the medical field such as disinfectants, photochemical, waste containing mercury (dental amalgam), laboratory chemicals and general anesthesia, etc.

Infectious Waste

Infectious waste can be defined as the waste that is tainted with pathogenic agent and due to the presence of diseases which according to the current state of knowledge, may lead to such type of waste. The estimated amount of unregulated infectious waste per day per bed varies between 8000 to 1100 gm, if regulated, would vary between 50 gm and 1500 gm.

The infectious waste should be dealt with separately and undergo controlled disposal. This prevents diseases and epidemics from spreading. The definition of what waste is infectious differs from one country to another and even from one hospital to another, depending upon how well informed and trained the personnel are.

Waste Management

The following steps are important in the medical/dental waste management:

- i. Segregation
- ii. Packaging
- iii. Labeling
- iv. Tracking.

Segregation

Infectious waste must be segregated from other waste at the point of origin. This separation should not entail additional labor for the health facility personnel. Infectious waste storage for one or two days may be possible in special sealed cooled rooms, if available in the hospital.

Packaging and Labeling

Separate infectious waste from the rest in specially marked waste containers, right at the point of origin, where the waste is produced. Container is labeled and marked, and infectious waste containers must have the universal biological hazard symbol on them. Color coded double lined plastic bags must be used in all regulated medical waste containers. A puncture proof container should be used for sharps.

Previous practice of recapping or chopping needles is no longer prevalent because of the potential injuries to corks and because of the aerosolization of the microorganism during the chopping procedure. Infectious waste storage areas should be disinfected regularly and are maintained at appropriate temperature, particularly if waste is being stored prior to treatment. Packaging should be rodent and vermin proof. The radioactive waste cannot be treated, destroyed or immobilized by any method. Containers of radioactive waste area are isolated in temporary collection area, with minimum exposure to individuals, until the waste has decayed to the point that it can be disposed off in a designated labeled container. Items used in handling radioactive materials are segregated in labeled containers.

Collection of Waste

Collected waste must be transferred from the point of origin to the collection points for processing and appropriate disposal. Waste should be collected in rigid or semi-rigid and leak proof containers. Hospital wastes are collected in one of three ways:

- i. Gravity chutes (chutes – A sloping channel for moving things to a lower level)

- ii. Carts
- iii. Pneumatic tubes

1. Chutes: Use-vertical transport.

Risk contaminants can be exhausted into hallways, if the door is left open during use. This can be avoided by maintaining higher pressure in the hallways or using self closing doors.

Disadvantage: Waste containers can get jammed.

2. Carts: Use-horizontal transports of bagged or containerized wastes.

Risk: Bags can break or tear during transport, exposing the workers to the waste.

3. Pneumatic Tubes: Use-transport waste in a large facility.

Advantage:

- High speed movement.
- Movement in any direction.
- Minimal intermediate storage of untreated waste in pneumatic tube.

Waste Disposal

Waste disposal is carried out using one of the following technologies:

- Sterilization with steam, hot water or partly with microwaves.
- Incineration.

Sterilization: Wastes are kept at the temperatures which can kills all the disease producing agents including spores.

Step-I: Disinfection chamber: Waste is treated with steam and reduced in size by means of slitting roller.

Step-II: IInd Disinfection chamber: Above mentioned process is continued.

Step III: Treated waste is disposed of with normal household waste.

Microwaves Sterilization

Used for the waste which have sufficient high moisture content. The air and moisture emitted from the microwave must be made safe by passing it over on activated carbon filter.

Incineration

This method is used for disposing infectious wastes. If the waste does not undergo immediate incineration in

Categories of biomedical wastes, container's color codes (Fig. 2.4)

Category	Class	Waste description	Type of container	Color coding
1.	Human, anatomical wastes blood and body fluids	Waste consisting of human organs, body parts, body fluids, blood and blood products, and items saturated or dripping with blood and body fluids removed during or after treatment, surgery or autopsy or other medical dental procedures.	Single use containers or plastic disposable bags	Red
2.	Animal waste	Waste consisting of animal tissues, organs, body parts, bedding, body fluid and blood products, items contaminated with blood and fluids, wastes from surgery, treatment, autopsy and wastes of experimental animals used in research, waste generated by veterinary hospital, colleges and animal houses.	Single use container or plastic disposable bags	Orange
3.	Microbiology	Waste from laboratory cultures, stocks or specimens of microorganism live or attenuated vaccines, human and animal cell cultures used in research, infectious agents from research and industrial laboratories waste from the production of biological toxins, dishes and devices used to transfer cultures.	Single use container or plastic disposable bags	Light blue or yellow
4.	Waste sharps (Dental)	Waste consisting of used and unused sharps such as needles, syringe, scalpels, blades, glass. Dental disposable/undisposable sharps instrument, etc. that are capable of causing puncture and cuts.	Sturdy cardboard glass or plastic container.	Yellow with black stripes
5.	Highly infectious waste	Wastes containing highly infectious living and nonliving pathogens, exposure to which could cause disease.	Single use containers or plastic disposable bags	Yellow
6.	Isolated waste	Biological waste from discarded materials contaminated with blood, excretion exudes or secretions from humans or animal isolated due to communicable disease.	Single use containers plastic disposable bags	Yellow or yellow with black strips
7.	Discarded medicines	Waste comprising outdated, contaminated and discarded medicines.	Reusable sturdy cardboard, glass or plastic container	Yellow or Yellow with black strips

Contd...

Contd...

Category	Class	Waste description	Type of container	Color coding
8.	Discarded glassware	Wastes generated from glassware and equipment used.	Reusable sturdy cardboard, glass or plastic container	Black
9.	Solid waste	Waste generated from soiled cotton, dressings, plaster casts, linen, beddings, including packaging materials.	Single use container or plastic disposable bags	Yellow
10.	Disposable	Waste generated from disposable items other than waste sharps.	Reusable sturdy cardboard, glass or plastic container, or plastic bag	Yellow, light blue or yellow with black stripes
11.	Liquid waste	Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities.	Not applicable (NA)	NA
12.	Biotechnology waste	Wastes generated from activities involving genetically engineered organisms or products and their cultures, which have been declared safe.	Single use containers or plastic disposable bags	Yellow, light, blue or yellow with black stripes.
13.	Slaughter house waste	Waste generated in the form of animal tissues, blood and body fluids.	Disposable plastic bags	Orange
14.	Incineration ash	Ash from the incineration of any biomedical waste.	Disposable plastic bags	Yellow with black stripes
15.	Chemical waste	Chemical used in the production of biological and chemicals used in disinfections, such as insecticides, etc.	Sturdy containers, plastic holding bags	Yellow or Yellow with black stripes.



Fig. 2.4: Red, gray, yellow, red-yellow transparent containers are used for human, anatomical wastes blood and body fluids, Gray Reusable Pathological Waste Container, Yellow Reusable Chemotherapy Medical Waste, yellow disposable sharps container respectively

a waste incineration plant there is a risk of its starting to decompose at room temperature. Modern facility of this type are available in all sizes from small plants with a daily capacity of about a 100 kilos for small hospitals, up to large plants with daily capacities of several tons for waste disposal centers.

Facility Option

- i. Single in house facility
- ii. Joint faculty serving several hospitals together.
- iii. Delegating the tasks to an independent collection service.

1. Single in House Facility

Disadvantages

- Requirement leads to an initial high investment.
- The plant is utilized only under certain conditions.

Advantages

- Independence of operation (waste disposal) is assured and correctly dealt with.
- Daily disposal is possible.

2. Joint Facilities Serving Several Hospitals

Disadvantages

- Cooled storage rooms are necessary.
- Dependence on external organization may leads to problem.

Advantages

- Better utilization of the plant is ensured.
- Lower investment is required.

3. Delegating the Task to an Independent Collection Service

Disadvantages

- The waste is not under the hospitals control right up to the time of disposal.
- There is the risk of arbitrating pricing.
- Cooled storage rooms are necessary.

Advantages

- No investment in incineration is required.
- The Cost can be kept under control by proper selection of the waste.
- Waste disposal is not a part of the functions of a hospital.

Waste Treatment

Loading of waste: Small plants with a daily capacity of up to about 500 kilos are often loaded by hand. The combustion chamber is filled with waste and tapped up once or twice. The larger plants are loaded discontinuously for about eight hours by means of a mechanical loading system. In this way waste is burned in the combustion chamber every 10-15 minutes.

Combustion Chamber (Low Temperature Carbonization)

In this chamber, the waste is dried and broken down. The quantity of air introduced inside the combustion chamber is just sufficient for the drying process for the waste and the production of low temperature carbonization gas consequent to the breakdown takes place without added energy.

Reheating Chamber

It is in a state of constant depression. The low temperature carbonization gases contain a large volume of combustible energy rich gases. In the mixing area, these are turned into an inflammable gas by adding fresh air. This mixture of gases is then burned in the ignition and burning area, with the addition of more fresh air. In order to achieve complete burnout, the necessary quantity of fresh air is monitored using oxygen probe. The temperature between 400°C (at the start of the process) and about 800°C (at the end of process) are reached in the combustion chambers. On completion of the combustion process any unburnable residues become sterile depending on local legislation, processing in the reheating chamber takes place at temperature ranging from 850 to 1200°C.

Heat Exchangers

The energy contained in the flue gases or waste gases can be utilized for the production of warm water or hot water, in the larger plants. This energy is available for the duration of the loading period and during the burning out phase of the carbon.

Purification of the flue gases: There are new regulations pertaining to the maximum permissible emission limits from incineration plants. The gases scrubbing facility is required to comply with these limits and are divided up into several stages of scrubbing.

- a. *Dry flue gas cleaning:* The dust content in the air emitted is reduced by means of a film; additives such as lime can also precipitate certain harmful acid components.
- b. *Wet purification system:* Stage-I Harmful gases are quenched and brought down to a temperature of about 80°C.
Stage-II: Fine dust and aerosols are separated and often washed by ionization. This leads to broken down of harmful components into dioxin and furan. The 1st small plants for hospital waste in which dioxin and furan originating from the flue gases are limited to a maximum value of 0.1 ngr/Nm³.

Advantages of Incineration

- The temperature in the combustion chamber guarantees that the residues are sterile.

- The waste is reduced to about 3 percent of its original volume depending on the amount of incombustible waste loaded.
- The residue requires no further treatment and can be handed over to a controlled final place of storage.
- The process works regardless of the composition of the waste, and does not require special monitoring.
- The service personnel never come into contact with the waste and therefore, it is universally acceptable from an ethical point of view. Even in the event of a possible breakdown of various component of the plant, the personnel do not come into contact with the waste during the trouble shooting period.
- The processes comply with even today's very strict environmental protection limits.
- Implementation of this technology is possible not only in industrialized countries, but it is particularly suitable for third world countries like India.
- Presently, a large number of indigenous as well as multinational companies are providing equipment and solution for hospital waste. While deciding on the equipment to handle hospital waste, it is advisable to keep the following points in mind:
 - a. The quantity and type of waste to be handled by the equipment.
 - b. Whether the equipment meets the current regulatory standards.
 - c. Can it be upgraded to meet future regulatory norms?
 - d. Will the equipment be supported with maintenance services and spares for the next 10 years?

Waste Minimization Options

Waste minimization include many source reduction or recycling activities by the generator that's results in reducing either the quantity or toxicity of the hazardous waste, consistent with the goal of minimizing present and future threats to health and the environment.

Source Reduction

It can be achieved by process modification and by the implementation of policies and procedures that will reduce waste. The key operating practices that can be utilized to effect waste minimization are as follows:

- Waste segregation
- Controlling inventories with "just in time" purchasing.

- Providing an area where chemical and liquid wastes cannot drain to the sewer in the event of an accident.
- Buying drugs in containers sizes that permit formulations of daily doses, with the least quantity of excess product leftover.
- Centralized purchasing and dispensing of drugs and other hazardous chemical.
- Requesting suppliers for recyclable containers whenever possible to reduce chemical drum waste and disposal cost.
- Using 1st in and 1st-out policy for dispensing drugs and chemicals in order to minimize the waste generated, because of extended self life. New supplies should be entered in inventory book and dispensed drugs and chemical also entered in stock dispensing book.
- Minimizing acceptance of free sample that are likely to become hazardous waste.
- Avoiding mixing waste, such as xylene with alcohol, chromic acid (glassware cleaner) with water.
- Determined dilution rates of alcohol that can be discharged to the sanitary sewer system.
- Reducing photographic waste from imaging equipment. Such as waste water containing photographic chemicals and silver from film. Use of Ammonium thiosulphate for extending the life of fixing solution of X-ray and addition of acetic acid to fixing bath to keep the pH level of the bath optimally low and avoid mixing of used X-ray fixer and developer.
- Collecting and storing waste in a closed plastic container, labeled hazardous waste, used fixer, with the date indicating when the fixer was 1st added.
- Contacting a recycling service when enough fixer has accumulated (Usually 20 to 40 gallons).
- Trained employee should be employed for hazardous material management and waste minimization.
- Using electric devices for measuring temperature and blood pressure is the most effective way of eliminating mercury from waste streams.

Recycling and Reclamation

- Spent solvent are generated by the laboratory, pathology, histology and maintenance departments.
- Aqueous based cleaner can be used instead of hazardous solvent.
- Many solvent can be recovered by on site distillation and recycled.
- Dialysis units generate a spent solution that contains 3 to 4 percent formaldehyde in water. Some user reportedly use reverse osmosis to recover formaldehyde.
- A spent fixer solution, used in radiography department contains high concentration of silver which is economically valuable and can be recovered easily.
- After controlling processing temperature very closely, to improve image quality, it also greatly extended the useful life of processing chemicals, reducing the quantity sent for disposal.

CONCLUSION

- The population of India is endangered, as no controlled waste disposal is taking place.
- In many countries necessary laws and guidelines have been introduced for allowing environment friendly waste disposal.
- There is an urgent need for educating and informing everyone concerned with hospitals and the populations at large.

Set-up of Pediatric Dental Clinic

INTRODUCTION

Good business practices are essential to a profession as they are to other enterprises. So, there is no reason why a dentist with personality and skill should find himself incompetent in practice management. Being a good dentist is not the only thing required to keep the appointment book full, change has finally and irrevocably caught up with the private practice of dentistry.

- We have to study the changing dental scene and adapt our practices to meet the new challenges of today. Within this population there is decreased demand due to better preventive care in the form of more sound diets. The widespread use of fluorides, better quantity dentistry and longer lasting restoration. A more consumers, conscious, educated society is beginning to shop around the health care at an ever-increasing variety of treatment facility.
 - Today is the age of consumerism and they want as much information as possible. Before starting a new practice various aspects must be considered, because marketing a professional practice is very hard. So, before setting up a Pedodontics clinic following points should be kept in mind:
1. **Location:** Selecting a location is the first and foremost point to consider before establishing a clinic. There are many factors that should be considered in locating a dental office for the type of practice one wish to establish.
 - *Check social and economic status of residing people:* Our office location should ideally reflect the target population pattern and the dentist to population ratio in that area. It is easy to start

the practice where need exist, than carve out a share of already overcrowded market. It is important to know that social and economic status of the people residing in that particular area.

- *Easy access to school:* If possible, dental office should be near to the well-established neighborhood school.
 - *Transportation and parking facility:* A dental office should be in high visibility, high traffic location and near well-recognized, famous area so that every time patients can reach easily. With busy schedule and the increasing cost of driving, patients do not want to travel long distance for their dental care so proper transportation facility should be available. Every pediatric clinic should have proper space available for parking.
2. **Office decoration or organization:** Once the location is selected, the type of office decoration must be considered. If one is to limit one's practices to children, the entire office from the reception room through the treatment room can have a definite modification.
 - *The reception area (Fig. 3.1):* The reception area is designed to be patient and parent oriented not dentist centered. An attractive and comfortable environment should be designed for both children and parent. The interest of patients of preschool age through the late teenage period needs to be considered as well as the interests of adults. The decor of the reception area deserves careful planning with these various age groups in mind before the dentist turns the decoration of the reception area over completely on interior



Fig. 3.1: Pediatric dental office's waiting area with toys, etc.



Fig. 3.2: A TV set must be kept in one corner of the room for the entertainment. Some cartoon channel Ex. (POGO, Cartoon network) must be available

decorator, thought should be given to the excessively stimulating, excitable atmosphere that may be universally created by the use of many bright color and design.

- *Waiting room:* Waiting room is an important part of reception area. It should be well lighted. Preferable with ceiling or well attached handicraft fixtures. Waiting room can also be used to present dental health material. Fantasy characters on the wall and color of the room. Bright color and design make the room excitable and stimulating. Neutral color such as light green or blue for wall decor promote a tranquiller feeling and permit the use of attractive color accessories such as pictures, wallpaper murals magazine holder. Fantasy character on the wall make the environment more familiar and friendly for children, it amuses the children a lot. Various decoration themes could be created by means of maps and pictures of foreign countries. Other themes may be related to education history, transportations, science, and animal's picture in the natural habitat, season or holidays.
- *Children chair and table:* Children chair and table should be available with cartoon character made on it where they can sit and read.
- *Small library:* A beautiful and small library should be made in the waiting room. Reading material, magazine, publication must be kept there for

various age group and it should include a wide range of topics. Usually children visit dental clinic with their parent, mother. Cookbooks afford busy mothers interesting reading. A pad and pencil can be placed alongside the cookbooks for the mother to copy any recipes. Thus, an interesting and productive waiting period is provided to the mother while the child is in the treatment room.

- *Soothing music:* Soothing and muffled music in the reception room have a comforting effect on both parent and patient and dispel coldness often felt in a silent room. A handy record player with well chosen record or a tape recorder and amplification system will provide comfort to frighten fearful and tearful children.
- *Television (Fig. 3.2):* A TV set must be kept in one corner of the room for the entertainment. Some cartoon channel Ex. (POGO, Cartoon network) must be available.
- *An aquarium (Fig. 3.3):* An aquarium is always a source of entertainment and may be placed either in the reception room or in the treatment room where it is visible to the child. It helps in behavior modification.
- *Appointment cards:* Appointment cards and appointment announcement should be made educative and so, that it helps in behavior modification of children. So, the child feels that these are addressed to him. A sketch of some



Fig. 3.3: An aquarium is a source of entertainment and helps in behavior modification of a child in the dental office

character of fantasy on the cards will help in doing this.

- *Refreshments:* An investment of few hundred rupees in decorating the reception room can make a big difference in practice. Coffee, tea, juice and fresh fruits are very inexpensive but are nice touches that may create a warm and friendly atmosphere.
- *Play room (Fig. 3.4):* A small play room should be made near to waiting room. Different shape, size and colored toys can promote a child's interest in providing a home like atmosphere and indirectly convey to the child that the staff is interested in him or her. Selected toys preferably of large size, including building blocks and wall attached activity center have proved to be main attraction of children of all ages.
- *Operating room (Fig. 3.5):* The operating room may be made well appealing to the child if good animal pictures in their habitat are present on the wall and are suggestive of children at play or a portrait of a carefree and laughing child is always good. A TV can be fixed to ceiling or near the dental chair at eye level, it serves as a distraction. All the equipment must be placed in such places, where it is not much visible to the child.
- *Dental personnel:* The dentist should realize the limitation of his allotted working time and should employ personal or attendant dental staff to permit him more time for those tasks that cannot be delegated to others.
- *Receptionist:* Each time a child visits the dental clinic, the receptionist will transfer the child and the parent from the reception room to the dental



Fig. 3.4: Play area with different shape, size and colored toys can promote a child interest providing a home like atmosphere and indirectly convey to the child that the staff is interested in him or her



Fig. 3.5: Operating room should be colorful, animal pictures in their habitat present on the wall. They are suggestive of children at play and helps in the development of positive attitude for future dental treatment

health education and prevention area. Receptionist is the people who first interacts with the parents and child patient. So, they should complete the basic information and health history forms

efficiently and cautiously. Receptionist should give the best-suited appointment to the patient according to their own choice.

- **Hygienist:** The hygienist can make an important contribution to dental care of a child. The efficient utilization of a chair side assistance is extremely important in a Pedodontics practice because:-
 - a. It decreases the length of dental appointment thus aiding in child management.
 - b. It decreases the number of steps and movement necessary, resulting in less fatigue to pediatric dentist.
 - c. To get more efficient chair side assistant, modern equipments are required. Contoured chair have been found most effective in children practice. The patient rest in a supine position with his body parallel to the floor and feet slightly elevated. The dentist operates in a sitting position on a comfortable contoured stool. All equipments are conveniently located near the assistant such as high and low speed suction, airtor hand piece and water syringes are mounted on a bracket extending partially over the chair.
 - d. Well integrated instructions make it possible for these instruments to be handed to the dentist as needed. The assistant has everything needed for any specific procedure within easy reach without leaving the chair.

The amalgamator and all needed general supply and drugs should be available in a portable cabinet and it should be present along side of the assistant.

How to Communicate with the Child in Dental Operatory

- Communication is a complex, multisensory process. It includes transmitter, a medium and a receiver. The dentist in dental health team is the transmitter, the spoken word frequently is the medium and the child patient is the receiver.
- For pediatric dentistry, word substitutes are like a second language for the child patient. It is important to be careful in selecting words and phrases. With new child patient the following are example of word substitutes (Euphemism) that can be used to explain procedures to children.

<i>Dental terminology</i>	<i>Euphemism or Word substitute</i>
Rubber dam	Rubber raincoat
Rubber dam frame	Coat rack
Water syringe	Water gun
Suction	Low speed vacuum cleaner
Topical fluoride gel	Cavity fighter
Alginate	Pudding
Air syringe	Wind gun
Sealant	Tooth paint

Record Keeping

- Since, the complete value of child dentist care may not become clear until several years after treatment, so accurate, complete and legible records are essential.
- Uniform and understandable records are necessary if summarize of finding and treatment are to be written in the future. Thorough record keeping by the entire office staff is a critical requirement for fulfilling the practitioner's obligation to analyze accurately the success or failure of individual and over all treatment procedure.
- Routine record keeping requires updating a child's health history at each appointment. The patient's health history form should be revised at each recall visit.

Health Education Room

- Space should be allocated in the dental office where the child and parent can be given proper instruction about preventive procedures. Although this information can be presented in any area of the dental office, a separate room away from possible area of stress to the patient is most desirable.
- Instruction in oral hygiene procedure should be explained fully and participation by the child should be made mandatory until toothbrushing and flossing become an established habit pattern. This may require observing the patient go through routine number of times.
- There are many adjuncts available recently in kit form, to teach the children and attendant or parent. Educating the parent is desirable to supervise the child while performing these duties at home. Slides, films strips, records, films, pamphlets, charts and models are available from number of sources.
- Predicate dentist should emphasize plaque control regime. Plaque removal must be an integral part of

the educational program. Technique such as plaque staining and the phase microscope to demonstrate viable microorganism are valuable teaching aids to convince both the parent and patient. A well illuminated mirror before which children can practice and perfect their toothbrushing and flossing technique will be of great benefit. Caries activity test can also be used as an educational tool.

- *Nitrous oxide OT*: A different operatory should be made in the pedodontics clinic for the procedure to be undergone under general anesthesia. Proper position of personnel and equipment should be given in operating room.

Modification of Clinic for Disabled Child

A disabled child is one who has mental physical or social condition that prevent the child from achieving full potential when compared to other children of the same age.

- Disabled children present challenges that require special preparation before the dentist and office staff can provide acceptable care. In addition parental anxiety concerning the problems associated with a disabled child frequently delay dental care until significant oral disease has developed. Some dentist feel uncomfortable providing treatment for disabled children to feeling may result in loss of greatly needed service.

Dental Office Access

The rapidly expanding elderly population, the presence of disabled children and the emergence of progressive legislation for people with disabling condition of all ages are three important factor that should prompt dentists to address cost efficient way to make their office facilities and operatory area accessible for person with disabling condition.

- In the dental operatory a 4 feet wide width should be used in the doorways. In the dental suite where floor circulation is at premium aisle passage in the operatory area should be planned.
- Wheelchair turning (Fig. 3.6) space and top space under furniture and fixtures may be more readily accommodated if one operatory is specifically designed with a movable dental chair, instrument control unit and suction system.



Fig. 3.6: Wheelchair should be readily available for handicapped children in the dental office

- Movable equipment and dental chair should enhance the opportunity to back the patient into the operatory. Thus, enhancing the need for more wheelchairs turning space. If possible a wider turning rod would be desirable to accommodate wheelchair extensions and adaptation that are required by some persons.
- Dental chair should be adjustable according to height of different wheelchair design. If patient cooperation cannot be obtained the dentist must use alternative instruments and methods such as physical restraint and sedation. Following are some commonly used physical restraints in pediatric dental clinic.

Physical restraining device	
Body	• Papoose board • Triangular sheet • Pedi wrap • Bean bag • Safety belt or Extra-assistant
Extremities	• Velcro strap • Towel and tape • Extra-assistant
Head	• Fore arm body support • Head positioners • Plastic bowl

Child Examination, Diagnosis and Treatment Planning

Dental care for children is best achieved after a thorough orofacial examination, thoughtful and truthful diagnosis and formulation of a proper treatment plan. The manner in which these can be accomplished during the child's 1st visit to the dental office; it enables the good relationship between the dentist, the child and the parent. The child and the caretaker (parent) can be properly prepared for any dental care as follows:

1. A warm friendly approach and giving regards to the child by dentist or dental staff, quickly makes a friend of the apprehensive child and an interest in the active listening of parental voice.
2. The dentist question and statements should be in easy and understandable language.
3. The orofacial examination should be done with easy movements, utilizing a minimum of instrument to avoid alarming the child.

AIM AND OBJECTIVE OF CHILDS OROFACIAL EXAMINATION

The child's orofacial examination centers around four major objectives:

- i. Introduction to the pediatric dentistry.
- ii. Risk assessment and oral examination.
- iii. Prevention of dental diseases.
- iv. Treatment of dental disease.

Introduction to the Pediatric Dentistry

The initial orofacial examination should provide foundation for the development of a positive attitude towards dentistry. The method of examining child as well as the recommended environment can provide a

pleasant, non-threatening and truthful introduction to the dentistry for the child and the parents.

Risk Assessment and Orofacial Examination

Medical history, history of current feeding and oral hygiene practices, clinical findings, the child's socio-economical status and physical environment can provide the basis for an estimate of the child's risk for developing dental diseases. Orofacial examinations begins with an evaluation of the head and neck region and an inspection, palpation of the oral cavity to detect any pathologic process or the early evidence of orodental diseases, leading to an assessment of the child's oral development.

Prevention

A major emphasis during child's initial visit to the dental clinic should center on the counseling of parent regarding their roll in prevention of dental diseases. Preventive counseling should include dietary counseling with respect to feeding practice and snacking pattern in between meals, proper oral hygiene procedure, fluoride assessment and application, resulting in the development of an appropriate prevention program.

Steps of the Examination

Initial Parental Contact with Dental Clinic or Hospital (Table 4.1)

The parent usually makes the 1st contact with the dental clinic or hospital by telephone. The initial conversation between the parent and the dentist is very important.

Table 4.1: New patient (preappointment) telephone interview chart	
• Date of Call	
• Taken by (Receptionist/Dental Personnel).....	
• Appointment (Day/Time/Month/Year)	
• Call for earlier appointment	
• Patient name.....	Sex.....
• Age of Patient	
• Ph. No.....	Mobile No. E mail.....
• Permanent Address:	
• Other Family member who are patient.....	
• Name/occupation of referential (if any).	
• Its Dental visit	Yes.....No.....
If no, are there current X-ray to be requested from another office Yes.....	
No.....	
If Yes,	
– Name of the Dentist	
– Address	
– Phone	
– Date called	
– Date received	
• Special Dental Concern	
• Special Medical Concern	
• Emergency (a) Last filling (Date of filling and date of last filling) (b) Bumped tooth/# tooth/knocked out tooth (c) Tooth Ache Type/Duration of pain.	
• Other Symptom:	
– Sensitive to hot/cold/sweet, Bleeding from gum, constant pain, swelling, apprehension, aware at night, other.	
• Dental Insurance:	
Yes	No or other coverage.
• Patient informed that fee for Fist visit is due at the time of examination.	
• Patient informed will be happy to file insurance for subsequent visit.	
• Special Comment.	
Date and Time	Signature of Interviewer

- i. Emergency
- ii. Recall visit
- iii. Postoperative examinations or complete.
 - i. *Emergency examination*: Emergency examination provided at the site of injury and is basically designed

- ii. *Recall visit:* It is a thorough follow-up after an initial complete examination. Its main objective is to measure the changes that have occurred since the completion of the treatment. The periodic examination is done in most cases, every 3 to 6 months.
- iii. *Complete examination:* The information recorded during this conversation, constitutes the initial dental record of the patient. The following information must

be recorded in the form of chart which is the most convenient and commonly used method.

Interview and Counseling

The interview and counseling portion of the dental visit is completed prior to the examination of the child.

- i. Special concerns of the parent are identified so that it can be used during the examination of the child.
- ii. If the child displays unnecessary excitement, activity or interest during the examination the parent predictably will direct their attention towards the child during the discussion that follows and not towards dentist therefore, the child can be occupied with toys in a non-threatening manner prior to the examination. So, the parent can direct their attention towards the discussion.

Once preappointment information has been checked, the Pedodontist greets the child and parent both and discusses the parental concerns, reason for seeking care and any information from the preappointment chart that requires further classification based on recent information chart and appropriate recommendation can be made regarding each aspects of an overall orofacial disease prevention program.

The Child's Position During Dental Treatment

For Infants (Lap to Lap Position)

The Pedodontist and the parent or caretaker are seated face-to-face with their knee touching. The dentist's upper leg forms the 'Examination Table' for the child. The child's legs present in the lap on the parent allowing the parent to restrain the child's legs and hands. A dental assistant is present to record the dentist examination findings as they are dictated and to help in restraining the child if required. If primary molars have erupted, the pediatric dentist will need an explorer and mini torch associated mouth mirror to complete the oral examination. If the parents are more concerned about the appearance of certain orofacial tissues, the dentist will prefer to conduct the examination on the dental chair where hand instrument can be transferred efficiently, effectively and safely and where light can be easily adjusted and modified.

Position of Dental Assistant

The dental assistant seated slightly higher to the level of dentist to permit good visibility and to better anticipate the dentist needs. The assistant is also in good position to hear and records the dentist findings.

The parent or dental assistant also help in restraining the child's arm, legs and the child's hand is positioned in the bends of the parent's arm. The dentist establishes a chair side position so that not only the dentist's hand but also the lower arm and chest may be available for the support of the child's head if required.

Complete Examination

The child's examination should be done under following major headings.

- i. Case History (Medical/Dental)
 - Patient chief complain
 - Prenatal/Postnatal/ Infancy history.
- ii. Clinical Examination:
 - General appraisal of the patient
 - Detailed orofacial examination
 - Supplementary examination and special laboratory test.
- iii. Diagnosis: Diagnosis can be made by thorough case history and clinical examination with specific radiographic and laboratory test.

Case History

A thorough case history of child dental patient is essential in order to:

- a. To establish a good contact with the child and parent or caretaker.
- b. Essentiality of radiograph or any specific laboratory test depends upon the pathognomic symptom or sign given by the patient at the time of thorough history and clinical examinations.

So, case history is essential for diagnosis of disease and subsequent treatment plan. The recorded history of a child patient can be divided into following categories:

- i. Vital statistics
- ii. Parental or caretaker history
- iii. Prenatal and natal history
- iv. Postnatal and infancy history.

Vital Statistics (Table 4.2)

This is essential for office records, through this records, Pedodontist obtained some information about the socioeconomic status of the family. The child's physician should be concerned in case of future emergency or if additional medical information is required. The chief complain should be recorded in the mother's tongue or child's own words either child may be in acute problem or merely desire for routine care.

Parental of Caretaker History (Table 4.3)

It provides information about hereditary pattern of disease or development through their forefather. It is also designed to provide information about the dentist value and importance from parent's point of view. Since, the attitude of the parents towards dentistry may be reflected in the apprehensiveness of the child and the desire of the parent's as regards his dental care.

Prenatal and Natal History (Table 4.4)

It often provides important information about abnormal colors, shapes and structure of deciduous and its succedaneus teeth. Pedodontist also emphasizes the effect of drugs and metabolic disturbances, which occurs during the formative stage of tooth development.

Postnatal and Infancy History (Table 4.5)

Review the vital system of the child patient. It also provides such important information about previous preventive treatment for dental caries, developmental disturbances of dental significance, allergies, oral habits and the child behavior and his/her attitude towards their environment.

The length and direction of history depends on the circumstances surrounding each case. In emergency situations, the history is usually limited to essentials regarding the offending lesion or condition and the

Table 4.2: Format of history recording of vital statistics

- Date..... Time.....
- Name of child
- Date of Birth.....
- Race and Sex.....
- Name of Caretaker (supplying the information).....
- Relationship: Mother/Father/Others.....
- Occupation of father and Mother.....
- Home address of Child.....
- Phone.....E mail.....
- With whom does the child live.....
- Child present physician.....Phone.....
Address.....
- Who referred child.....
- Child's chief complaint.....

Table 4.3: Parental history

- Are you denture wearer yes/no
- Is your spouse wearing denture yes/no
- If above yes at what age were your teeth removed..... and your spouse.....
- Why yours/teeth and yours spouse teeth gray, yellow, green or brownish in color? If yes explain.....
- Did your teeth wear down excessively (due to Bruxism/Diet Habit..... and Your Spouse.....
- Are you/your spouse frightened of a dental appointment

Table 4.4: Prenatal history and natal history

Prenatal History

- Illness during this pregnancy?
- If yes. (I, II, III Trimester duration).....

- Were you on drug, doses and duration of drug therapy.....

- Were you on high vitamin/calcium diet during pregnancy...
- Rh factor incompatibility between you and your spouse

- Rh factor incompatibility between you and your spouse.

- Was there fluoride content in drinking water.....

- Where you lived during pregnancy.

- Natal History**
- Full term/premature Baby

- Full term/premature Baby ☐ Yes ☐ No

• Was he/she jaundiced at Birth ?	Yes	No
If yes, when did clinical manifestations begin?		

- If yes, physiological/infections jaundice.

Was he/she given transfusion of blood?

Was he/she is a blue baby ?.....

Table 4.5: Postnatal and infancy history

Postnatal and Infancy History

- If yes, time, duration and type of drug therapy given.....

If yes – for how long?

- Any diet supplement given during infancy (fluoride/ vitamins/calcium/iron, etc.)
- Drugs given in the form of syrup or drops

If yes, it is cariogenic or noncariogenic

- And for how long period of time was it given.....
- Did he suck a Sugar teat?

- Did your child have any childhood disease during infancy if yes, name the disease and drug therapy given

- Did he have Rheumatic fever/diabetes/cardiac problem or blood anemia/bone # and frequency of #.

- Does he fails to perspire during hot season – Yes/No
- Does he have any mental/physical disability – Yes/No

- If Yes, explain it.....

- Does your child eat snacks between meals – Yes/No
- Does he/she suffer from frequent toothache/gum bleed/# of Ant teeth?

- Is he/she allergic to any food/L.A./drug
- Is there difficulty in stopping bleeding when he cut himself?

- Is the child hemophilic? Yes / No

- Habit history – Thumb sucking/Mouth breather.
- Does he have difficulty keeping up with his school

- Does he/she fear the dentist? Yes/No

- If yes, do you know why?

presence or absence of systemic disease. In most cases a self noted history questionnaire may be of great value.

2. CLINICAL EXAMINATION OF CHILD

A. General Survey of Child

- i. *Stature of child*: General survey of a child done quickly as the child enters the reception room or dental operatory. The 1st observation is whether the child is overall tall or short for his particular age. The child can be classified in following categories:
 - Normal height for his age.
 - Too short height for his age.
 - Too tall height for his age.

Suspected variation can be measured by a long-term records of the child's growth to determine whether the present stature is the result of constant growth pattern or whether it is a growth change occurring at some definite point in the child's development or growth spurts.

- ii. *Gait of child*: As child walks into the dental operatory, Pedodontist can quickly ascertain whether the gait (manner of walking) is normal or affected. Abnormal gait is usually seen with sick child walking with unsteady gait of weakness.

Types of Gait

- i. Waddling (walk with short step)
- ii. Equinus (walking like a horse)
- iii. Scissor (two legs move like a pair of scissor)
- iv. Hemiplegic's walking
- v. Shuffling walking

- vi. Wobbly walking (move unsteadily from side to side due do illness, tiredness or anxiety).
- vii. Staggering gait (walk unsteadily as if about to fall)
- viii. Ataxic gait (ataxic walking)

- iii. *Speech development (Fig. 4.1)*: One of the most important achievements of the human being is development of speech, a significant form of communication among persons. Infants with severe hearing problems may have abnormally slow language development.

For speech or language development the child's hearing capability and visual system must develop and function normally. So children are able to proceed along a normal course of language development only where there neuroanatomic mechanism are sufficiently mature. Language acquisition must be proceeding by the evolution of the child's cognitive power from concrete to abstract conceptualization.

Level 1

Level 1 showed the 1st 3 months of age during which there is a gross reception of stimuli and vestigial discrimination and localization of sound. At this level child will stop activity with or turn toward the sound of human voice.

Level 2

Showed 4 to 11 months of child, during which he/she develops the ability to integrate sensory stimuli (Audible) into pattern and to differentiate intricate stimuli. This can be represented by the child's babbling sound

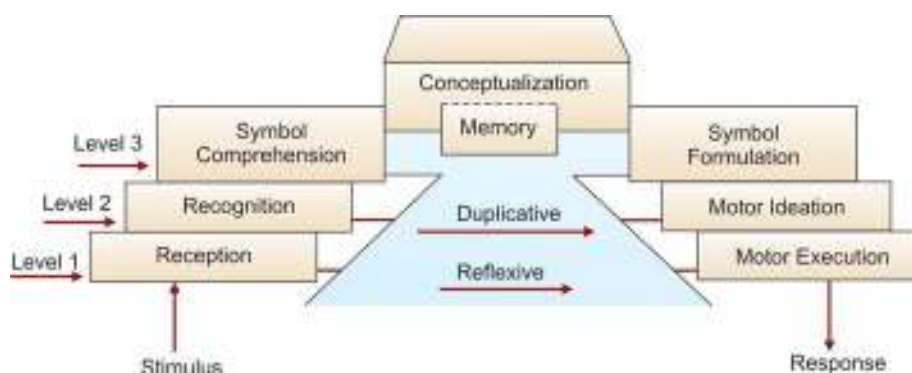


Fig. 4.1: Complex development process of language development

(Vocal play, with random production of different speech sound).

At level 2, child can discriminate various speech sound patterns and develop sufficient motor control of the physical mechanism to accurately imitate these sound patterns. The children also react appropriately to gestures and can respond to words such as Tata and bye-bye. The child is also able to stop an activity when said 'no'.

Level 3

Represent by the age of 12 to 18 months. At this level the child can comprehend and follow simple commands. Child will develop a vocabulary of up to 50 single words before being able to put words together.

Each three level of development, memory appears to play an integral part in the dynamic interplay associated with language learning.

CHILD-LANGUAGE DEVELOPMENT

1. *At 18 months of age:* Child will begin to put two word sentences together and Vocabulary increases up to 272 words.
2. *At 24 to 30 months of age:* Child will begin to put three word sentences.
3. *At 3 years of age:* The basic grammar of language has been learned and the child can use simple single clause statements, questions and commands.
4. *At 3 to 3½ years of age:* The child begins to evolve more complex sentences structure containing more than one clause and conforming to the basic patterns of sentence orders.
5. *At 3½ to 4½ years of age:* A passive grammatical structure begins to develop around 4 years of age vocabulary increases about 1450 words and at 5 years of age Vocabulary about 2000 words.
6. *At 5 years of age:* During this time the child becomes more aware that similar words may not have the same meaning and that phrases may have a meaning other than its literal one.
7. *At 6 years of age:* Vocabulary increases up to 2562 words. The child begins to express abstract ideas and nuances of meaning in speech and continues to develop this ability until puberty.

The following types of speech disorders should be considered:

- i. Aphasia
- ii. Delayed speech.

- iii. Stuttering (Repetitive speech)
- iv. Articulatory speech disorder.

Motor Aphasia

It is a rare condition and usually denotes loss of speech secondary to CNS disorder.

Delayed Speech

Speech retardation can be considered if the child does not talk by the age of three year. Common causes of delayed speech are as follows:

- Hearing loss.
- General developmental disorder
- Intellectual retardation
- Sensory defect
- Severe prolong illness
- Lack of motivation
- Poor environmental stimulation
- Neurological injured child.

Repetitive Speech or Stuttering

It occurs in almost all children at sometime during the preschool period. Parents are advised not to over concern and show apprehension about repetitive speaking. It may block the normal flow of Speech.

Repetitive Speech or stuttering is more common in boys than girls. Psychological stresses play an important role in the development and persistence of repetitive speech. Cluttering is an unusual type of speech disorder characterized by repetition of words or phrases, false start, changes in context in the middle of the sentence and general verbal confusion.

Articulatory Speech

The articulators include the lips, tongue, teeth and palate and the vocal folds. Articulatory speech or sound formation is being positioned appropriately for the correct production of a sound or group of sounds. Speech clinicians have categorized phonetics disorder into three main acoustic symptoms.

- i. A substitution of one sound for another, example: 'Th' sound for S' sound.
- ii. Distortion of a sound wherein that produced resemblance the correct sound but it is defective in nature.
- iii. *Omission of a sound:* Some articulatory defect occurs within the limits of normal development,

although children with cerebral palsy or CNS damage, cleft palate or malocclusion often have articulatory defect. Paralysis of laryngeal and pharyngeal muscles, cerebral palsy, may alter the quality of speech and produce a voice with nasal twang.

Speech articulation errors of interest to the pediatric dentist encompass a number of location and functional patterns in the oral cavity and pharynx. For purpose of clarity and continuity, the discussion to follow will focus on anatomic areas beginning at the lips and ending at the adenoid mass.

The pediatric dentist should not be expected to construct an appliance for speech, speech therapist that will ensure normal |S| sound production although dental appliance therapy may help speech patterning, but the pediatric dentist should use caution in assuming responsibility for speech or encouraging the parent or child that speech will improve from any dental therapy.

The pediatric dentist can play an important role in counseling the family and suggesting appropriate resources when significant non-fluencies are noted in child's speech. The following guidelines are advised:

- i. Do not discuss the speech symptoms directly with the child.
- ii. Ask the Parent/caretaker general question about the child speech as to the ease of talking.
- iii. Contact a speech therapist and report the symptom observed.
- iv. During dialog with child, attempt to maintain eye contact during non fluencies of speech and avoid completing words that the child block on.

Hands

By taking the child's hand in the dentist hand or putting his hands on the shoulder of child. The dentist not only establishes a warm communication and faith but also is afforded an opportunity to further appraise the general health. In most cases the hands will feel normal, but occasionally there will be a feeling of increased temperature or moisture or dryness.

- All primary and secondary skin lesions can be seen on the hand (vesicle, ulceration, scale, etc.).
- The shape, number and size of the fingers should be evaluated.

- The nails of hand should be inspected bitten short that showed anxiety tension.

Temperature of Body

Elevation in body temperature at rest is one of the common symptoms experienced by the children. There may be increase in body temperature after eating or exercise or when the environment is not conducive to body cooling (Ex. Moist and Hot environment).

- Dental abscess or acute gingival disease and numerous other oral and respiratory infections may result in a febrile condition in children.
- Degree of fever, its pattern and the child response are often factors indicative of certain pathosis.

EXAMINATION OF HEAD AND NECK

- i. *Size and shape of head:* The following types of child heads are usually seen.

A. Macrocephaly: It is an enlarged head. It frequently occurs due to developmental or early traumatic disturbances.

B. Microcephaly: It is a smaller head than normal size. It may occur due to the growth disturbance, disease or trauma affecting the central nervous system (CNS).

- Abnormal head shaped may be caused by premature closure of the skull sutures or interference in the growth of cranial bones or abnormal pressure within the skull.

- ii. *Hair and skin:* Hair and skin should be examined for following region.

- Alopecia or loss of hair may occasionally be seen in young patient.
- A common baldness is a small, discrete, round area characterized by a raised indurated, inflamed line suggesting the ringworm disease or fungal infection.
- Those children who are suffering from congenital ectodermal dysplasia, his/her hair is characterized by scanty, fine and light in color or may be absent. This disease is often seen in boys than girls.
- Certain other hormonal imbalances may cause hair losses, while the addition hormonal medication may cause hirsutism or excessive growth of hair.

- Face skin should be observed for the sign of disease. A number of primary and secondary skin lesions may be found on the face.
- iii. *Facial swelling and asymmetry*: Slight facial asymmetry considered as normal.
 - Asymmetry of the face can be psychological or pathological.
 - Infant sleeping habit particularly in children born at less than full term and within 24 hours of delivery, have been shown to affect the shape of the face permanently.
 - Pathological facial asymmetry may be produced by abnormal intrauterine pressure, cranial nerve paralysis, fibrous dysplasia of bone and familial hereditary disturbances.
 - Infections like bacterial, viral and trauma are the principal cause of facial asymmetry in child.
- iv. *Ears*: Pedodontist should be aware of any deficiency of hearing in the child patient and examine external auditory meatus for pus discharge. Pedodontist also determine whether the referred pain from the dentition is the possible cause of earache. If palpation of external ear and mastoid process reveals some tenderness and hot in touch, it indicates that the inflammation exists within the ear itself.
- v. *Eyes*: Pedodontist should observe the child's eye for following region:
 - i. Swelling or Puffing around the eye.
 - ii. Presence or absence of conjunctivitis.
 - iii. Any defect in the iris.
 - iv. Presence or absence of any crusting or lesion on the eyelids.
 - v. Any abnormal lacrymation
 - vi. Any difficulty in child's vision/or wears power glasses.
 - vii. Presence or absence of inflammation in child's eye.
 - viii. Action of the eyelids.
 - Inflammation associated with maxillary teeth may extend to the orbital region causing swelling to the eyelids and conjunctivitis.
 - Children with upper respiratory tract infection like chronic sinusitis and allergy have puffiness of the eyelids and periorbital tissues.
 - vi. *Nose*: Nose is examined for any abnormality in the size, shape or colors. Pedodontist should check nasal drainage for any upper respiratory tract. If scars observed on the nose, it is indicative of surgical repair of developmental anomaly or trauma. The extension of inflammation via the maxilla may alter the size, shape, and color of the nose, because of close proximity of the nose to the oral cavity. The extension of cyst or tumor from within the oral cavity, usually the maxilla may encroach up to the nasal passages.
 - vii. *TMJ Examination* (Figs 4.2 and 4.3):
 - Measurement of maximal jaws opening capacity and individual vertical overbite should be included



Fig. 4.2: Closed mouth TMJ examination (see the location of index and middle finger)



Fig. 4.3: Open mouth TMJ examination (see the location of index finger and middle finger)

in a functional examination of the masticatory system.

- TMJ should be examined for any restricted movement, subluxation, dislocation, mandible deviation, pain or any clicking sound.

Method

Pedodontist stands as nearly as possible, in front of the child as the dental chair will permit, he may place his hands lightly on the child's cheek in the area of TMJ. Ask the child open and close his mouth slowly, then from closed centric, have him move into the lateral excursions by asking him to chew slowly on his posterior teeth. The lateral aspects of the TMJ are palpated bilaterally while the patient performs two or three maximal jaw openings. Pain on palpation, Pain during opening, irregular jaw movement as well as TMJ sounds are recorded (Stethoscope is used to hear the TMJ Sound). Palpation of the jaw muscles should be limited to Masseter and Temporalis muscles for TMJ disorder.

viii. *Neck examination:* Neck is examined by both observation and palpation. Skin of the neck is examined for presence or absence of primary or secondary skin lesion and scars of surgical repairs. In the course of examination, Pedodontist should stand in back of the child patient and gradually passes the flat surface of his fingers over the parotid region, down under the body of the mandible to the sub-maxillary and sublingual regions and thence palpate the Triangles of the neck.

- Pedodontist should check for any external swelling on the neck that may represent enlargement of major salivary glands. A significantly enlarged parotid gland will alter the facial contour and may lift the ear lobe. To evaluate parotid gland function, dry the cheek mucosa around the orifice of each parotid gland duct and massage the gland externally and observed the nature of excreted material. In normal gland clear and free flowing secretions will be readily seen. A restricted flow of parotid secretions and viscous, cloudy and purulent discharge indicate the infections of parotid gland and needs additional evaluation of the parotid glands.
- For the submandibular and sublingual glands, use bimanual palpation. (Insert the gloved index finger besides the tongue on the floor of the mouth and

locate the two salivary glands and any enlarged submandibular lymph node using a second finger placed externally). Check the location, texture, size of gland and any tenderness or nodules.

- Neck examinations also includes examination of submandibular and cervical lymph nodes (Drainage of the oropharynx and other tissues of the head and neck and anastomosing with lymphatic from the abdomen, thorax, breast and arm, the midline structure (Ex. Hyoid bone, Cricoids and Thyroid Cartilages, Trachea and Thyroid gland).
- Ask the child to extend their neck and check the clavicle, sternomastoid and trapezius muscles, which define the anterior and posterior triangles of the neck.
- Palpate the hyoid bone, thyroid, cricoids cartilage and trachea, observe any displacement or tenderness.
- Examine the external jugular vein as it crosses the sternomastoid muscle.
- Palpate anterior to the tragus of ear for preauricular nodes, at the mastoid and base of the skull for posterior auricular and occipital nodes, under the chin for submental nodes and further posterior for submandibular and lingual nodes.
- The superior cervical lymph nodes lie above the sternomastoid muscle, the deep cervical lymph node lie between the sternomastoid and cervical fascia. To examine the deep cervical lymph node, ask the patient to sit erect and to turn his/her head to one side and to relax the sternomastoid muscle, use thumb and fingers to palpate under the anterior and posteriors border of relaxed muscles and repeat the procedure on opposite site and also palpate the posterior cervical lymph node in the posterior triangle close to the anterior border of the trapezius muscle. Finally examined for supraclavicular lymph node just above the clavicle, lateral to the attachment of the sternomastoid muscle.

ix. *Intraoral Examination* (Figs 4.4 to 4.6):

Pedodontist should use simple intraoral examination procedure to accustom the child to manipulations with mirror, probe and other instrument in the oral cavity. The child oral cavity should be thoroughly examined in a systemic way in order to avoid omission of important sign and symptom.

Breath: The breath of a healthy child is usually pleasant and even sweet. Bad breath or 'HALITOSIS' may be attributable to either local or systemic factors.



Fig. 4.4: Intraoral examination with acrylic finger guard



Fig. 4.6: Lap to Lap position, during intraoral examination of the child



Fig. 4.5: Intraoral examination of a child (see the position of child, dentist and assistant)

- a. Local factor of mouthbreathing are poor oral hygiene, food lodgment in the mouth due to malposed—teeth/appliance/periodontitis/dehydration of gums in mouth breather strong smelling volatile food, etc.
- b. Systemic Factor for Halitosis
 - i. Sinusitis
 - ii. Liver disease
 - iii. Diabetes
 - iv. Malignancies of upper elementary tract
 - v. Typhoid fever
 - vi. Hypertrophy and infections of adenoid tissues
 - vii. GIT obstruction and infection.

Oral Mucosa

Oral mucosa should be examined properly and if necessary wiped off the mucosa starting from the inner surface of the lips and continuing to the mucosa on the inside of the cheeks including the upper and lower alveolar sulci. The lips should be checked for size, shape, colors and surface texture, and be palpated using thumb and forefinger. The palatal mucosa is examined with the help of mirror under adequate light.

- The mucosa of tongue and floor of the mouth are examined after careful retraction of the tongue with the help of mouth mirror or tongue blade, which may include palpation, inspection, and ulceration, changes in color of surface, swelling or fistulae are observed and noted on the case sheet.
- During alveolar process examination, a special attention should be given to any minor swelling or retraction of the gingiva which should be a sign of periapical or inter radicular pathological process.

Saliva

Saliva should be examined for rate of flow, consistency, color and quantity and quality. The quality of saliva may be very thin, normal or extremely viscous in nature, the excess secretions or purulent discharge from the salivary duct is indicative of infections of the salivary glands.

Gingiva

Gingiva should be examined for its size, color consistency, capillary fragility, contour, surface texture, and bleeding tendency or any lesion present on the gingiva. The gingiva should be dried before examination can be made. In addition to visual examination and exploration with instrument, firm but gentle palpation should be used for detecting pathological changes in normal resiliency and locating area of pus formation and discharge. The distribution of gingival disease and its acuteness or chronic condition should also be noted on the case sheet.

Examination of Tongue and Sublingual Space (Fig. 4.7)

The child should be asked to extend the tongue to note its size, shape, color, texture and movement pattern. Pathological enlargement of the tongue may be associated with cretinism or mongolism, cyst, neoplasm of the tongue tissues, etc.

- Tongue surface mucosa is examined for desquamation of the papillae, changes in color and tenderness which may be associated with certain avitaminosis, anemia or stress disorder.
- Abnormally short lingual frenum may hamper the tip movement of tongue. Such frenum can be responsible for certain speech defect (frenectomy can be done).
- To examine the dorsum of the tongue\tip of the tongue should be grasped with a cotton gauge square



Fig. 4.7: Finger palpation of sublingual and submandibular space

between thumb and forefinger and gently elevate the tongue. Any lesions are examined bidigitally for its size, shape and consistency.

- Dryness of the tongue may be due to dehydration caused by mouthbreathing habit or xerostomia in case of agenesis of salivary gland.
- The floor of the mouth and underside of the tongue should be examined for cyst, ranula or ulcerations, swelling in the floor of the mouth may cause the tongue to be elevated and affect the speech and tongue movement of the child. The opening of the sublingual and submaxillary salivary glands may become clogged, causing a mucous retention cyst or ranula.

Examination of Palate

- The child's head should be tipped back slightly for correct observation and examination of palate's shape, color, size and presence or absence of any lesion.
- The consistency of deformities swelling should be investigated carefully by palpation. Scar on palate may be evidence of past trauma or surgical repair of developmental anomalies like cleft lip and cleft palate. Mucosal color of the palate may be changed by neoplasm, infections or systemic disease, trauma or chemical agents.

Pharynx and Tonsil's Examination

To examine the pharynx and tonsil area the Pedodontist must depress the tongue with either a mouth mirror or a tongue blade to note any color changes, ulcerations or swelling. The proliferation of the laryngeal tonsil may be so extensive that minor space exists in the throat for the passage of food, water and air.

Examination of Dentition

Both dentition (Primary and permanent) examined for number, of teeth, its color, size, shape occlusion and malformation.

A. Number of Teeth

- Anodontia (Absence of teeth) is a rare condition. Partial anodontia or oligodontia is a more common in comparison to anodontia.

- Missing single teeth are more important in the permanent dentition than in the primary dentition. Mandibular second premolar and maxillary lateral incisors are the teeth most often missing.
- Supernumerary teeth are most often seen in the midline of the maxilla but may occur anywhere in either arch (Example- Mesiodens and Paramolar).

B. Size of Teeth

True macrodontia or microdontia is a rare condition. However, single teeth may be judged small in case of Peg laterals or may appear large in case of gemination or fusion.

C. Color of Teeth

Abnormal staining of children teeth may be divided into following type:

- Extrinsic staining.
 - Intrinsic staining.
- Extrinsic stain can be caused by chromogenic bacteria, colored food, material alba, producing various colors on children's teeth including black and green stain.
 - Intrinsic stain can be caused by blood dyscrasias, amelogenesis imperfecta, internal resorption and drug such as tetracycline group.

D. Occlusion of Teeth

The occlusion of the child is examined by asking the child to bite down on his posterior teeth. As the child closes down, Pedodontist guide the mandible gently but firmly into the most retruded comfortable position of the condyle (Centric Relation). The molar and cuspid interdigitation should be checked bilaterally.

E. Malformation of Teeth

Physical injuries and enamel hypoplasia is the most common cause of malformed teeth. In addition teeth may be dilacerated, microdontia, geminated, fused, notched, Peg shaped from various systemic or developmental disturbances.

F. Caries Detection

Certain anatomical differences in primary teeth such as extremely large pulp chambers, prominent pulp horns

and their proximity to external surface of tooth can be evaluated radiographically that makes it vulnerable to caries development. It should be examined early and treated promptly.

- Detection of the incipient carious lesion in teeth can be approached by several methods.
 - With mirror and sharp explorer. Pit and fissure caries and cervical caries can be detected.
 - Bitewing radiographs are essential for the detection of interproximal lesion, especially those between the wide contacts of primary molars.
- Caries activity test may be performed for early detection of caries development. Those tests are as follows:
 - Lactobacillus counts test
 - Snyder test
 - Alban's test
 - Salivary viscosity test
 - Salivary reductase test
 - Salivary flow test
 - Enamel solubility test.

Uniform Dental Recording

Most commonly used tooth numbering system is as follows:

- Universal system
- Federation Dentaire International (FDI System).

Universal System

This system of numbering permanent teeth from 1 no. to 32, beginning with the upper right 3rd Molar (numbered 1) and progressing around the arch to the Upper left 3rd molar (numbered 16), down to the lower left 3rd molar (numbered 17) and around the arch to the lower right 3rd Molar (32). The Primary teeth are identified in the Universal system by the First 20 letters of Alphabet, A through T.

1 2 3 4 5 7 8	9 10 11 12 13 14 15 16
32,31,30,29,28,27,26,25	24,23,22,21,20,19,18,17

Permanent Dentition (Universal System)

A B C D E	F G H I J
T S R Q P	O N M L K

Primary Dentition (Universal System)

Federation Dentaire International (FDI System)

According to this system, the 1st digit indicates the quadrant and the second digit showed the type of teeth within the quadrant. Quadrants are allotted the digit 1 to 4 for the permanent teeth and 5 to 8 for the primary teeth in a clockwise sequence; starting at the upper right side, teeth within the same quadrant are allotted the digit 1 to 8 (and Primary teeth 1 to 5) for permanent teeth from the midline backward.

18 17 16 15 14 13 12 11	21 22 23 24 25 26 27 28
48 47 46 45 44 43 42 41	31 32 33 34 35 36 37 38

(FDI System, Permanent Dentition)

55 54 53 51	61 62 63 64 65
85 84 83 81	71 72 73 74 75

(FDI System, Primary Dentition)

OTHER DIAGNOSTIC AIDS

1. **Auscultation (Stethoscope in Dentistry):** Stethoscope is used for the auscultation of the TMJ sound, which amplifies the joint sound for both the patient and Pedodontist. It can reveal noises diagnostic for numerous conditions. The intensity and nature of sounds (clicks, pop, and crepitus) should be recorded accurately. Stethoscope is also used for detecting any abnormal occlusal movements by recording grinding, grating or any rubbing sound.
2. **Percussion:** Percussion test of a tooth makes it possible to evaluate the status of the periodontium surrounding the tooth. The tooth is struck a quick and moderate blow, initially with low intensity by the fingers then by increasing intensity by using the handle of mirror or blunt instrument on each cusp of teeth and each surface of teeth to determine whether the tooth is tender or not, if tender which root/surface is involved.
3. **Palpation:** The test is done with finger tip using light pressure to examine tissues consistency and pain response. Its value lies in locating the swelling over an involved tooth and determines the following:
 - i. Whether the tissues are fluctuate and enlarged sufficiently for incision and drainage.
 - ii. To find out exact location of pain and its intensity.
 - iii. To find out location of adenopathy.

- iv. To find out bone Crepitus in case of fracture of alveolar or facial bone.

4. **Radiographs:** Radiograph is a useful diagnostic aid in the orofacial examination of the child. Radiograph should be performed when the patient history, sign and symptom leads to the conclusion that further useful information may be necessary to get the diagnosis.

Indication for Radiograph in Children and Adolescence

- i. Detection of the carious lesion in primary, mixed and permanent dentition with a proximal contact area.
- ii. Injury to the tooth and supporting tissues.
- iii. Disturbances in tooth development and growth.
- iv. Examination of pathological condition.

Radiograph provides following important information about:

- i. Presence/absence of incipient carious lesion.
- ii. Anomalies of teeth.
- iii. Alterations in calcification of teeth.
- iv. Alterations in growth and development.
- v. Alteration in the integrity of Periodontal Membrane.
- vi. Alteration in supporting bone change in trabecular pattern and bone density).
- vii. Changes in the integrity of teeth.
- viii. Pulpal evaluation.
 - Two types of pediatric dental films are available:
 - i. Intraoral X-ray film
 - ii. Extraoral X-ray film

PULP VITALITY TEST

These tests are used for checking the vitality of the pulp. The following methods are employed:

Electric Pulp Testing

The objective of the electric pulp test is to stimulate the pulpal response by subjecting the tooth to an increasing degree of electric current.

Method

After drying the crown portion of teeth an electrolyte is applied on the tooth. One electrode placed against the electrolyte applied enamel of the crown occlusobuccally or incisolabial surface. The patient cheek

is retracted with free hand of the dentist. This hand contact with patient cheek completes the electrical current (One electrode contact with tooth surface and other electrode have a contact with dentist hand). The current is increased slowly and pain sensation is recorded. A positive response is an indication of vitality of pulp and helps in determining the normality or abnormality of pulp. This test is not reliable for Primary dentition.

Thermal Testing

This test involves the application of cold and heat to a tooth to determine pulp sensitivity to thermal changes.

- a. *Heat testing:* The area to be tested is isolated and dried, warm air or hot gutta-percha is directed to the exposed surface of tooth and patient response is noted. If a higher temperature is required to get a response, usually indicates the presence of a pulpal or periapical disorder, requiring endodontic treatment. Hot water or hot gutta-percha, hot burnisher or hot compounds are used to deliver a controlled temperature to the tooth.
- b. *Cold testing:* Cold can be applied on the tooth surface in several different ways.
 1. A stream of cold air can be directed against the crown of previously dried tooth and also at gingival margin.
 2. Frosted ice of refrigerator packed in the open ended (without needle) syringe can be applied over the isolated dried tooth surface.
 3. Tooth can be isolated under rubber dam and sprayed with ethyl chloride.
 4. CO₂ snow has also been used for application of cold to teeth.
 5. A response to cold indicate a vital pulp regardless of whether that pulp is normal or abnormal.

Laser Doppler Flowmetry

Laser Doppler flowmetry measures the velocity of RBCs in pulp capillaries. It is a noninvasive and painless alternative to traditional neural stimulation methods, so it is a promising pulpal test for young children (for primary dentition).

The flowmetry produces regular signal fluctuation for vital teeth. A nonviable tooth shows no synchronous signals but produces irregular fluctuations or very steep spike trace that was attributed to a movement artifact.



Fig. 4.8: Pulse oximetry with dental lead

Pulse Oximetry in Evaluation of Pulp Vitality (Fig. 4.8)

It is a completely objective test requiring no subjective response from the patient that directly measures blood oxygenation saturation level. To determine oxygen saturation, the pulse oximetry measures and compare amplitude of the ratio of transmitted infrared with red light. This ratio varies with relative fraction of oxygen saturated to unsaturated hemoglobin and hence used to calculate oxygen saturation.

These characteristic infers that the pulse oximetry is also capable of evaluating the blood vascularity status within a tooth and therefore pulp vitality. The dependence on a pulsatile blood flow appears to be a disadvantage of the use of the pulse oximetry.

Fiberoptic Transillumination Test for Teeth

It is used to identify, proximal surface caries in anterior teeth. Transillumination is accomplished by placing light source on the lingual side of the anterior teeth and directing the light through the teeth. Proximal surface caries (except incipient lesion) appears as a dark area along the marginal ridge when light directed through the tooth. It is also used to detect color changes of tooth that may indicate loss of vitality.

Study Casts

Study models are accurate plaster replicas of the teeth and their surrounding soft tissues. It is an essential diagnostic aid that enables to study the arrangement of teeth and occlusion from all direction.

Study models used for following purpose:

- i. Study of occlusion from all aspects.
- ii. Accurate measurement can be made in dental arch, (with help of study cast only).

- iii. To assess the treatment progress by comparing with previous diagnostic cast.
- iv. It can be used in assessing of the nature and severity of malocclusion.
- v. It helps in motivation of the patient and to explain the treatment plan as well as progress to the patient and parents.
- vi. Study models are useful to transfer records in case the patient is to be treated by another clinician.

Laboratory Investigation (Table 4.6)

Laboratory investigations are used to differentiate between the presence and absence of a disease or, used as predictors of disease:

- Laboratory investigations are an extension of the physical examinations finding. Example- Tissues, blood, Urine or other specimens are obtained from the patient and are subjected to microscopic, biochemical, microbiological or immunologic examinations.
- A laboratory investigation alone rarely establishes the nature of an oral lesion, but when interpreted in conjunction with information obtained from the history and the physical examination and the results of laboratory test will frequently confirm the diagnosis of a specific disease.
- Specimen directly obtained from the oral cavity (Example- By scraping of oral mucosa, biopsy specimens and swabs of throat and exudates) as well as the specimen more commonly submitted to the clinical diagnostic laboratory (i.e. blood) may provide information that is valuable in the diagnosis of oral lesion such as Candidiasis, pulpal and periodontal abscess, pharyngitis and lesion of oral mucosa and jaw bones.
- Screening diagnostic clinical and laboratory procedures such as blood pressure measurement, complete blood counts, blood chemistry screening, throat culture for infections with hemolytic streptococci and detection of antibodies to hepatitis viruses and HIV have also been used for epidemiological purposes in dentistry.

Photographs

Used for detecting facial asymmetry and comparative study for preoperative and postoperative changes.

Advance Diagnostic Aids

Probes

Definition: Probe is an instrument, which is usually flexible and used for exploring the depth and direction of a wound or sinus or caries.

Periotemperature Probe

Periotemperature probe is used for detection of early inflammatory changes in the gingiva by measuring temperature rise. This probe detects pocket temperature differences of 0°C from a referenced subgingival temperature. Higher temperature probe are signaled with a red emitting light.

Fluoride Probe

It is a computerized periodontal probe consists of a probe, handpiece, a digital screen, a foot switch. It is used to measure pocket depth.

Advantages

- i. High degree of accuracy
- ii. Digital readout
- iii. Constant probing force.

Foster-miller Probe

Couples pocket depth determination with detecting of cemento-enamel junction from which clinical attachment level is automatically detected.

Toronto Automated Probe

This probe allows simultaneous measurement of gingival attachment level and Probing velocity. Sulcus is probed with NiTi wire that is extended under air pressure. The probing velocity may be a useful clinical method for the ancillary measurement of early loss of gingival attachment level. It can also detect biophysical changes in the dento-gingival junction of progressive inflammatory lesions.

DNA Probe

DNA probe is used to identify the microorganism associated with periodontal disease. This probe identifies species specific sequences of nucleic acid that make up DNA thereby permitting identification. The DNA library includes probe for *A. actinomycetemcomitans*, *P. gingivalis*, *C. rectus*, *F. nucleatum*, etc.

Table 4.6: Common diseases, their investigations and treatment chart

S.No.	Disease	Investigations	Treatment
1.	Diabetes	1. Blood sugar level • Fasting blood sugar • Postprandial blood sugar • Random blood sugar. 2. Oral glucose tolerance test. 3. Urine test for ketone bodies	1. Dietary management 2. Oral hypoglycemic agent 3. Insulin therapy
2.	Viral hepatitis	• SGOT and SGPT level • Serum bilirubin • Prothrombin time • Serum alkaline phosphates • Urine urobilinogen	Bedrest Light diet in the form of fruit, juices, soft drink and glucose and good amount of protein.
3.	Rheumatic	1. Blood examination • Shows leukocytosis • Raised ESR • Raised C-reactive protein 2. Anti-streptolysin antibodies titer 3. Throat swab culture for group A-β hemolytic <i>Streptococcus</i> 4. Chest X-ray 5. ECG and cardiograph	1. Salicylate 2. Corticosteroid therapy 3. Antibiotics- procaine penicillin
4.	Infective endocarditis	1. Blood culture and examination • ESR raised • Leukocytosis • Normocytic, normochromic anemia. 2. Increased serum C₃ level 3. Urine examination and ECG	Antibiotics 1. Penicillin 2. Cefazolin 3. Vancomycin 4. Tetracycline
5.	Anemia	• Blood Hb level, RBC count • Mean cell volume WBC count • Reticulocyte counts, platelets count • Peripheral blood film and serum iron level	1. Iron supplement 2. Vitamins supplements 3. Blood transfusion
6.	Hemophilia	• Bleeding time, Platelet counts • Level of factor VIII • Level of von Willebrand's factor	1. Intravenous infusion of factor VIII (plasma concentrate) 2. Blood transfusion
7.	Leukemia	• Blood Hb level, platelet count • WBC and reticulocyte count • Bone marrow examination • Peripheral blood film shows blast cells	1. Specific drug therapy • Intrathecal drug therapy • Hydroxyl urea and mercaptopurine 2. Supportive treatment • Anemia, bleeding due to thrombocytopenia • Antibiotics for infection control 3. Bone marrow transplantation
8.	Tuberculosis	• Mantoux test • Sputum examination • Chest X-ray • Blood examination	Antitubercular drug therapy • Rifampicine • Isoniazid • Pyrazinamide • Ethambutol • Streptomycin

Periodontal Probe

Periodontal probe are used to measure the depth of pockets and to determine their configuration. The typical probe is tapered instrument calibrated in millimeter, with a blunt rounded tip.

Types of Periodontal Probe

- The Marquise color coded probe
- The UNC 15 probe
- The University of Michigan 'O' Probe with Williams marking at 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 mm.
- The Michigan 'O' probe with marking at 3, 6 and 8 mm.
 - i. *The WHO Probe (Fig. 4.8)*: 0.5 mm at ball tip and mm marking at 3.5, 8.5 and 11.5 mm with color coding from 3.5-5.5 mm.
 - ii. *Other advanced diagnostic aids*:
 - a. *Xeroradiography*: It is an X-ray imaging system that uses the xerographic copying process to record images. The main advantages of xeroradiography over conventional radiography are enhanced edge image and sharper picture. No use of developer or fixer solution.
 - b. *Use of computers in dental office*: Computers help us by retention of thousands of patient records in small disk or hard disk and whenever it is required can be seen easily. It also helps in comparative digital study of radiograph or cephalograms.
 - c. *Ultrasonic*: The fundamental use of high sonic vibrations is to define areas of differing physical properties by reflection of waves from the surface

of adjacent areas of tissues it also helps in defining the:

- i. Pulp anatomy
- ii. Shape of soft tissues
- iii. Neoplasm.
- d. *CADIA (Computer Assisted Densitometry Image Analysis System)*: In this system, a video camera measures the light transmitted through a radiograph and signals from the camera is received by image processor of the computer that allows storage and manipulation and the images.

DIAGNOSIS

Collection of Important Information

- It should be collected and noted. Certain pathognomic sign may lead to an early diagnostic decision. All historical facts about the child should be systematically collected and correlated.
- It is often necessary for the dentist to make a diagnosis before all the facts have been collected to prevent the disease process from progression (Ex. ANUG).
In some cases a period of observation may be necessary before the final diagnosis and their respective therapy.

Evaluation of Patient Record

There must be critical evaluation of collected facts in relation of the overall picture and the chief complaint. Not infrequently parents are poor historians. The clinical signs, symptoms noted by the dentist may differ from parent given history/facts.

Making the Diagnosis

The history, clinical examination and laboratory investigation results are important in making the diagnosis through the information collected; several disease processes might be suggested. There is always the possibility that more than one disease may be present at the same time. In few cases consultation with super specialist is necessary before to reach final diagnosis and treatment plan.

TREATMENT PLANNING

- A. *Medical treatment*: When the history and Examination suggest a medical problem, Pedodontist should

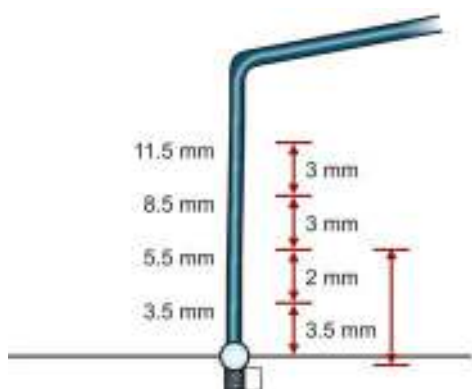


Fig. 4.9: Sketch diagram of the WHO periodontal probe

consult the child physician to discuss the health safety, of the child during orofacial treatment if a parent is uncertain about a disease (i.e. Rheumatic fever), but has answered questions affirmatively that suggest a disease, the child should be referred to a Pediatrician for proper evaluation.

- B. *Systemic treatment*: Premeditation for apprehensive child, spastic patient or those with cardiac problems is frequently necessary. Such premedication should be done only after consultation with the child pediatrician. The exact doses of all the drugs to be used should be entered on the treatment plan sheet.
- C. *Preventive treatment*: After the medical status and premedication regime of child are established, his teeth should be thoroughly cleaned. This offered the dentist a splendid opportunity to teach him tooth brushing and other home oral hygiene aids.
 - Pedodontist can learn about the patient temperament, apprehensiveness and oral health status during the oral prophylaxis and homecare instruction. After initial prophylaxis, Pedodontist should evaluate the caries susceptibility of the child's tooth. If active caries is evident, diet counseling advised to the mother.
 - Topical and systemic fluoride applications (if necessary), diet substitution and more regular fibrous meals are provided to the child and inhibit the habit of snacking between meals. Pit and fissure sealant can be applied on the occlusal surface to prevent the further progression of carious lesion.
- D. *Preparatory Treatment*:
 - a. *Behavior management*: Child's behavior shaping should start right from the First visit to the dental clinic or Hospital.
 - b. *Caries control*: Further progression of multiple carious lesions should be checked immediately by removing carious part and filled with temporary non-irritating dental materials before permanent treatment.
 - c. *Orthodontic consultation*: Minor orthodontic correction should be carried out before evaluating the space maintenance programmed.
 - d. *Oral surgery*: Grossly carious, non restorable teeth should be extracted, after evaluating the teeth during first appointment.
 - e. *Endodontic therapy*: Sometimes, a tooth may need endodontic therapy to save.

E. *Corrective therapy*: When medical and preparatory phase have been completed, final corrective treatment can be started.

- a. *Restoration*: Permanent filling, inlays, onlays, stainless steel crown would be included in this phase.
 - b. *Prosthetic therapy*: Tooth replacement, Jacket crown and appliance for speech and appliance for cleft lip and palates would be included in this phase.
 - c. *Early orthodontic intervention to be carried out* to improve the future esthetics.
- F. *Maintenance phase*: Depending upon the risk factor of individual and his oral hygiene status, a 3 - 6 months recall visit may be advised.

REVISIONS OF A TREATMENT PLAN

Once the treatment plan is approved, any alteration that arise during treatment should be explained to the parent and noted on the child record sheet. The parent will usually accept a better change in treatment if the dentist takes the time to explain the cause of action. Treatment plan revision may be anticipated in mixed dentition cases and when the child's growth pattern is likely to be unusual or in such cases as children with a severe handicapped or skeletal disharmony.

Position of Dental Team and Patient Around the Dental Chair

The operator and patient must be positioned to provide access and an unobstructed view of the operating field. There are 4 major zones of activity around the dental operative field these are:

- i. Operator's zone
- ii. Transfer zone
- iii. Assistant zone
- iv. Static zone.

Several common positions within the operator's zone as described for right-handed operators are:

12 o'clock position: It is utilized for mandible and maxillary anterior segments. A common fault in operating at this position is to use direct vision, resulting in severe bending of the operators back and neck.

11 o'clock position: It is considered the most universal operating position, provides access to all areas except the more distal areas of the mandibular right quadrant

and the cervical areas on the patient's right posterior quadrants.

9 and 7 o'clock position: This is an alternate position for the mandibular right posterior quadrant. It is usually used in conjunction with a mirror.

- A desirable posture for the operators is one in which the operators is seated well back on the stool with feet flat on the floor, legs relaxed and relatively together and thighs parallel to the floor. The back is straight and supported by the backrest.
- The patient is positioned in a semi-supine or supine position so that the operative field is over the operators lap at the height of the operators elbow. The patient may aid the operator's problem by slight head rotation towards or away from the operator. This Supine position enables the operators fore arms to be parallel to the floor when working in the operative field.

Lighting of the Operative Field

- The operatory light should be positioned at arm's length from the operators, having a light closer to the operative field, does not appreciably increase the

light intensity and visibility. At closer distance the light may increase patient discomfort from heat production and may physically impair movement within the operative field.

- Higher light positions are used when working in the mandibular arch; lower light positions are used for the maxillary arch.

In many cases the light is in the higher positions when using direct vision, and in the lower positions when using indirect vision.

BIBLIOGRAPHY

1. Coulehan, et al. Gasolin sniffing and lead toxicity in Navajo adolescent. *Paediatrics* 1983;71:113-7.
2. Moskow, et al. Examination of the patient. in Goldman and others, editors: *Current therapy in dentistry*. Vol 4, St Louis, Mosby, 1970.
3. Okeson, et al. Temporomandibular disorder in children. *Pediatric Dent* 1989;11(12):325-33.
4. Riva C, Ross B, Benedek GB. Laser Doppler measurements of blood flow in capillary tubes and retinal arteries. *Invest Ophthalmol* 1972;11(11):936-44.
5. Stern MD. In vivo evaluation of microcirculation by coherent light scattering. *Nature* 1975;254(5495):56-8.

Dental Radiology for Child and Adolescent

DEFINITION

It is defined as the study and use of radiant energy and isotopes, applied to medicine and dentistry for the diagnostic purpose. X-rays were discovered by Sir Williams Conord Roentgen in 1895. They are called X-ray because of their unknown property at that time. 1st dental use of X-ray was done in 1896 by Wolkhoff.

X-ray tubes are mainly of two types:

1. *Gas tube*:
 - a. Crooke's tube
 - b. Snook hydrogen tube.
2. *Coolidge tube (Fig. 5.1)*: It was designed by William David Coolidge in 1913. In this the electron are produced by heating a filament in vacuum to about 2000°C by passing 60-100 kV of current. Heating the filament produces electron which are proportional

to its temperature. This is called as Thermionic emission.

Properties of X-rays

1. It travel at speed of 1,86,000 miles/sec.
2. It ionizes gases.
3. It does not deflected by magnetic field.
4. It also affects photographic plate.
5. It causes fluorescence in several materials like Barium platino cyanide.
6. It cannot be focused by lens.
 - Suggested radiographic survey for pediatric patient of different age group with no previous history of radiograph.

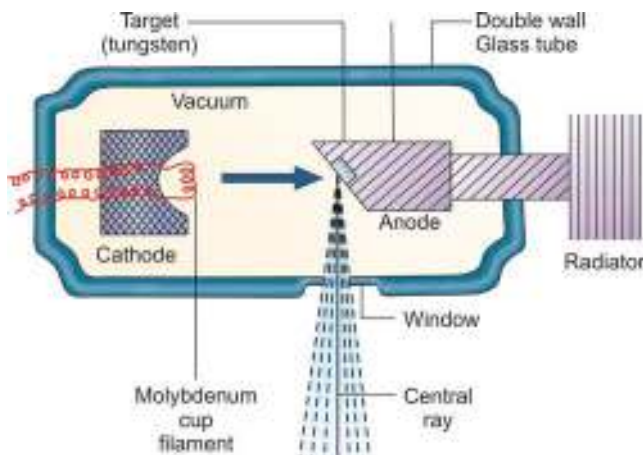


Fig. 5.1: Sketch diagram of vacuum Coolidge tube with electrodes. The electron is produced by heating a filament in vacuum to about 2000°C by passing 60-100 kV of current. The electrons are targeted over anode producing X-ray

Age (year)	Tooth consideration	Radiograph
3-5	• No apparent abnormality (open contact) • No apparent abnormality (closed contact) • Extensive caries • Deep caries	• None • 2 posterior bitewing, size zero film • 4 film survey (2 bitewing, size zero, 2 occlusal radiograph) • Selected IOPA in addition to 4 film survey.
6-7	• No apparent abnormality • Extensive or deep caries	• 8 film survey • Selected IOPA radiograph in addition to 8 film survey
8-9	• No apparent abnormality • Extensive or deep caries	• 12 film survey
10-12	• No apparent abnormality • Extensive or deep caries	• 16 film survey

Types of dental radiograph		
Intraoral	Extraoral	Specialized
IOPA	Lateral Oblique jaw • Lateral ramus • Condyle	Panoramic
Bite Wing	Skull Projections • Lateral skull projection • PA view • Projections of max. sinus • Tangential zygomatic Projection	Sialography
Occlusal radiograph	TMJ Projections • Lateral TMJ articulation • Transcranial articulation • Anteroposterior articulation	Xeroradiography and Radiovisiography

RADIOGRAPHIC TECHNIQUES IN DENTISTRY

Intraoral Radiography (Fig. 5.2)

They are the backbone of dental radiography. There are three categories of intraoral radiography:

1. Periapical; Used to show a tooth and its surrounding bone and associated structure.
2. Bitewing
3. Occlusal.



Fig. 5.2: IOPA X-ray of maxillary anterior region

Two Projection techniques are followed for IOPA X-ray



Paralleling Technique (Fig. 5.3)

- It is also called right angle or long cone technique. X-ray film and tooth are parallel to each other, and X-ray passes at right angle to them. To achieve this, the film is placed farther away from the object, particularly the maxilla. This will tend to magnify the image. This undesirable effect can be reduced by using longer cone.

Bisecting Angle Technique (Fig. 5.4)

It is based on Cieszynski's rule of isometry. It advocates that two triangles are equal if they have two equal angles and a common side. In dentistry, the film is placed close to lingual surface of the teeth, resting on the palate or in the floor of the mouth. The plane of the film and the long axis of teeth form an angle, with its apex at the point where the film is in contact with the teeth. When this angle is bisected by imaginary line or plane, two congruent angles, with a common side is formed. Central beam of X-ray will complete the third side when directed perpendicular to the bisecting line. The two triangles will be right angle triangles and congruent with the corresponding equal sides. As a result, the image cast on the film will be of the same length as of tooth.

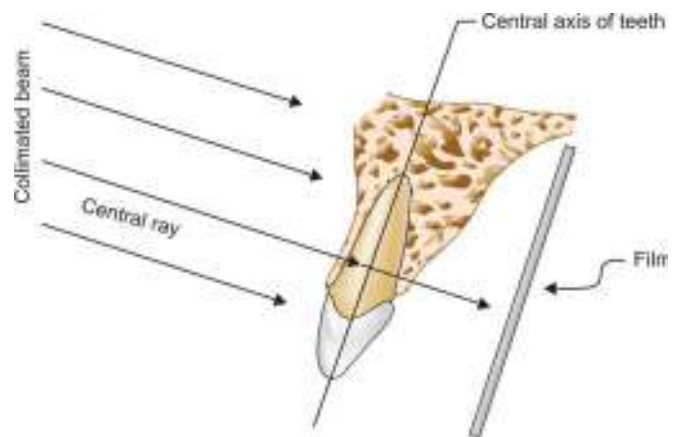


Fig. 5.3: Sketch diagram of paralleling technique of dental X-ray. See the position of X-ray film, long axis of tooth and central beam of X-ray

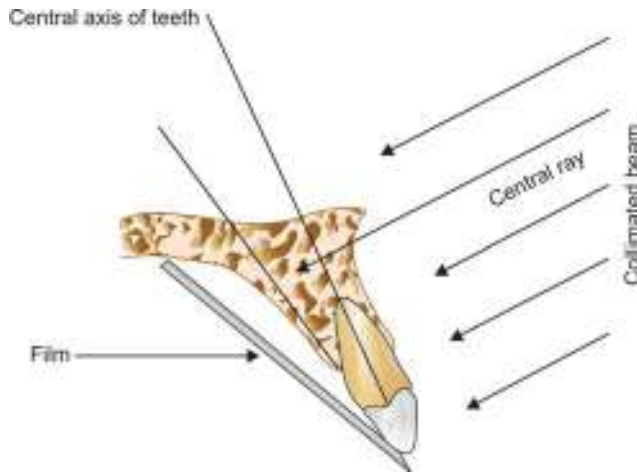


Fig. 5.4: Sketch diagram of bisecting angle technique of dental X-ray. See the position of X-ray film, long axis of tooth and central beam of X-ray

This technique is not as accurate as paralleling technique, and should be used in conjunction with other technique and when paralleling technique is uncomfortable or fails.

Bitewing Technique (Figs 5.5A and B)

A no. 0 bitewing film is usually appropriate for a younger child. The head is positioned in such that midsagittal plane

is perpendicular and the ala tragus line is parallel to the floor. The dentist holds the bite tab against the occlusal surface of the patient's mandibular teeth with index finger and ask patient to close mouth slowly. The central beam of X-ray enters through the occlusal plane at a point below the pupil of eyes. The vertical angle is +8 to 10 degrees. Bite wing radiograph shows only the crown portion of teeth and the adjacent alveolar bone. It is used to detect:

- Interproximal caries
- Secondary caries below restoration
- Periodontal conditions
- Calculus deposit.

Advantage

- It reduces cone cutting of film.
 - Patient stabilizes the film by holding it within the teeth.
 - Film is placed in between tongue and teeth, parallel to long axis of maxillary and mandibular teeth.
- Bitewing radiograph are of two types:

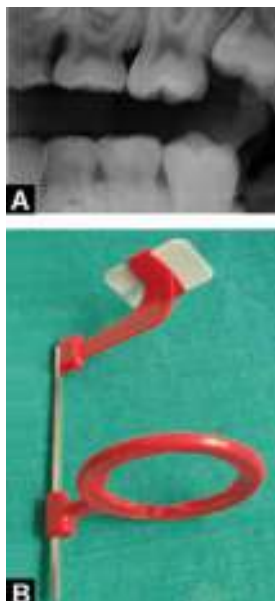
Premolar bitewing	Molar bitewing
• Canine to premolar region of maxillary and mandible is covered • Central ray is passed between premolar contact area • Vertical angulations +5	• Maxillary And Mandibular molar region is covered • Central ray is passed between molar contact area • Vertical angulations +10

Occlusal Radiographic Technique (Fig. 5.6)

1. Anterior maxillary occlusal technique
2. Posterior occlusal technique



Fig. 5.6: Occlusal radiograph showing palatal location of mesiodens



Figs 5.5A and B: (A) Bitewing radiograph, (B) Bitewing film along with holder

3. Anterior mandibular occlusal technique:

- In anterior occlusal technique, patient's occlusal plane should be parallel to the floor and sagittal plane should be perpendicular to the floor. A no. 2 film is used. The film is placed in the patient's mouth. The midsagittal plane bisects the film. The anterior edge of the film should extend approximately 2 mm in front of the incisal edge of central incisors. The central beam of X-ray is directed to the apex of the central incisors and half inch above the tip of the nose. The vertical angle is +60 degrees.
- In posterior maxillary occlusal technique, the patient's occlusal plane should be parallel to the floor and a no. 2 film is placed in patient's mouth so that the long axis of the film is parallel to the floor. The anterior edge of the X-ray film should extend just mesial to the canine. The buccal edge of the film extends 2 mm beyond the primary molar crown. The patient is asked to bite lightly to hold the film. The central beam of X-ray is directed towards the apex of primary molars. The vertical angle is +50 degrees.
- Anterior mandibular occlusal technique is identical to that of anterior maxillary occlusal technique, except that film must be placed in such way that tube side faces the X-ray source. The patient's head is positioned so that the occlusal plane is a -45 degree angle. The X-ray beam is directed through the symphysis region.

It covers large segment of dental arch, including palate and floor of the mouth. It is used to detect:

- Impacted canine and molar
- Unerupted teeth
- Roots
- Foreign bodies in jaw
- Stone in salivary gland duct
- Maxillary sinus
- The location, nature, extent, and displacement of fracture in maxilla and mandible.

Advantage

It gives three dimensional location of the object along with periapical radiograph.

Periapical Radiographic Technique

IOPA radiograph can be taken by two techniques, paralleling and bisecting angle technique as described above.

1. *Molar projection:* In this projection the plane of the film should be parallel to the buccal surface of the molars. 3rd, 2nd and all or part of 1st molar is recorded in this X-ray film.
2. *Premolar or primary molar projection:* The film is placed parallel to the buccal surfaces of the molars. 1st molar, 1st and 2nd premolar or 1st and 2nd primary molars, and distal surfaces of the canine are recorded.
3. *Permanent or primary canine projection:* The film should be positioned so that the central beam of X-ray is parallel to the proximal surfaces of the canine and lateral incisors therefore perpendicular to the film.
4. *Permanent or primary incisors projection:* The film is positioned so that the central incisors are centered mesiodistal on the film. The central beam is parallel to the contacts of the proximal surfaces and perpendicular to the film.

Panoramic Radiography (Fig. 5.7)

Body section radiography uses a mechanism by which the X-ray film and the source of X-ray move simultaneously in opposite direction at the same speed.



Fig. 5.7: Panoramic radiograph of an adolescent patient. See the dental implant embedded in the region of congenitally missing bilateral maxillary lateral incisors

Panoramic X-ray is considered a supplement rather than a substitute for, the IOPA X-ray. Panoramic X-ray can be valuable when patient with disabilities are examined, if the patient can sit and hold his head in position. Drawback of panoramic X-ray is lack of image detail for diagnosing early caries.

Buccal Object Rule (Fig. 5.8)

Embedded or unerupted teeth can be localized by using buccal object rule. This rule states that the image of any buccally oriented object appear to move in the opposite direction from a moving X-ray source. On the other hand, the image of any lingually oriented object appears to move in the same direction as a moving X-ray source.

Patient's head is positioned so that the sagittal plane is perpendicular to the floor and the ala tragus line is parallel to the floor. An IOPA film is placed and exposed. A 2nd film is placed in the same position as the 1st film and exposed with shifted horizontal angle either anteriorly or posteriorly along with same vertical angulations.

Skull Projection

PA View (Fig. 5.9)

Indications: It is used to examine the skull for:

- Diseases, trauma, abnormalities
- Mediolateral dimensions of skull in cephalometrics.

- Frontal and ethmoidal sinus
- Orbit and nasal fossa.

Film placement: Is done by placing the cassette vertically by a holding device.

Head position: Is done so that the Canth meatal line is parallel to floor.

Central ray: Is directed perpendicular to film in horizontal and vertical dimensions

- From 91-102 cm.
- For cephalometrics : 60 inches.

Exposure parameter: 75-80 kV.

Lateral Skull Projections (Fig. 5.10)

It is also called as Lateral cephalograms.

Indications: It is used to examine.

- Skull
- Trauma
- Abnormalities
- In orthodontics for facial growth
- In prosthetics and surgery for preoperative/postoperative treatment record.

Film placement: Vertical and 5 × 7 inch film is used.

Head position: It is positioned in a way that occlusal plane is parallel and sagittal plane is perpendicular to the floor.

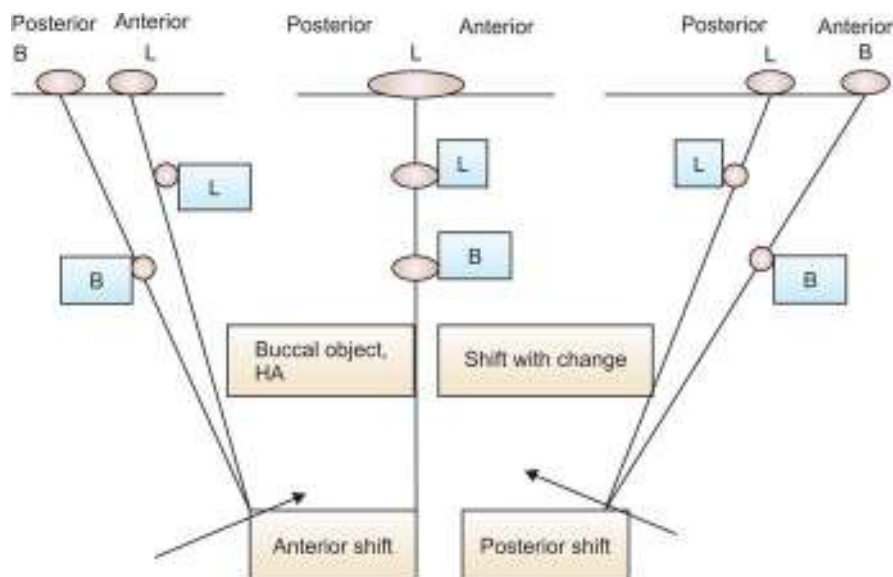


Fig. 5.8: The buccal object rule, B, L denotes buccal, Lingual respectively, HA; denotes horizontal angle



Fig. 5.9: Head position for PA view of skull. See the position of tip of the nose, forehead and X-ray plate

The long axis of the film, also perpendicular to the floor, rest on the patient's shoulder and against the face. The patient is asked to rotate the head toward the film until the nose rests against it. The cone is positioned that the central X-ray beam enters at a point half an inch behind and below the angle of the mandible on side opposite to the film. The central beam is perpendicular to the horizontal plane of the film.

Exposure parameters: 75-80 KvP depends upon X-ray machine and film.

Sub-mentovertex Projections (Fig. 5.11)

It is also called base or full axial projections

Indication: It is used to examine:

- Base of the skull
- Condyle
- Sphenoid sinus
- Curvature of mandible
- Lateral wall of maxillary sinus
- Fractured zygomatic arch.

Head position: Patient head and neck are hyper-extended and vertex of the skull is placed at centre of cassette. The film is placed vertically.



Fig. 5.10: Head position for lateral cephalograms, The X-ray cone is positioned that the central X-ray beam enters at a point a half inch behind and below the angle of the mandible on side opposite the film. The central beam is perpendicular to the horizontal plane of the film



Fig. 5.11: Position of head and neck during submento-vertex radiography. X-ray plate adheres base of skull

TMJ Projection

It is the most difficult area to visualize due to superimpositions.

Lateral TMJ Articulation: It is used to view TMJ of one side. Patient is seated uprightly with midsagittal plane perpendicular to floor. Central ray is passed from a point half way between external auditory meatus and outer canthus of eye, drops straightly down to ala tragus line. This technique is common for both open and close mouth. Vertical angle is -10 degrees. Exposure parameter: 65-75 Kvp.

Transcranial TMJ Articulation

The cassette and film are placed perpendicular to floor. The head is placed in a way that ears, cheeks, temporal region touch the cassette.

- Central ray: 2-5 inches above external auditory meatus.
- Vertical angle: 20-25 degrees.
- Exposure parameter: 65-75 kvp.

Anteroposterior TMJ Articulation

The Cassette is placed at the back, head perpendicular to floor. The head is erect and occlusal plane parallel to floor.

- Central ray: passes through orbit.
- Vertical angle: +30 degrees.
- Exposure parameter: 65-75 kvp.
- It is also called Orbito ramus technique.

Hazards of Radiation

Radiobiology is the branch of science which deals with the effect of radiation on human beings.

1. **Latent period:** It is the gap between radiation exposure and clinical symptom to arise. The effect of X-ray on cellular level could be:
 - *Reversible:* Cell returns to pre radiation state.
 - *Irreversible:* When the change is permanent.
2. **Threshold Erythematous dose: (T E D): 250 RAD.** In dental radiology we are using only $\frac{1}{2}$ of TED.
3. **Maximum Permissible Dose (MPD):**
 - Initially it was -1.2 RAD per week. Now it is -0.3 RAD per week.
 - Total accumulated dose should not exceed -5 RAD per month.

4. **Lethal dose:** It is the dose required to kill 50% of individual in 30 days of radiation exposure. It is designated as: LD -50/30.
5. **IOPA Radiographs** required only 24-48 rem. (1000 rem = 1 rad). So we can take nearly 100 radiographs safely in one month.

Effect on Cells

1. Inhibition of cell mitosis and metabolism.
2. **Chromosomal aberrations:** Radiation causes breakage of chromosome. The Breakage or union may take place at different levels, other than normal that may cause transferring of genetic material.
3. **Cell mutation and Death:** Since X-ray causes changes in physical properties of cell and vital structure like protein from primary to secondary and tertiary forms. Cytoplasm shows increased permeability and nucleus show decreased cell division.
 - Treatment of dry mouth and gums is only symptomatic; mouth-wash, tooth paste, moisturizer or artificial saliva can be used.

Composition of artificial saliva: Lysozyme, lactoferrin, glucose oxidase, lacto peroxide, hydroxy ethyl cellulose, xylitol, starch hydrosylate, benzoic acid, zinc gluconate.

PRECAUTIONS

- Wear lead apron.
- Maintain 6 feet distance from the X-ray source.
- The operator and tube angle 90-135 degrees.
- Use proper film holders. The tube should not be held by the operator.
- Use of protection guards at the gonads and reproductive organs.
- The walls of X-ray room should be coated with lead.

Personnel monitoring: Is physical measurement of X-ray radiation. It is done by

- Film badges
- Thermoluminescent badges.

Film badges: They are worn on chest and cover doses from 10 mR to 1000 mR. They give whole body radiation coverage under normal conditions.

Acute radiation vs chronic radiation

Acute Radiation: These effects are seen in nuclear accidents and not in dentistry. Following effects are seen:

0–25 rem no effect

25–50 rem minor blood changes

50–200 rem vomiting

200–300 rem death can occur after 6 weeks

400–700 rem hematological changes, no survival

700 and more CNS changes, death in few hour

During the treatment of malignant tumor, 5000-6000 Rad is given undercontrolled conditions in 3-10 days time

Chronic radiation: Is seen in workers, i.e. it is an occupational hazard. In dentistry, the hazard is with the operator.

Following are the effects:

Radiation burn: It appears like sun burn. The skin becomes dry, discolored and has burning sensation, nail become friable and cuticle around nails is affected. Evident changes in blood supply of sebaceous and sweat gland. Cracks may also appear on skin.

Loss of Hair and Cataract

Mucous membrane:

- Redness, inflammation.
- Breakdown of mucous membrane due to friability of connective tissue.
- Membrane becomes atrophic and avascular.
- Secondary infections like *Candida albicans*.

Taste buds:

- Loss of taste is most common.
- Normal sensation comes in 60-120 days.

Salivary Gland: They come under exposure during treatment of cancer in oral cavity and oropharyngeal region. It causes:

- Inflammation involving serous acini
- Increased salivary amylase
- Increase in viscosity of saliva
- Progressive fibrosis.
- Concomitant parenchymal degeneration.
- Increased acidogenic microflora, e.g. *Streptococcus*, *Lactobacillus*, *Candida*.
- Salivary gland capacity is reduced to 44%.
- Dryness subsides in 6-12 months.

Teeth:

- Teeth buds show retarded growth.
- Malformation
- May erupt prematurely
- Adult teeth are very resistant to X-ray there is no change in crystalline structure.

Bone:

- Loss of vascularization and hemopoietic cells.
- Lack of osteoblastic and osteoclastic activity.
- Necrosis of compact bone.
- Osteoradionecrosis.

Osteoradionecrosis of tooth socket

Etiology: Pre and post radiation extraction.

Exposure: 4000-8000 rad.

Clinical feature:

- Periodontal abscess.
- Inflammation.
- Swelling and drainage.
- Sequestrum and osteomyelitis.

Treatment: Hyperbaric oxygen

Thermo luminescent dosimeter: They are materials like; LiF Al_2O_3 CaSO_4 . They have a tendency to emit light when exposed to radiation. Emitted light is proportional to the exposure of radiation. They can measure gamma rays as low as 1 mR and as high as 10 R.

Ionization chamber: Is used as pocket dosimeter. It is a small glass tube with gases at atmospheric pressure. It has a capacitance that gets charged by exposure, a fibro electrometer with eye piece is attached. So that it could be monitored.

Photographic film Emulsion: It consists of a sensitive emulsion layer. Radiation causes ionization of silver

bromide crystals. When the film is processed the amount of blackening shows the degree of exposure.

BIBLIOGRAPHY

1. Alcox RW, Jameson WR. Patient exposure from intraoral radiographic examinations, JADA 1974;88:568-79.
2. Myer DR. Radiation exposure during panoramic radiographic in children, oral surg 1978;46:588-93.
3. National council on radiation protection and measurement: Radiation protection in pediatric radiology, report no. 68, Washington, DC, 1981.
4. White SC, Rose TC. absorbed bone marrow dose in certain dental radiographic technique, JADA 1979;98:553-8.

Normal Child Development

INTRODUCTION

Study of child development provides us an opportunity for integration of various biological, psychoanalytical, learning, psychosocial and interactive theories into one coherent view. This study is especially important for Psychiatrist and Pedodontist who are trying to understand the period from conception to adolescents when development is most substantial, dramatically, and fundamentally important. The developmental features of child are:

1. Development as inherent in nature; genetic predisposition.
2. Development as transactional in nature; the transactional quality of development which is interplay of nature (environment) and nature (child's nature) forms the basis of most current thinking and research. Developmental tutoring recognizes that children interact with their environment even before birth in ways that significantly stimulate or inhibit potential. For example- A mother who ingested folic acid helps her fetus to avoid the risk of spina bifida.

Normality in developments; usually, normality means freedom from pathology. In this context (not without opposition), labeling a child as normal with respect to developmental maturity is a common practice. In child's psychiatry normality conveys a continuum (series of similar item in which each is almost same as the one next to it but the last is very different from the first) with various period of rapid change. This concept of normalcy is important for understanding a critical, transactional principle; a child's development operates as a two way street of regression and progression. Typically occurring

before growth spurt, environmental or internal change can create a street that causes developmental skills in particular areas to be lost. This phenomenon is called as regression.

- Neurotic regression of a child pertaining to the self perpetuating psychosocial isolation means break between individuals and their environments- that hamper further development in other areas. Example- a neglected 3 to 5 year old child who is emotionally regressed will have trouble developing social empathy, applying temperamentally assertive skills, and cognitively refining problem solving tools.
3. Distinct area of development; to study child's development, growth is often differentiated into distinct developmental areas. Each area is considered to mature independently, yet they interact in ways that ultimately change the outcome of each separate event. A child's development has seven significant areas to be considered.
 1. Physical development (Table 6.1)
 2. Temperamental development (Table 6.2)
 3. Cognitive (means mental processes of understanding) development
 4. Social development
 5. Emotional development
 6. Moral development
 7. Psychosexual development.

Clinical Significance of Developmental Theories

Developmental theories help both Psychiatrist and Pedodontist to understand how a single cell grows into a complex child who has all the skills necessary to enter

Table 6.1: Physical development- CNS maturation: comparing language, perception and motor skills

S.No	Average age	Language achievements	Perceptual achievements	Motor achievements
1.	Gestational	_____	Can hear sound	Can swallow, suck thumb, move limbs
2.	Infancy (Birth to 3 months)	Understands phenomes; responds to sound, chomsky's language acquisition device.	Sound, touch, smell, taste presents in newborn; see patterns and shape contrast.	Balances head; lifts by arms.
	2 months	Cooing (type of sound), turn taking with care givers	All perception more acute	Rolls side to side; reach for object.
	16 to 18 weeks	Knows friendly from friendly voices	Seeing more focused, sees all colors, and patterns; vision and hearing coordinated.	Sits, pokes; crawls, plays.
	28 to 40 weeks	Native language discrimination	Responds to motion; size constant; sees depth.	Sits, pokes; crawls, plays.
	6th months	Babbling; self-expression for needs	_____	_____
	40 weeks - year	Words connected to meaning; 1st words	Can see feature, Childs see at 20/100 at 6th months	Stands, walks, build.
	1½ to 2½ years	First sentence- two words; 50 words vocabulary	track objects	Scribbles,
3.	Early childhood			
	2 to 3 years	Three word sentence; uses small word, morphemes to alters meaning; marked rise in vocabulary	Intermodal developing between perceptions	Sphincter control; jumps; laterally appears.
	3 to 5 years	Subtleties of tone and inflection, vocabularies increases to 14000 words	Perceptual pathways integrated; intermodal functions well developed	Tricycle, self dependent, copies circle; fine motor developed, pencil, scissors.
	5 years	End of baby talk; end of second language easy, child can make self fully understood	_____	Full postural control
4.	Middle childhood			
	6 to 11 years	Metalinguistics understood; Childs improve inflection pronouncement		Boys better grows motor skills; girls overall more developed
5.	Adolescent, 11 years and older	_____	_____	Gains in gross motor performance; gross motor performance tapers at age 14; boys spurt through teens

Table 6.2: Gordon model of temperaments—newborn to 6 years

Traits	Descriptions
Verbal/nonverbal	Utterances, including words but not cognitive quality
Goal directed/non goals	Degree to which a child think in terms of goals
Assertive/nonassertive	Expresses effectively needs
Active/passive	Degree of movements
Aggressive/non-aggressive	Easy of crossing into another's space without permission
Deliberate/impulsive	Time spent doing task, not necessarily goal directed
Resistance/acceptance	Attitude towards change

into adolescence. By incorporating major developmental theme, theories help explain principles of development and create guidelines for translating concept into practical applications.

1. Theories help Pedodontist and Psychiatrist both to predict behavior in children and often explain the significance of their observations.
2. Clinicians can test hypothesis that pinpoint factors that influence development.
3. Understanding the significant theories in each of the above seven major developmental areas is a valuable tool for the clinician attempting to integrate the wealth of developmental knowledge of infants and children.

Temperamental development: Temperamental development involves the maturation of traits that allow children to respond to new situation, task and opportunities. Caregiver frequently comments colloquially (of words and language, used in conversation but not in formal speech or writing) upon a child's temperament; where did this child's behavior come from? Usually such comments come from parent's acknowledgements that they do not recognize a particular child's traits (a particular quality in child's personality) as familiar to their own experiences.

Assessment of temperaments: The clinical assessment of temperamental development focuses on a task orientation approach that incorporates the negative and positive aspects of temperamental traits. Gordon listed eight temperaments traits and their opposites and categorized by their presentation at significant chronological ages and in each gender.

- Information for assessing such traits comes from clinical observation of each child.

Practical Implication of Temperamental Development

In general, traits that coincide with a child's chronologically determined developmental task are the most significant because they frequently determine how children are received and perceived.

- A child who is temperamentally deliberate and goal directed functions well in the traditional school setting.
- An impulsive, non goal directed child may be mislabeled as having an attention problem or characterized as unmotivated.
- Temperamental qualities may alter behavior in critical ways.

- Verbal temperaments in children are a major factor in recognizing the need for psychiatric treatment.
- As a child matures, temperamental qualities can have critical long lasting consequences.

Cognitive development: Children must find out the way of understanding, to learn, to remember, to solve the problem, and to organize their environment. Cognitive development in children includes all the processes that lead to maturation of their mental activity. Theories and skills of cognitive developments in infants and children are shown in Table 6.3.

Social development (Table 6.4): Once children have formed a sense of themselves, they can think about and interpret their experiences in other situations. The process by which children develop a sense of them and then relate that knowledge to their experiences of others constitutes social development.

Emotional development (Table 6.5): Emotional development can be seen as the literal acquisition of emotions. Children must develop the ability to recognize and use their emotions appropriately. They must also become successful in a complex maturation process that entails learning to become emotionally responsive rather than emotionally reactive to internal experiences of emotion.

Theories of emotional developments; several approaches help explain how infants and child acquire emotions. Behaviorist and social learning theorist explain emotions as developing secondary to either stimulation or classical conditioning. J Watson theory postulates that emotions are available and are easily stimulated from birth: fear is evoked by loud noises, or loss of support, rage is stimulated by restrictions, and love is aroused by touching.

Integrated theory (acquisition of basic emotions); this is four stage emotional development theory.

Stage 1: Innate emotion, emotional responsiveness

Stage 2: Self conscious emotional reactivity

Stage 3: Emotional self awareness connecting emotions with effects.

Stage 4: Emotional responsiveness to feeling of others.

Adoptive theory (Anna Freud's model of defenses as tools for emotional growth); emotional maturity is quantitatively based upon a number of available emotional defenses acquired successfully by the child. Such defense includes denial, repression, sublimation, regression, projections, reaction

Table 6.3: Theories and skills of cognitive development in infants and children.

<i>Period of development</i>	<i>Piaget's cognitive spatial stages</i>	<i>Vygotsky's sociocultural stages</i>	<i>Cognitive achievements</i>
Gestational			Fetus can learn sound and responds differently to them after birth.
Infancy: Birth to 2 years	Sensorimotor	Endowed instincts	Infants think with their eyes, ear, and senses.
1 to 4 months	Imitations, smiles playful	Ethological concept: Infants are born with basic perceptual sense	New born can learn to suck to produce certain visual display or music.
4 to 8 months	Looks for objects partially hidden		Can remember for 1 month periods.
8 to 12 months	Peek a boo, find hidden objects		Can play with parent by looking for partially hidden objects.
12 to 18 months	Explores properties and drops objects		Memory improves; body parts used as objects, remember hidden objects, can stack one object with another, and knows animal sound, name objects, knows body part and familiar picture. Can understand, causes not visible.
18 months to 2 years	Mental representation, make believe play; memory of objects		Same as above.
Early childhood (2 to 5 years)	Transductive reasoning 2 to 7 years- preoperational, include concepts: Egocentric, animistic, lack of hierarchy, centration, irreversibility.	Private speech; self speech, self guidance, talk to self and teaches self	Development of language, and make believe, no sign of logic, 3 year old can count 2 to 3 object, know color and age 4 year – can fantasize without concrete props. 5-6 years get humor, understands good and bad.
Middle childhood 6 to 11 years	7 to 11 year- concrete operational, include concept: hierarchical classification conservation, decentration spatial operation, transitive inference	Internal speech, complex cognition: Self reflection, sustained attention, recall; problem solving planning, categorization	7 to 11 years old have good memory, recall, can solve problems.
Adolescent, 11 to 19 years	Formal operational, include concept: Hypothetic- deductive reasoning; quick thinking, excuses. Imaginary audience- every one looking at them, personal fable Propositional thinking- logic		Abstract and reason. Can think of all possibilities.

Table 6.4: developmental social mile stone with age

Age	Developmental Social milestone
2 months	Social smile
3 months	Recognizing mother
6 months	Smiles at mirror image
9 months	Wave bye-bye
12 months	Plays a simple ball game
36 months	Knows gender

formation, substitution, rationalization, compensation and escape.

Emotional maturation: Predicted upon genetic predispositions, environmental exposures and behavioral repetitions occur through the development of complex interactive pathways within a child's brain. Example—persistent and pervasive anxiety of children who are neglected or abused as infant, stem from enormous stimulation and subsequent high degree of development of those, particularly brain synapses.

Psychosexual development: Psychosexual development involves the process of infants and

children learning to view themselves and other in terms of gender. It includes aspects of sexual, physical maturation. There are three stages describes psychosexual maturation. From infancy onwards, most psychosexual maturation focuses upon the psychological stages of sexual development.

Stage 1: Gender identity; A child's perception of self as either male or female begins at 3 to 4 years. 2/3rd of 3 to 7 years old children know their own sex, based upon cues such as clothing and hair.

Stage 2: Gender roles: The formation of a concept of behavior related to their own gender identity.

Stage 3: Gender relationship: The formation of children's attractions to a particular gender in others.

Freudian theory of psychosexual development:

His theory however, has both historical significance and relevance for social, emotional, and moral development. The basis of Freud's schema is that children move through a series of stages during which a conflict between their biological drives and social expectations is confronted. Inherent in this theory is the concept of the critical role that ages 0-5 play in personality development. Freud's

Table 6.5: Children showing emotional skills and developing emotional behavior at different age group

Age	Emotional skill	Developing emotional behavior
0 to 2 months	Love evoked by touching Fear evoked by loud sound Rage evoked by body restriction Brain pathways for emotion forming	Social smile and joy shown responds to emotions of others
3 to 4 months	Self regulations of emotion starts Brain pathway of emotions growing	Laughter possible and more control over smile, anger shown
7 to 12 months	Self regulation of emotion grows	Able to elicited more responsiveness Denies to cope with stress
1 to 2 years	Increase intensity of basic three Same, pride appear, envy, embarrassment appear, displaces on to other children	Some indications of empathy, starting expression of feeling, like attention and approval; enjoy play alone.
2 to 5 years	Can understand cause of many emotions.	Empathy increases with understanding, more response and less reaction; self regulation Aggression become competition by age 5. Shows sensitivity to criticism and care about feeling of others
5 to 11 years	Can begin to find ways for regulating emotions and for expressing them identified with adult to cope Can react to the feeling of others More aware of others feeling	Ego rules until age 6 empathy become altruism Super ego dominates

suggest that psychosexual development occurs in five stages.

- Birth to 1 year; period of oral gratification (oral stage)
 - From 1 to 3 years; children's egos redirect their ids in anal term (Anal stage)
 - From 3 to 6 years; the id (feeling) impulses of children are transferred to the genitals (phallic stage).
 - From ages 6 to 11 years; sexual instincts cool down or become latent while the super ego develops in relation to peers (Latency stage)
 - From 12 to 19 years; sexual activity begins, sexual activity increases (Genital stage).
7. Moral development: Moral maturation refers to children's acquisition of internal standards that guide their observable actions or behavior. Male and female morality develops along different tracks. Women's moral development ends in compassion and an ethics of caring, where as men's morality culminates in a moral system dominated by the ethics of justice and the assertion of rights.

BIBLIOGRAPHY

1. Astor RA. Children's moral reasoning. *Child dev* 1994;65: 1054.
2. Bandura A. A social learning theory. Prentice Hall, Englewood Cliffs, NJ, 1977.
3. Brazelton TB. Neonatal Behavioral Assessment-scale. Lippincott, Philadelphia, 1984.
4. Campos JJ. Handbook of child Psychology. Wiley, New York, 1983.
5. Chess S, et al. The process of development: interaction and goodness of fit. In the dynamics of psychological Development. Brunner, Mazel, New York, 1980.
6. Freud S. Three essay on the theory of sexuality. in standard Ed. of the complete psychological work of Sigmund Freud, vol 7. Hogarth press, London, 1966.
7. Ghuman JK, et al. Early detection of social interactions problems: Development of a social interactions instrument in young children. *J Dev BehavPediatr* 1998;19:411.
8. Kohlberg L. Moral stages and moralization: the cognitive-development approaches. In moral development and behavior, T Licon, ed. Rand Mc Nally, Chicago, 1969.
9. Rutter M. Developmental psychiatry. American psychiatry press, Washington, DC 1987.
10. Saudino K, et al. Infant temperament and genetics. *Child dev* 1991;62:1167.

Behavior Management of Children

Treating children can be one of the most enjoyable aspects of a dental practice. A child's spontaneity, honesty, and sense of humor can provide the dentist with a refreshing reprieve from the rigors of a daily routine. Although most of the children are well behaved patients, some have fears or anxieties about dentistry that makes their behavior extremely challenging and often frustrating for a dentist to manage.

The purpose of this chapter is to provide some considerations that will allow the Pedodontist to accurately diagnose and change such disruptive behavior. The major difference between the treatment of children and adults is the relationship. Treating adults generally involves a one to one relationship, that is, a dentist–patient relationship. Treating a child, however, usually relies on a one to two relationship, dentist-pediatric patient and parent or guardians. This relationship can be represented by a triangle. The child is at the apex of the triangle and is the focus of attention of both the family and the dental team. This triangle is known as pediatric treatment triangle (Fig. 7.1). The social environment has been recently included in the Pediatric treatment triangle. The line drawn in the triangle represents lines of communication which is reciprocal in nature.

Childhood Development (Table 7.1)

To diagnose and treat behavior problems, Pedodontist must understand normal abilities of children at different ages. It is important to note that children vary in their development and that chronologic and psychologic ages do not always correspond. Thus, the Pedodontist must consider both when planning a management technique.

Birth to 2 Years of Age

Acquisition of the sense of trust begins. His basic behavioral patterns revolve around an instinctive desire for maintenance of an established routine. His tension



Fig. 7.1: Modified pediatric treatment triangle

Table 7.1: Average age and age range of selected physical developmental milestones

Developmental task	Average age	Normal range
Focuses on light	2 weeks	1 to 4 weeks
Lies on stomach, lifts chin	3 weeks	1 to 10 weeks
Birth weight doubled	6 months	5 to 7 months
Rolls from back to stomach	7 months	5½ to 11 months
Sits alone	7 months	6 to 11 months
Stands with support	10 months	7½ to 14 months
Stands alone	13½ months	9 to 18 months
Walk alone	14 months	10 to 20 months
Bowel control attained	18 months	1 to 2½ years
First menstruations	12 year, 9 months	10 to 17 years

is reduced by securing food, sucking and having dry diapers. As his/her needs are consistently met by other, his sense of trust in them grows. At the same time his proper care promotes successful physical growth. The infant is incapable of rational response in the dental situation. Techniques to manage infants utilizing the assistance of parents/care taker are discussed later.

At 2 Years of Age

This is the period of tremendous physical, intellectual and emotional growth for the child.

- Showed mastery of toilet training
- Develops a sense of achievement, self control and independency from others.
- Vocabulary may vary greatly (from 12 to 1000 words).
- Child's comprehension may be more dependant on facial expressions and tone of voice than words alone.
- Showed fear of falling, sudden unexpected movements, loud noises and strangers.

Note: The dental situation with unusual sounds, smells, bright light and tilting chair can produce fear in the child. It is advisable to have the parent accompany him into the operatory to provide him with security and reassurance.

At 3 Years of Age

- Child develops an average vocabulary of 1000 words.
- He/she is able to speak in sentences and capable of communicating in the dental situation.
- Has very active imagination, likes stories.
- Remains closely attached to the parent.

At 4 Years of Age

- Tries to impose powers
- Participates in small social groups
- Many independent self help skills
- Knows thank you and please word.

At 5 Years of Age

- Five years marks the ending of early childhood. This child is now able to accept community experiences and group activities. He is readily separated from parent and his fears have usually diminished.
- He is proud of his accomplishments and possessions and is particularly responsive to praise.

- Positive comments about the cloths or personal appearance of a 5 year old child are very effective in establishing rapport.

At 6 Years of Age

- 6 year marks a critical turning point for a child. Entering school he becomes a part of peer group with which he compares himself and seeks acceptance from. The school experience demands mastery and achievements and provide continual feed back and evaluation. This is very important for the 6 year old as his/her success, or lack of it, can greatly affect his self-esteem. If a child develops a sense of inadequacy or inferiority, his autonomy or independency will erode and his behavior in a stressful situation like a dental visit may regress to that of a younger age.

School also establishes the teacher as another powerful authority figure in addition to the parent. The child's ability to understand this transfer of authority at school will benefit him in relating to the dentist as a person to be obeyed in the dental office. Like the 4 year old, the 6 year old may harbor irritational fear of object, people and bodily harm. Proper introduction to the dental experience, however, will generally enable these children to cope quite successfully with their anxieties.

At 7 to 12 Years of Age

In these year child becomes increasingly independent of his parents and more closely intertwined in peer groups. He learns more about the outside world and begins to develop a sense of concern and social responsibility. He learns to question, inconsistencies and confirm to the rules of society, though he still has fears. He generally is more capable of managing them in socially acceptable ways. He may still experience anxiety but will tend to hide it with false bravado or stoic silence. He has learned to deal with unpleasant situation and can generally be well managed in the office with a thorough explanation of dental procedure.

Factors influencing children's dental behavior:

1. Parental attitude on childhood behavior
 2. Medical history
 3. Awareness of dental problem.
- 1. Parental attitude on childhood behavior:** Specific types of parental attitudes have been identified that

can lead to characteristic maladaptive behavior in their children.

- a. **Overprotective attitude:** These parents do not allow their children opportunity to experience and learn to cope with the problems and anxieties of life. As a result, they are frequently very shy, fearful of new situations, and lacking in self confidence. Parent may harbor anxieties about dentistry because of previous personal experience and well impart these anxieties to their children. Over protective parents cling to their children in the waiting room and may insist on accompanying them to the operatory, regardless of their ages.
- b. **Overindulgent attitude (Tending to allow doing whatever child want):** Children of over indulgent parent often develop distorted view of their position in society. They learn to manipulate their parent into satisfying all of their wants and tend to act superior, bossy, and demanding. Typically, they present the same type of behavior when confronted by the dental situation and often classified as the defiant or spoiled child.
- c. **Overauthoritative attitude:** These dominating parent expect behavior from their children that is incompatible with their ages. They are not supportive of their anxieties but rather constantly criticize them. They may compare them with older siblings and demand the same behavior. These children will often be afraid of overtly resisting the dentist but will commonly use delaying tactics in an attempt to avoid the dental procedures. These children can grow to resent their parent and other authoritative figures.
- d. **Rejecting/under affectionate attitude:** This group includes a variety of parental behavior that range from mild, lack of interest to rejection or physical abuse. Parental lack of affection or attention that they show to their children may be a result of heavy workload or other interest or caused by severe emotional problems. Children in these homes develop very poor self images and may present with a variety of behaviors. The physically abused child is often stoic and non responsive to painful procedures. The abused child might also be loud and aggressive, seeking the attention that is missing at home.

2. Medical history: There is a general agreement that child who view medical experiences positively are more likely to be cooperative for the dentist. Few studies have shown that previous surgical experiences adversely influences behavior at the 1st dental visit, but this was not the case in subsequent visit.

3. Awareness of dental problem: Few children may approach dental office knowing that they have a dental problem. The problem may be as serious as a chronic dental abscess or as simple as extrinsic staining of the dentition. However, there is a tendency towards negative behavior at the 1st dental visit when the child believes that dental problems exist. The finding may be the results of anxiety or apprehension transmitted to the child by a parent.

Child behavior pattern in the dental office/ clinic: The key to successful management of children presenting with disruptive behavior is to accurately diagnose the offending behavior. Once recognized, the Pedodontist can utilize an appropriate behavior management technique to control it. Wright classified behavior of children in to three categories:

1. Cooperative.
2. Lacking in cooperative ability.
3. Potentially cooperative.

Cooperative Behavior

Most children seen in the dental office are cooperative in behavior. Cooperative children are reasonably relaxed. They have minimal apprehension. They may be enthusiastic. They can be treated by straight forward behavior shaping approach and they perform within the frame work provided.

Lacking in Cooperative Ability

This category of classification includes very young children with whom communication can not be established and comprehension can not be expected, because of their age, they lack cooperative abilities. This category also includes specific disabling condition that severely limits their communication skills. Management of such cases is often best accomplished through the use of pharmacologic agents for sedation or general anesthesia.

Potentially Cooperative Behavior

This category includes most of those children aged 3 through teens that pose management problems in the dental office. They present with fears about the dental experience that may be objective as a result of previous experience or subjective due to information received from parent, sibling or peers. Within this group, the following distinct behavior can be identified:

- 1. Hysterical or uncontrolled behavior:** This is typically seen in 3 to 4 year children at their 1st dental visit. This behavior is characterized by loud crying, kicking and temper tantrums. The cause of excessive fear that is often a result of feeling or attitudes about dentistry which were suggested to the child by parent or siblings. The classic example of this behavior is a 3 to 4 year old child who present with nursing bottle caries. The child has learned to manipulate his parents by demanding the bottle to fall asleep with at night and by responding with a temper tantrum, if he is denied.
- 2. Defiant or obstinate behavior:** This child has been known as 'spoiled kid'. He controls his behavior in a sense by challenging the authority of the dentist. These children have a potentially serious emotional problem that is probably manifested at home, school and other area of life. The child who present with passive resistance to dental treatment also expresses a form of obstinate behavior. He will sit still, teeth clenched together, avoiding eye contact with the dentist and ignoring any attempt at communication.
- 3. Timid behavior:** Timid or shy behavior is often expressed by young children particularly at the initial dental appointment. It is a result of the child's anxiety about the dental experience and how he is expected to perform in the office. The child's anxiety may prevent him from listening attentively to the dentist so instruction must be given slowly, quietly, and repeated when necessary. Once the child gains confidence in the dentist and learns about the new environment he gains confidence in himself and can become an excellent patient.
- 4. Whining behavior:** The child with this type of behavior can be extremely frustrating to treat. He allows treatment to be provided. However he whines throughout the entire procedure. Scientist, Elsbach characterized the whining as a compensatory cry which the child produces to vent his anxiety over

the treatment. Usually this child will complain of pain even after repeated injections of anesthetics. Children generally grow out of this behavior pattern as their self confidence and their confidence in the dentist increase.

- 5. Tense cooperative behavior:** This child wants to cooperate but is obviously fearful. His eye follows every moment of the dentist and his hands often clench the arm rail on the dental chair. He accepts treatment but may cry at a particular anxious moment such as the injection. His behavior can improve or depreciate depending upon the dentist's concerns and sensitivity to his feelings.
- 6. Stoic behavior:** This child might generally be considered to be cooperative. He sits quietly and passively and accepts all dental treatment including the injections without protest or any sign of discomfort. He does not talk readily and may appear taciturn (tending not to say very much in a way that seems unfriendly) if not sad. Attention is called to this behavior pattern because it is characteristic of children who have been physically abused.

Frankl behavioral rating scale: Another system which has been used in behavioral science is Frankl behavioral rating scale. This scale divides observed behavior into four categories, ranging from definitely positive to definitely negative. Following is the description of the scale.

Rating 1: Definitely negative: This category of children showed refusal of treatment crying forcefully, fearful or any other overt evidence of extreme negativism.

Rating 2: Negative: Child is reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced.

Rating 3: Positive: Acceptance of treatment at time caution; willingness to comply with the dentist, at time with reservations, but patient follow the dentist's directions cooperatively.

Rating 4: Definitely positive: Develops good rapport with dentist, shows interest in dental procedures, laughing and enjoying.

Principle of behavior management: The success of behavior management is based on the attitude and integrity of entire dental team. Dental office and dental personnel must have the following quality:

1. **The positive approach:** There is general agreement that the attitude or expectation of the dentist can affect the outcome of a dental appointment. Thus, positive statement increases the chances of success with children (Fig. 7.2).
2. **The team attitude:** Personality factors of the dental team play an important role in the success of behavior management. For example, warmth welcomes with interest that can be conveyed without a spoken word are critical when dealing with children.
3. **Organization:** Pediatric dental clinic must be well organized. Each dental staff must train for his specialized work. For example, if a child creates disturbance in the reception area who will manage with the problem? Each dental office must devise its own contingency plans, and the entire office staff must know in advance what is expected of them and what is to be done. Also, a well written plan has to be available for the dental office team.
4. **Truthfulness:** The truthfulness of dental team is extremely important in building trust; it is a fundamental rule for dealing with children.
5. **Tolerance:** It refers to the dentist ability to rationally cope with misbehaviors while maintaining

composures (state of being calm and in control of yours feeling or behaviors). Recognizing individual tolerance level is especially important when dealing with children. Different individual showed different tolerance level. For example, an upsetting experience at home can affect the clinician mood in the dental office. High tolerance level prevents loss of self control.

6. **Flexibility:** The dental team has to be flexible and prepared to change its plans at the time of treatment as situations demand.

Behavior management technique: Pinkham has accurately stated that a dentist must be a proficient 'observer and analyzer' of a child's behavior to succeed in managing it. Once the child's disruptive behavior is accurately diagnosed, the dentist can choose from a variety of techniques to successfully manage it.

Communication to the child (Fig. 7.3): Communicating with child is the real key to behavior management. It is the goal of other management techniques to be discussed and is indicated for every child seen in the dental office. The Pedodontist should be able to communicate effectively with most children who are 3 years of age or older. Eye contact must immediately be made with the child as he/she enters into the dental operatory. The child should be greeted in a warm and friendly manner and asked open ended questions to find out about his interests, likes, and dislikes. It is extremely important that the child respond to the dentist. Once the child has relaxed sufficiently to engage in a conversation, the dentist can proceed with an orderly explanation of the events to follow.



Fig. 7.2: Child patient should be rewarded with small gift (toys) after successful dental treatment, which helps in the development of positive attitude towards future dentistry and helps in the development of faith on the pediatric dentist



Fig. 7.3: Dental surgeon is trying to establish communication with a child by showing fish in the aquarium. This will help in the development of child's faith on the pediatric dentist



Fig. 7.4: Dental surgeon was using TSD technique. See the instrument tray along with dental instruments. Pedodontist should tell about the instrument, shows and then use for dental procedure

Tell, Show, Do Technique (TSD Technique, Fig. 7.4)

Communication to the child in a dental operatory must be in understandable languages. Use appropriate euphemism during dental treatment. Tell, show, do method of introducing dental technique is extremely effective for shaping the child's behavior and conditioning him to accept the treatment. It is important to use terms that will not frighten the child but will allow him to associate the dental sensations that he will experience with one that he already knows. During TSD technique, Pedodontist must use simple understandable language with appropriate euphemisms (word substitute, Table 7.2).

Note: It is also important that the child knows exactly what is expected of him during the dental procedure. He should be told the following rule:

1. Keep your hands in your lap
2. Hold still
3. Make no loud noises.

These rules enable the Pedodontist to treat the child as quickly as possible and other children will not be disturbed in the operatory.

Table 7.2: Dental instrument and their commonly used word substitute or Euphemism

<i>Dental equipment</i>	<i>Euphemism</i>
Radiographic equipment	Camera
Explorer	Tooth feeler
Rubber dam	Rain coat
Anesthetic vials	Sleepy water
Rubber dam clamp	Tooth button
Hand piece	Whistle
Stainless steel crown	Cowboy hat
Amalgam restoration	Silver soldier
Three way syringe	Water gun
Fluoride	Cavity fighter
Light cure machine	Torch
Mouth mirror	Tooth mirror
Chip blower	Tooth dryer

Denying fear: The child may express fear about the dental visit and this fear should not be denied. Dentist must be truthful in front of the child. Truthfulness helps in developing trust.

Voice control: Sudden and firm commands are used to get the child attention or stop the child from whatever is being done. The change in voice tone from gentle to firm or soft to loud is frequently effective in gaining the child's attention and reminding him that the Pedodontist is an authority figure to be obeyed. Chambers theory suggests that voice control becomes most effective when used in conjunction with other communication skills.

Asking approval: A common mistake made by a general dentist who confuses communication with the child is asking for approval to proceed. Actually if given a choice, the child may decide that it's not okay! It is appropriate to allow children to exercise some degree of control such as choosing the flavors of fluoride. This control enables the child to develop self confidence in the situation and can foster good rapport at future appointments.

Delaying tactics of child patient: Some child patient continuously asking questions in the dental operatory but rather than seeking answers, he/she is attempting to delay the procedure to follow (usually the injection). Other avoidance techniques include repeated urgencies to use the bathroom and complain of stomach pain. This child's anxiety is only heightened by succumbing



Fig. 7.5: Small child is seeing the dental work in the mouth of other patients. This technique will help child to develop positive attitude towards future dentistry. This technique is known as modeling

to these interruptions. Thus, the Pedodontist should calmly but firmly proceed. The child may cry during the injection procedure, but once it is completed he will usually cooperate fully.

Modeling (Fig. 7.5): Modeling is a type of behavior modification technique where a young patient can learn about the dental experience by viewing other children receiving treatment. Several scientists have reported that this technique seems to improve the behavior of apprehensive patient who have no previous dental experience.

One simple method of modeling is to allow the child to come in and observe the treatment of older sibling. Several Pedodontist employ modeling by utilizing open bay operator, so that treatment of several children is visible from any dental chair. Another modeling technique that has been shown to be effective in gaining cooperative behavior involves showing a video tape of a child undergoing treatment. Video tape equipment is now readily available at a reasonable cost, thus this technique has great clinical practicality for use as a modeling system in the private dental office.

Desensitization (Fig. 7.6): This is also a type of behavior modification technique. It is used to retrain a child who present with prestablished fear and



Fig. 7.6: Desensitization of three-way syringe fear by directing light air pressure on the skin of the child's hand

uncooperative behavior. The fear may be the result of an unpleasant dental experience or negative comments about dentistry by the child's parents, siblings, or peers. To begin desensitizing a child, it is extremely helpful to learn the source of fear.

The dentist can then begin a program of behavior shaping using TSD technique to teach the child new and more pleasant associations with the anxiety provoking stimuli. Example – A 3 years old child may be fearful of an oral prophylaxis because of a story told by a play mate or the design or sound of three way syringes. Applying desensitization technique would involve allowing the child to touch and hold the hand piece with a prophylaxis angle accompanied by an explanation such as following “Yash! This is your tooth polisher and this little rubber cup makes your teeth shine. It also shines your finger nails, however, so let's polish one of yours teeth so you can see how it feels”. As child discovers that anticipated pain does not occurs, his previous fears are extinguished and he begins to trust the dentist.

Flooding technique: Flooding is described as a behavior modification technique that eliminates a child's attempts to avoid experiences that he perceives to be undesirable, by preventing his avoidance or escape. Once the child is exposed to the perceived undesirable experience, he appropriately learns that there was no reason for him to attempt to avoid the situations. Two



Fig. 7.7: Home technique to establish communication to the negatively behaving child and to get the attention of child

different behavior management technique employed in children dentistry follow the principle of flooding. They are hand-over-mouth (aversive conditioning) and physical restraints. Both of these technique have received wide spread acceptance by Pedodontist.

a. Hand over mouth technique (Fig. 7.7): The hand over mouth technique is used to establish communication with a child who is capable of cooperating. It is appropriately applied to the children over the age of three year who have normal intelligence and who have no physical disability that prevent them from understanding the dentist instructions. It is also used for those children who resist treatment by kicking, screaming, or throwing temper tantrums. Dismissing and reappointment to a such children only teach them that their negative behavior is successful in avoiding dentistry. Thus, the use of home disrupts this maladaptive learning.

The technique involves holding the child on the dental chair with the assistant helping to restraint flailing arms and legs. The Pedodontist firmly places his hands over the child's mouth and calmly whispers in his ear 'Listen! Dear; I want to talk with you. I will take my hand away when you stop making noise. Pedodontist use voice control along with HOME technique. Pedodontist makes eye contact, awaits the affirmative nod of understanding, then immediately

removes his hand and praises the child for his cooperation. Thank you Yash, I knew that you could be a good helper. Occasionally, Pedodontist will need to reapply the technique several times to gain cooperation.

b. Physical restraints: Physical restraints in the dental office can range from gentle holding a child's hands during the injection procedure to full body restraints with papoose board. The objectives of physical restraints are, to use the minimum amount of restraints necessary to stop interfering pediatric patient movements. Restraints are removed when the child learns that resistance is unnecessary and he is willing to cooperate. The child should be praised extensively for his cooperation.

Restraints are usually used for patients who are not capable of understanding the dental procedure. Thus, children under age of three or mentally retarded patient whose disruptive behavior might preclude safe delivery of dental care are often restrained. Pharmacological agents are frequently used along with restraints to sedate these patients for treatment. Restraints are also indicated for patient with physical disability such as athetoid cerebral palsy. These patients often ask the Pedodontist to restrain them during dental treatment because they have difficulty in controlling movements of their arms and legs.

Management of infants and precooperative children: Young children, generally up to the 3 years are usually incapable of understanding dental procedure and will be fearful of leaving their parents in the waiting room. In these cases, the parent should accompany the child into the operatory. If possible, the child should sit alone in the dental chair while the parent quietly sits in view of the child. If the child is too young or resistant to examination, the parent can assist the dentist by holding the child in Lap to Lap position. If restorative technique is indicated, the child may need to be seated alone or on the lap of parent on the dental chair (Fig. 7.8).

Clinical Tips for Tough Cases

1. Distracting the child during unpleasant moments of the visit is extremely helpful. Telling a story during the injection keeps the child from dwelling on the discomfort.
2. Allowing the child to play with a toy during the administration of fluoride can also keep the child's



Fig. 7.8: The fearful child may be seated on her mother's lap for oral examination. See the hands and legs of mother who prevent unwanted movement of child's hands and leg with the help of her extremities

minds off of a potentially unpleasant situation. Once the child is cooperating, he should not be ignored. The dentist or caretaker should talk to him throughout the appointment.

3. Profound local anesthesia is necessary so that child feels pain free experience. It helps in development of future cooperative behavior.
4. Appointment should not be given during naptime of a child.
5. Since, children vary in their abilities to understand and communicate, the Pedodontist can not expect complete cooperation from every child. Especially in frustrating cases, the Pedodontist should stay calm. If the management technique fails and the dentist gets angry, it is time to try another technique.

Parent child separation: Scientist Starkey advocated that parent child separation is necessary in the dental operatory because of the following reasons:

1. The parent often repeats the orders, creating annoyance for both dentist and pediatric patient.
2. The parent injects orders, becoming a barrier to development of rapport between the dentist and child.
3. The dentist is unable to use voice intonation (The rise and fall of the voice in speaking) in the presence of the parent because he/she may be offended.

4. The child divides attention between parent and dentist.
5. The dentist divides attention between parent and child.

Note: Author strongly recommends presence of parent with the child patient in the dental operatory for the following conditions:

1. Disabled child: A parent can be a major asset in supporting and communication with a disabled child, often providing important information and interpretation.
2. Age factor: Very young children (those who have not reached the age for understanding and full verbal communication) have a close symbiotic relationship with parent. It should be noted that children 3½ to 4 year old appeared to benefit most from the presence of the parent. Those older than 4 years demonstrated equal levels of response to dental care regardless of parent's presence.

CONCLUSION

Establishing good communication with the child and parent is the most important 1st step in developing positive attitude in the child about dentistry. Once an accurate diagnosis of disruptive behavior is made, the Pedodontist can select appropriate management techniques. Properly employing this technique, the dentist can manage the behavior of the majority of children and can realize the enjoyment and satisfaction of treating them.

BIBLIOGRAPHY

1. Adelson R, Gold fried MR. Modeling and fearful child patient. J dent. Child 1970;37:476.
2. Association of pedodontic diplomats: Survey of attitude and practices in behavior management. Pediatric. Dent 1981;3:246.
3. Bowers LT. The legality of using hand over mouth exercise for management of child behavior. J child 1982;49:257.
4. Chambers DW. Managing the anxiety of young dental patient. J dent. Child 1970;37:363.
5. Machen and Johnson. Desensitization, model learning and dental behavior of children. J dent res 1974;53:83.
6. Rombom HM. Behavioral techniques in Pedodontics: The hand over mouth technique. J dent Child 1981;48:208.
7. Wright GZ, Alpern GD. Variables influencing childrens cooperative behavior at the 1st dental visit. J dent Child 1971;38:124.
8. Wright GZ. Behavior management in dentistry for children, Philadelphia, 1975, WB saunders.

Nutritional Considerations for Children and Adolescents

INTRODUCTION

Nutrition can be defined as the science of food and its relationship to the general health. Nutrients are the part of the food that play an important role in the development and growth of the body or its maintenance. The term nutrients or food factor is used for dietary constituents like proteins, vitamins and minerals.

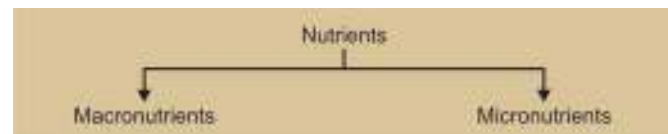
Dietetics

Dietetics is the practical application of the principles of nutrition. It includes the planning of meals for the healthy and sick people. A newer concept of nutritional science has become popular now a day. It mainly includes epidemiological assessment of nutritional status of communities, nutritional and dietary surveys, nutritional surveillance, nutritional and growth monitoring, nutritional rehabilitation, nutritional indicator and nutritional intervention.

Classification of Foods

- A. Classification by origin:
 1. Foods of animal origin
 2. Foods of vegetable origin.
- B. Classification by chemical composition:
 1. Proteins
 2. Carbohydrates
 3. Minerals
 4. Fat
 5. Vitamins.
- C. Classification by predominant function:
 1. Body-building foods, e.g. milk, meat, poultry, fish, eggs, pulses, groundnuts, etc.

2. Energy-giving foods, e.g. cereals, sugars, roots and tubers, fats and oils.
 3. Protective foods, e.g. vegetables, fruits, milk
- D. Classification by nutritive value:
1. Cereals and Pulses (legumes)
 2. Vegetables
 3. Nuts and oilseeds
 4. Fruits
 5. Animal foods
 6. Fats and oils
 7. Sugar, Condiments and spices.



- Nutrients are organic and inorganic complexes contained in food. There are about 50 different nutrients which are normally supplied through the foods we eat. Each nutrient has specific functions in the body. Most natural foods contain more than one nutrient. These may be divided into:
- **Macronutrients:** These are proteins, fats and carbohydrates which are often called “**proximate principles**” because they form the main bulk of food. In the Indian dietary, they contribute to the total energy intake in the following proportions:
 - Proteins 7 to 15 percent
 - Fats 10 to 30 percent
 - Carbohydrates 65 to 80 percent.
- **Micronutrients:** These are vitamins and minerals. They are known as micronutrients because they are required in very small amounts which may vary from micrograms to several grams. A short review of basic facts about these nutrients is given below.

PROTEINS

Proteins are complex organic nitrogenous compounds. They are composed of carbon, hydrogen, oxygen, nitrogen and sulphur in varying amounts. Some proteins also contain phosphorus and iron and sometimes other elements. Proteins differ from carbohydrates and fats in that they contain nitrogen, this usually amounting to about 16 percent. Proteins constitute about 20 percent of the body weight in an adult.

Functions of Proteins in the Body

- Body building—This component is small compared with the maintenance component, except in the very young child and infant.
- Repair and maintenance of body tissues.
- Maintenance of osmotic pressure.
- Synthesis of certain substances like antibodies, plasma proteins, hemoglobin, enzymes, hormones and coagulation factors.

Proteins are connected with the immune mechanism of the body. The cell mediated immune response and the bactericidal activity of leucocytes has been found to be lowered in severe forms of protein energy malnutrition. Proteins can also supply energy (4 kcal/gram) when the calorie intake is inadequate, but this is not their primary function.

Sources of Proteins

Humans obtain protein from two main dietary sources:

- Animal sources:* Proteins of animal origin are found in milk, meat, eggs, cheese, and fish. Egg proteins are considered to be the best among food proteins because of their high biological value and digestibility. It is used in nutritional studies as a “reference protein”.
- Vegetable sources:* Vegetable proteins are found in pulses (legumes), cereals, beans, nuts, oil etc. In developing countries like as India, cereals and pulses are the main sources of dietary protein because they are cheap, easily available and consumed in bulk.

FATS

Fats and oils are concentrated sources of energy. They can be classified as:

- Simple lipids, e.g. triglycerides.
- Compound lipids, e.g. phospholipids.
- Derived lipids, e.g. cholesterol.

The human body can synthesize triglycerides and cholesterol endogenously. 99 percent body fat is available within the adipose tissue in the form of triglycerides. In normal human being, adipose tissue constitutes about 10 to 15 percent of body weight.

Fatty Acids

- Hydrolysis of fat yields fatty acids and glycerol. Fatty acids are divided into saturated fatty acids such as lauric, palmitic and stearic acids, and unsaturated fatty acids which are further classified into mono-unsaturated and polyunsaturated fatty acids.
- The polyunsaturated fatty acids are mostly found in vegetable oils, and the saturated fatty acids mainly in animal fats. However, there are exceptions, as for example, coconut and palm oils, although vegetable oils, have an extremely high percentage of saturated fatty acids. On the other hand, fish oils, although they are not vegetable oils, contain poly and mono-unsaturated fatty acids.

Essential fatty acids are those that cannot be synthesized by humans. They can be derived only from food.

- Linolenic acids
- Arachidonic acids.

Not all polyunsaturated fatty acids are essential fatty acids. Linoleic acid is abundantly found in vegetable oils.

Sources

- Animal fats
- Vegetable fats
- Other sources.

Functions

- They are high energy foods, providing as much as 9 kcal/gram.
- Fats serve as vehicles for fat-soluble vitamins. Fats in the body support viscera such as heart, kidney and intestine and fat beneath the skin provides insulation against cold. Without fat, food is limited in palatability.
- Vegetable fats are rich sources of essential fatty acids which are needed by the body for growth, for structural integrity of the cell membrane and decreased platelets adhesiveness.
- Polyunsaturated fatty acids are precursors of prostaglandins.

- Cholesterol is essential as a component of membranes and nervous tissue and is a precursor for the synthesis of steroid hormones and bile acids. Thus, fats and oils are useful to the body in several ways.

CARBOHYDRATE

The major component of food is carbohydrate, which is the main source of energy, providing 4 kcal/gram. Carbohydrate is also essential for the oxidation of fats and for the synthesis of certain nonessential amino acids. The main sources of carbohydrate are starches, sugar and cellulose. Starch is found in abundance in cereals, roots and tubers. Sugars comprise monosaccharide (glucose, fructose and galactose) and disaccharides (sucrose, lactose and maltose). These free sugars are highly water soluble and easily assimilated. Free sugars along with starches constitute a key source of energy. Cellulose which is the indigestible component of carbohydrate with scarcely any nutritive value, contributes to dietary fiber.

- The carbohydrate reserve (glycogen) of a human adult is about 500 g. This reserve is rapidly exhausted when a man is fasting. If the dietary carbohydrates do not meet the energy, endogenous sources are used by the body to maintain glucose homeostasis.

Dietary Fibers

There are two types of dietary fibers:

- Insoluble fibers include cellulose, hemicellulose and lignin.
- Soluble fibers are pectins, gums and mucilages.

Functions of Fiber

- It absorbs water, and this increases the bulk of the stool and helps to reduce the tendency of constipation by encouraging bowel movements.
- Dietary fibers are resistant to digestion in the digestive tract.
- Fiber also inhibits fecal mutagen synthesis by changing colonic pH and bacterial metabolism.
- Cancer of stomach and colon have been linked directly to a low fiber diet.
- Dietary fiber is known to be associated with reduced incidence of coronary heart disease.

Advantage

- Fiber has no metabolic effects.

Disadvantage

Too much of fiber can decrease the absorption of valuable micronutrients.

- A daily intake of about 40 grams of dietary fiber is desirable. Indian diet provides 50-100 grams per day of fiber when whole grain, cereals, pulses and vegetables are consumed daily.

NUTRITIONAL REQUIREMENTS

Basic Concepts

The science of human nutrition is mainly concerned with defining the nutritional requirements for the promotion, protection and maintenance of general health in all groups of the population. The nutritional knowledge of diets is essential for growth of infants, children and adolescents, and for maintenance of health in adults of both sexes. "Recommended daily intake" or allowance (RDA) has been widely accepted.

Recommended Daily Allowance (RDA) (Tables 8.1 to 8.3)

The recommended intake of nutrients represents value judgments based on the existing knowledge of nutritional sciences. The recommendation is estimated to meet requirements of practically all healthy people.

- Because of their rapid growth rate, young children required more energy for each kilogram of body weight than an adult one.

Balanced Diet

A balance diet can be defined as "Diet which contains a variety of foods in such quantities and proportion that the need for energy, amino acids, vitamins, minerals, fat, carbohydrate, and other nutrients is adequately met for maintaining health, vitality and general well being." Balanced diet for children are given below in grams.

Types of Foods	Children			
	1-3 yrs	4-6 yrs	Boys 10-12 yrs	Girls 10-12 yrs
Cereals	175	270	420	380
Pulses	35	35	45	45
Leafy vegetables	40	50	50	50
Other vegetables	20	30	50	50
Roots and tubers	10	20	30	30
Milk	300	250	250	250
Oil and fats	15	25	40	35
Sugars	30	40	45	45

Table 8.1: Recommended daily intake of energy

Group	Body weight	Energy allowance/day
Infancy		
• 0-6 months		• 118 kcal/kg/day
• 7-12 months		• 108 kcal/kg/day
Children		
1-3 years	12.03	1240
4-6 years	18.87	1690
7-9 years	26.37	1950
Adolescents		
10-12 years (M)	35.4	2190
(F)	31.5	1970
13-15 years (M)	47.8	2450
(F)	46.7	2060
16-18 years (M)	57.1	2640
(F)	49.9	2060
Adults		
Male	60	
(light work)		2425
(moderate work)		2875
(heavy work)		3800
Female	50	
(light work)		1875
(moderate work)		2225
(heavy work)		2925
Pregnancy		+ 300
Lactation (First 6th months)		+ 550
(6-12 months)		+ 400

Source: Recommended dietary intake for Indians (ICMR 1990)

Table 8.2: Daily intake of energy

Age	Body weight	Kcal/Kg/24hrs
1 year (average)	112	
1 to 3 years	12.0	100
4 to 6 years	18.8	90
7 to 9 years	26.3	80
Reference man	60	45
Reference woman	50	40

Minimal Requirement of other trace element /day: Trace elements are as important as macronutrients for the development, growth and general health of human being.

Zinc	• 15 mg/day for men • 12 mg/day for women • 10 mg/day for children • 5 mg/day for infants
Copper	2.2 µg/day for adults
Chromium	Data not available
Selenium	Data not available
Molybdenum	Data not available
Fluorine	0.5 to 0.8mg/liter water

- Total body contents of chromium is less than 6 mg. It helps in carbohydrate and insulin function.
- Molybdenum deficiency is associated with mouth and esophageal cancer.

Table 8.3: Recommended daily nutrients allowance from infancy to teenagers (Based on ICMR 1990)

Group	Body wt in kg	Net energy kcal/d	Proteins g/day	Fat g/day	Calcium mg/day	Iron mg/day	Vit A µg/day retinol	Thiamin mg/day	Ribo-flavin mg/day	Nico-tinic acid	Pyrido-xine mg/day	Vit C mg/day	Folic acid µg/d	Vit B ₁₂ µg/day
Infants														
<6 month	5.4	108/kg	2.05/kg	—	500	—	350	55 µg/kg	65 µg/kg	710 µg/kg	0.1	25	25	0.2
6-12 months	8.6	98/kg	1.65/kg	—	500	—	350	50 µg/kg	60 µg/kg	650 µg/kg	0.4	25	25	0.2
Children														
1-3 yrs	12.2	1240	22	25	400	12	400	0.6	0.7	8	—		30	0.2-1
4-6 yrs	19.0	1690	30	25	400	18	400	0.9	1.0	11	0.9	40	40	0.2-1
7-9 yrs	26.9	1950	41	25	400	26	600	1.0	1.2	13	1.6	40	60	0.2-1
Boys (10-12 yrs)	35.4	2190	54	22	600	34	600	1.1	1.3	15	1.6	40	70	0.2-1.0
Girls (10-12 yrs)	31.5	1970	57	22	600	19	600	1.0	1.2	13	1.6	40	70	0.2-1.0
Boys (13-15 yrs)	47.8	2450	70	22	600	41	600	1.2	1.5	16	2.0	40	100	0.2-1.0
Girls (13-15 yrs)	46.7	2060	65	22	600	28	600	1.0	1.2	14	2.0	40	100	0.2-1.0
Boys (16-18 yrs)	57.1	2640	78	22	500	50	600	1.3	1.6	17	2.0	40	100	0.2-1.0
Girls (16-18 yrs)	49.9	2060	63	22	500	30	600	1.0	1.2	14	2.0	40	100	0.2-1.0

Nutrition assessment chart

Name Age Sex S.No. _____

Address Email

City State Country Ph. No.:

Clinical

1. General appearance: Normal built/thin built/sickly
2. Hair: Normal/lack of luster/dyspigmented/thin and sparse
3. Face: Diffuse depigmentation/ moon face
4. Eye: Conjunctiva - normal/dry on exposure for 1/2 min/dry and wrinkled/bitot's spots/ brown pigmentation/angular conjunctivitis/pale conjunctiva cornea - normal/dryness/hazy or opaque
5. Lips: Normal/angular stomatitis/cheilosis
6. Tongue: Normal/pale and flabby/red and raw/fissured/geographic Mottled enamel/caries/attrition
7. Teeth: Mottled enamel/ caries/attrition
8. Gums: Normal/ spongy/bleeding
9. Glands: Thyroid enlargement/ parotid enlargement
10. Skin: Normal/dry and scaly/follicular hyperkeratosis/dermatitis
11. Nails: Koilonychias
12. Edema: In dependent part
13. Rachitic changes: Bow leg or epiphyseal enlargement
14. Internal system: Hepatomegaly, tachycardia, mental confusion, etc.

Anthropometric

- Weight
- Height
- Mid upper arm circumference
- Head circumference
- Chest circumference.

Laboratory finding

- Hemoglobin
- Stool: Negative, ascariasis, amebiasis, etc.
- Blood smear: Negative/BT/filarial

Signature of clinician

Date _____ Time _____ Place _____

Address: _____

Ph. No.: _____

BIBLIOGRAPHY

1. ARC/MRC (1974). A report: Food and nutrition researcher, London, HMSO.
2. CIMS, Role of Zinc in health and disease.
3. ICMR (1990). Recommended Dietary intakes for Indians, New Delhi.
4. National institute of Nutrition, Hyderabad (1976). A annual report, 1976.
5. National institute of Nutrition, Hyderabad (1977). Ann Rep, 1976.
6. WHO (1970). Fluorides and Human Health, Geneva, WHO, Monograph (S. No. 59).
7. WHO (1984).Guidelines for Drinking Water quality Vol. 1 P55, Geneva WHO.

Eruption of Teeth, its Disturbances and their Management

TEETHING PROCESS

Eruption of the deciduous teeth usually begins in the 6th month of the child. Eruption of the deciduous teeth is usually preceded by salivation and child likes to put the fingers or toys into the mouth and try to crush it. This symptom indicates that the teeth will soon erupt. In most cases, eruption of deciduous teeth causes no distress to the child, or parents but sometime process causes local irritation which may interfere with the child's sleep. The small deciduous incisor usually erupts without difficulty, but difficult teething is commonly associated with larger teeth.

SIGNS AND SYMPTOMS OF TEETHING

Local signs

1. Swelling of the gingival mucosa over the erupting teeth.
2. Small patches of erythema on the cheek.
3. Inflammation of the gingival tissues before complete emergence of the crown, may cause a temporary painful condition, which may be relieved spontaneously after few days.

Systemic Signs

1. General irritability and crying
2. Loss of appetite
3. Sleeplessness and restlessness
4. Increased drooling of saliva
5. Increased thirst
6. Circumoral rash.

Teething And Associated Problems

The following symptom may be associated with teething process.

Systemic: Systemic problems are associated with types of infection which occur due to putting dirty object into the mouth during eruption of teeth.

1. Fever
2. Diarrhea
3. Convulsion
4. Vomiting
5. Cholera
6. Infantile paralysis.

Local

1. Eruption hematoma
2. Eruption sequestrum
3. Ectopic eruption
4. Transposition
5. Eruption cyst
6. Transmigration.

Management of Teething

Since, it is a physiological phenomenon so only symptomatic treatment and those special supporting treatment is considered which may hastened or facilitate the teething process.

Local Treatment

1. **Teething Toys:** A child uses their hands and mouth to explore unfamiliar objects. Various types of teething rings, keys and other toys in different shades are

available in mother craft shops. These toys are designed to satisfy the psychological natural tendency of the child to bite, chew and suck. The child may get relief from soreness by pressure of biting and teething toys which have a useful function. The caretaker of child should be advised to purchase only well made and smooth toys.

2. **Teething food:** In place of teething toys, hard rusk or biscuit preparations can be used. Teething food should not contain active sugar or sweetening agent since it may produce caries.
3. **Application of topical anesthetics:** If the child is having extreme difficulty during teething process topical applications of Mucopain ointment (salicylic acid+lignocaine) preparation is given 3-4 times/day.

Systemic Medicament

May be considered only if local treatment has been ineffective.

- i. Analgesic Preparation: Sugar free paracetamol preparation
(5 ml contains 120 mg of Paracetamol)
Upto 1 year: 5 ml at bed time
1-5 years: 10 ml at bed time.
- ii. Hypnotic and sedatives:
(5 ml contains 200 mg of chloral hydrate)
Up to 1 year: 2.5 ml BD or twice daily
1-5 years: 2.5-5ml TDS (thrice daily).

Eruption Cyst

Eruption cyst commonly occurs over primary second molar but some times is also associated with permanent teeth. The normal follicular space of teeth is filled with fluid or blood, forming eruption cyst or eruption hematoma. There is a bluish red area over the erupting tooth later there may be swelling of the gingival mucosa.

Treatment

1. It is a transient stage which resolves spontaneously most of the time but sometimes it becomes more serious causing prolong crying and loss of sleep.
2. Surgical excision.

Submerged Tooth (Infraocclusion)

A submerged tooth is one that has failed to maintain its position relative to adjacent teeth in the developing

dentition and is therefore below to the occlusal level. Submergence is commonly associated with primary molars but permanent molars may be occasionally affected. The prevalence of submergence in children varies from 1.3 to 8.9 percent (Kuroi, et al. 1981).

The most commonly affected submerged tooth are the mandibular primary first molar then mandibular second molar as compared to maxillary first and second molar.

Mechanism of Submergence

The mechanism of submergence appears to be related to ankylosis as a rhythmic alternative phase of resorption and repair of the bone. It is the normal phenomena of primary teeth resorption. If there is an excessive repair (excessive bone formation), it leads to the ankylosis of primary tooth. Further occlusal movement of the tooth is retarded or arrested and it falls below the occlusal level of neighboring teeth.

Treatment

1. Usually, it requires no treatment.
2. If there is a radiological sign of interference with premolar eruption or angulations of premolar or if there is danger of submergence below gingival level. The type of treatment required depends on the degree of submergence (Andlaw et al. 1974).
1. *Minimal submergence:* Marginal ridge of submerged tooth occlusal to adjacent contact area:-
 - i. Observe and recall visit every 6-12 month
 - ii. Make a radiograph and study model every 6 to 12 months.
2. *Moderate submergence:* Marginal ridge of submerged tooth just cervical to adjacent contact areas.
 - A. If submerged tooth does not interfere with premolar eruption, the tooth may be retained and restored to normal contact with stainless steel crown or composite.
 - B. If it interferes with the premolar eruption it should be extracted and place a space maintainer.
3. *Severe submergence (marginal ridge at gingival level):* Extract the submerged molar and maintain the space by space maintainer. A submerged permanent molar must be extracted ideally before it becomes submerged below the gingiva.
4. *Natal and neonatal teeth* (see chapter-Common pediatric oral pathology and their management).

5. *Ectopic eruption of permanent molar and its management*: The incidence of ectopic eruption of permanent first molar is 2-4 percent of the population. Ectopic eruption of permanent first molar results in premature atypical resorption of the primary second molar and impaction of the permanent tooth against the crown of the deciduous molar causing premature loss of primary tooth. Ectopic condition is more common in maxilla than mandible. Young DH (1957) classified the ectopically eruption permanent molar as:
 1. *Hold type of ectopic eruption*: When the first permanent molar is locked in place by second primary molar it is called as Hold type. The hold type of ectopic eruption are characterized by large teeth, small maxilla, larger than normal affected first permanent molar and second primary molars, erupting angle more obtuse than normal and delay calcification of affected first permanent molar.
 2. *Jump type of ectopic permanent molar*: Jump type of ectopic eruption of permanent first molar characterized by resorption of the distal part of the second primary molar but finally erupts into occlusion and also showed similar factors of hold type but less severe in intensity to make the affected molar to jump past the distal contour of second primary molar and erupt into normal occlusion.

DIAGNOSIS OF ECTOPIC ERUPTION

In 5-7 years old child, the diagnosis of ectopic eruption of permanent first molar is usually made with the help of radiograph. The high positioning of the 1st permanent molar in close proximity to the distobuccal root of the second primary molar or mesial inclination of the permanent tooth are indications, that ectopic eruption of the molars might occurs.

Pediatric dentist should check the inclination of the occlusal surface of second primary molar. In most ectopic cases, the distal surface of the primary molar is canted occlusally.

Treatment

Initially, treatment of ectopically erupted 1st permanent molar should be instituted to disimpact the 1st molar. If this is unsuccessful, it may be necessary to extract the primary second molar.

If the permanent 1st molar is impacted against the crown rather than the root of the primary second molar. It is possible to disimpact the permanent first molar by using soft brass ligature wire (0.5 - 0.7 mm diameter) or elastic separators.

Methods

1. Anesthetize the gingiva buccal/palatal to the tooth.
2. Holding the wire in artery forceps, pass it under the contact point from buccal to palatal.
3. Twist the end together on the contact point and do not over tighten the wire or the wire will snap.
4. Cut off ends leaving about 5 mm twisted together.
5. Tuck-in neatly to avoid traumatizing the cheeks or gingiva.
6. Recall visit in every 15 days and retighten.

Above method is used for less severe cases of ectopic eruption. But more severe cases modification of Humphrey appliance and Halterman appliance is used.

Humphrey appliance: A preformed steel band was adapted to the second deciduous molar on the affected side and a wire was adapted and soldered to the band. An S shaped loop was placed in the wire with the help of 139 no. pliers. The loop was opened slightly and was heat-treated before cementation of the loop. The distal extension of the wire was placed in an opening in the occlusal surface of the ectopically erupting molar. It needs to remove the appliance in 7-10 days for second activation of the loop.

Halterman appliance: It is a semi-fixed type of appliance involving the banding of the second primary molar and soldering the extension arm that runs distal to the ectopic molar. An orthodontic button is bonded to the occlusal surface of the ectopic molar and an elastic power chain is attached from this button to the small hook made into the most distal aspect of the extension arm. The power chain is changed every 2-3 weeks.

KESLING OR SELF LOCKING SEPARATING SPRING

The spring was designed primarily for separation of the teeth before orthodontic banding but can be used for correction of ectopic eruption of permanent molar, if there is sufficient dental development for its insertion

and cross arch anchorage is not required. The head of the spring is placed on the marginal ridge or near the middle of the contact area and held firmly with a cervical force, while the active arm is directed below the contact point of the ectopically positioned tooth. The patient should be recalled every 5 to 6 weeks for evaluation of the eruption progress and reactivation of the spring.

DELAYED ERUPTION OF PERMANENT TEETH

Localized eruption delay is more common in the permanent dentition than in the primary dentition. The following causes of delay eruptions are given below:

Incisors

1. Delayed resorption of primary incisors following trauma or necrosis of pulp
2. Supernumerary teeth and dilacerations
3. Very early loss of deciduous tooth and formation of a bone bridge into the socket.

Canines

Abnormal path of maxillary permanent canines.

Premolars

1. Impaction against other teeth due to abnormal angulations or crowding and delay resorption of deciduous molars
2. Submerged deciduous molar.

Molars

Impaction against teeth and other conditions such as any cystic lesion or fibrosis of wound overlying tooth may cause delayed eruption.

IMPACTION AND DELAYED ERUPTION OF MAXILLARY PERMANENT CANINES

The most commonly impacted tooth is mandibular first molar. Next in the frequency are the permanent canines. Maxillary canine tooth has the longest period of development and follows the most dubious course in its eruption and occupies several developmental positions, in succession and is easily deflected from its normal course of eruption.

The pediatric dentist should check the evidence of asymmetric eruption of maxillary canine in the dental

X-ray and oral examinations at the age of 9-10 years. If by the age of 10 years maxillary primary canine are not mobile and permanent canine are not palpable in the buccal sulcus, the radiograph must be taken to find out their position in the maxilla. The arch space available for the canine should be compared with the size of the unerupted tooth crown. The measurement of the opposite canine crown can be used for the measurement of impacted canine which can be made directly from the dental radiographs. If space available for the tooth is adequate and occlusion is normal the space should be maintained.

Treatment

There are following treatment options for treatment of delayed eruption of maxillary permanent canine:

1. *Extract maxillary deciduous canine:* If abnormal eruption of maxillary permanent canine is detected before the age of 13 years (Ferguson 1990). Extraction of primary canine results in correction of path of eruption of canine. After extraction a radiograph should be taken every 6th month to determine whether the position of the maxillary permanent canine has improved or not.
2. *Extraction of primary canine and surgical exposure of permanent canine's crown:* Usually, after extraction of primary canine the permanent canine erupts normally at the age of 10 to 13 years but may not erupt in an older patient. In such case surgical exposure of crown of maxillary permanent canine enhance the tooth eruption but some times it needs orthodontic treatment.
3. *Retain maxillary deciduous canine and extract the permanent canine:* Retained deciduous canine may remain functional into adult life, but its appearance may be considered unacceptable by the patient which presents a problem, if there is insufficient space for normal sized prosthetic replacement or if orthodontic therapy to open or close the space is not possible. If unerupted canine is left *in situ*, it may cause root resorption of lateral incisor or may undergo cystic degeneration in the follicular space. In this situation, permanent maxillary canine must be extracted, if it is not extracted radiograph should be taken every 6 months to check root resorption or cystic degeneration.

Anomalies of Tooth Form

Double teeth: A double tooth occurs most frequently in incisor and canine regions and more common in deciduous dentition than permanent dentition. Double teeth may be characterized by notching of incisal edge or by a longitudinal groove in the crown or by partial or complete separation of the root.

Double teeth are formed by fusion of two developing tooth germ. If fusion occurs between two teeth of normal dentition, one tooth appears to be missing from the dentition. The pulp chambers and root canals of double teeth may be united or separated, that depends on the nature, time and stage of dental development at which fusion occurs.

Management of Double Teeth

1. Requires no treatment, if primary double teeth.
2. In permanent dentition double teeth needs to be treated to improve their esthetics. Ideally separation of double teeth should be delayed until the child reaches at the age of adolescent or adulthood to allow some recession of pulp horn to occurs, thus reducing the risk of pulp exposure. If patient wants early (before 11 years of age) aesthetic improvement, then double teeth may be treated by pulpotomy or pulpectomy/ RCT and post crown considered for one or both part of double teeth.

If there is a single pulp chamber in double teeth and division of crown by disc is not possible then some improvement of appearance may be obtained by accentuating the longitudinal groove in the crown to simulate two separate teeth.

Peg Shaped Lateral Incisors (Fig. 9.1)

Peg shaped lateral incisor resembles with conical supernumerary tooth. Peg shaped lateral incisor may occur unilaterally or bilaterally. Palatal pits are usually associated with lateral incisors. Sometimes, the pit is deep and leads to a chamber formed by invagination of developing tooth germs. This is known as **dens in dente**; caries may develop in the depth of pits and quickly involve the pulp.

Treatment

1. If the dental arch is overcrowded the peg shaped lateral incisors may be extracted as a part of orthodontic therapy.



Fig. 9.1: Left upper peg lateral tooth and it was reformed through esthetic composite with the help of strip crown

2. **Porcelain thimble crown:** A normal shape of crown can be produced by porcelain thimble crown. No tooth preparation is required in peg lateral incisor for crowning. The entire enamel surface of tooth in acid etched and crown are bonded to it with composite resins cement.
3. **Resin crown with help of modifying cellulose acetate crown:** The appearance of peg shaped lateral incisor can be improved by using composite resin in a cellulose acetate crown form. A problem arises during adaptation of cellulose crown form, to the narrow neck of peg tooth. This may be overcome by making a longitudinal cut in palatal part of the cellulose acetate crown form overlapping the two sides and sticking with photographic film adhesive as shown in above diagram.

Tooth within a Tooth (Dens in Dente)

It is also known as evaginated odontome. A den in dente is a tooth in which an invagination of enamel and dentine appear as a tubercle on the occlusal or lingual surface. This condition occurs both in primary and permanent teeth. It is most commonly found in permanent maxillary central, lateral incisor and premolar. The diagnosis of dens in dente can be verified by dental roentgenograph.

Anterior teeth with dens in dente usually appear in normal size and shape. Tooth within a tooth characterized by an invagination lined with enamel and foramen cecum with probability of communication between pulp chamber and invagination cavity.

Management of Dens in Dente

1. If invagination causes no occlusal interference application of sealant or a restoration in the opening of the invagination are recommended.
2. If it causes occlusal interference, reduce the interfering enamel and restore with composite.

3. If pulp is exposed during reducing occlusal interference an endodontic procedure is recommended, depending on its pulp morphology and restorable crown.

Talon Cusp

It is an additional cusp that prominently projects from the lingual surface of deciduous and permanent teeth. It is morphologically well delineated and extends at least half the distance from CEJ to the incisal edge of deciduous and permanent anterior teeth.

Talon cusp most commonly seen on lingual surface of maxillary permanent incisor and deciduous incisor. Talon cusp is made up of enamel and dentine. Pulp projects into it to a variable degree. Dental X-ray is not helpful in determining the outline of the pulp horn and extension of pulp.

Problems Associated with Talon Cusp

1. Caries development in groove and fissure between cusp and tooth
2. Occlusal interference
3. Labial displacement of tooth during eruption.

Treatment

As soon as teeth erupts into the oral cavity careful examination of the talon cusp for presence of groove or fissure between the cusp and tooth should be performed.

1. If groove or fissure are present, seal it with composite resin or GIC or pit and fissure sealant.
2. If talon cusp causing occlusal interference, reduced the cusp at required occlusal level and check for exposure of pulp, if pulp is exposed, perform a conservative pulpotomy.

Dilaceration

Tooth with sharp bend in crown or root is known as dilacerated tooth. Dilacerations is most commonly seen in maxillary permanent central incisors. Most common cause of dilacerations is trauma to the deciduous teeth. That may cause dilacerations of crown or root of permanent succedaneous tooth.

Dilacerated tooth usually fails to erupt but may sometimes erupt into an abnormal position and can cause displacement of adjacent teeth.

Treatment

1. Unerupted dilacerated tooth usually require surgical extraction.
2. Erupted teeth with root dilacerations are extracted, if it is in abnormal position. Since, it is difficult to move by orthodontic force.
3. Following extraction, extracted space should be maintained by prosthesis or closed by orthodontically moved tooth.

ANOMALIES OF TOOTH NUMBER

Development of Supernumerary Tooth (Fig. 9.2)

During cap stage of tooth development, a deficiency in initiation and deficiency in proliferation will result in failure of tooth germ to develop and in less than the normal number of teeth. Excessive proliferation of the epithelial cell may results in epithelial rests. Epithelial rest cell may remain inactive or become activated as results of an internal or external stimulus. If epithelial rest are less differentiated it may develops cyst. If rest cell become more differentiated and detached for the enamel organ it may develop into a supernumerary tooth or odontome. The degree of differentiation of rests cell determine the development of cyst, odontome or supernumerary tooth.

Supernumerary teeth are most commonly occurs in premaxillary and less common in deciduous dentition than permanent dentition. Deciduous supernumerary tooth are usually normal or conical in shape. The permanent supernumerary teeth have a various shapes.

1. *Conical supernumerary tooth*: Small peg shaped teeth with conical pointed crown and root develop similar stage to the normal incisor. Most commonly seen in midline of the arch, between the central incisors and often erupts with central incisors, usually it is not inverted teeth. The inverted supernumerary teeth do not erupt. It may also cause rotation or other displacement of erupted teeth.
2. *Tuberculate supernumerary tooth*: It is a short barrel shaped with low cusp and little or no root. Supernumerary teeth are commonly seen palatal to permanent central incisors. It usually prevents eruption of permanent incisors.



Fig. 9.2: Palatally erupted mesiodens supernumerary tooth with its radiograph shows tilted central incisors, because tooth material size was more than arch size

3. *Supplemental supernumerary tooth:* This supernumerary tooth resembles with normal incisors usually, a lateral incisors
4. *Odontomes:* These are of various shapes and sizes.

Treatment

1. *Require no treatment:* If unerupted inverted supernumerary teeth is causing no displacement of erupted teeth. A periodic radiographic examination is essential to detect any undesirable changes that may occur.
2. *Simple extraction:* Extract the tooth as soon as conical supernumerary teeth erupt.
3. *Surgical extraction:* Surgical extraction of tuberculate and inverted conical supernumerary tooth can be done at the age of 8-10 years to minimize the damage to the permanent tooth. The space should be closed by means of orthodontic treatment.

Anodontia

Congenital absence of all teeth is known as anodontia and congenital absence of one or more teeth but not all is known as hypodontia.

Hypodontia in deciduous dentition is less common than in the permanent dentition. The permanent teeth most commonly congenitally absent are maxillary lateral incisors and mandibular second premolar. Hypodontia may be unilateral or bilateral absence of maxillary lateral incisors is often associated with a small peg shaped contralateral tooth.

Treatment

Treatment plan is primarily influenced by whether the arch is crowded or not. Complete anodontia give complete denture, which is remade every 6 months till arch growth is completed

1. *Hypodontia:* Functional type space maintainer is given after complete growth of arch. A fixed type of bridge may be given.
2. *Implant:* Implant may be the treatment of choice.

ANOMALIES OF TOOTH STRUCTURE

Enamel Hypoplasia

Amelogenesis occurs in two stages: Deposition of organic matrix or enamel matrix and mineralization. Any disturbance in enamel matrix formation or mineralization process can result into abnormalities of tooth structure.

A disturbance in enamel matrix formation produces enamel hypoplasia which is characterized by irregular thickness of enamel and presence of pits and grove in the enamel surface. Any defect in mineralization process the enamel thickness is normal but poorly mineralized. It can be found in both primary and permanent dentition.

ETIOLOGY OF HYPOPLASIA OF ENAMEL

A number of factors can adversely affects the amelogenesis and produce hypoplastic enamel

1. Nutritional deficiency (Vit. A, C and D)
2. Congenital syphilis

3. Exanthematous disease (Measles, chicken pox and scarlet fever)
4. Birth injury
5. Rh hemolytic disease
6. Local infection or traumas
7. Ingestion of chemical (like fluoride and tetracycline, etc.)
8. Amelogenesis imperfecta.

Enamel hypoplasia distribution on the crown portion of teeth depends upon the developmental stage of teeth when the systemic disturbances occur. If a severe systemic disturbance occurs within the second trimester of pregnant women. The following distribution of enamel hypoplasia may be expected.

In Primary Teeth

Molars and canine: Cervical and middle 1/3rd of crown

Incisors: Cervical 1/3rd of crown.

In Permanent Teeth

1. *First molars:* Occlusal 1/3rd of crown.
2. Central incisors and mandibular lateral incisors: Incisal 1/3rd of crown (Fig. 9.3).
3. *Canine:* Tip of the cusp.

Note: Maxillary lateral incisors will not be affected because they begin to develop later.



Fig. 9.3: Hypoplasia of enamel on the incisal 1/3rd of upper permanent central incisors

Problem Associated with Hypoplasia and Hypomineralization of Enamel

1. Hypoplasia of enamel
 - a. Poor appearance of anterior teeth
 - b. Rough hypoplastic area, predisposing to dental caries
 - c. Tooth sensitivity may be found
2. Hypomineralization
 - a. Unesthetic
 - b. Chipping of enamel
 - c. High attritional rate of occlusal enamel
 - d. Tooth sensitivity may be found
 - e. Attrition of dentine.

It is important to reassure and encourage the child and care taker or parents who may be demoralized by unaesthetic appearance of teeth. They should be advised that treatment is possible and encouraged to take an active interest in the treatment plan.

Treatment

For Primary Teeth

- Hypomineralized and hypoplastic molar: Stainless steel crown is indicated.
- Hypomineralized and hypoplastic incisor: Crowning or veneer is indicated.

For Permanent Teeth

Permanent first molars (hypoplastic)

- **At 6 years of age:** GIC cement or stainless steel crown or composite resin is recommended.
- **At 12 years of age:** After initial treatment of permanent first molars in the early mixed dentition, a decision must be made either to retain it permanently or to extract it at a time in dental development that will encourage the second molars to occupy their positions. If radiograph shows that unerupted canines and premolars are present and there is a sufficient space for their eruption, it may be preferable to extract the permanent first molars when child is in between 8-10 years of age. This treatment plan is specially indicative, if hypoplasia is due to systemic disturbance during infancy because the premolars and second molars will not be affected. If the cause is amelogenesis imperfecta, premolars and second

molars will be expected to be similarly affected and there is no advantage to be gained by extracting the first molars, except if extensive restorative treatment is required to maintain the teeth.

- **At 18 years of age:** Cast veneer crown is fabricated for permanent hypoplastic first molar.

FOR PERMANENT HYPOPLASTIC AND HYPOMINERALIZED INCISORS

- *At 6 years of age:* Composite resin, GIC cement, composite veneer or porcelain veneer is recommended.
- *At 18 years of age:* Porcelain veneer or jacket crown.

FOR HYPOPLASTIC CANINE AND PREMOLARS

- *At 12 years of age:* GIC cement/composite resin.
- *At 18 years of age:* Porcelain/cast crown/full cast veneer.

Enamel hypoplasia vs Nursing caries

Enamel hypoplasia	Nursing caries
Caries pattern: Max. incisors, second primary molar	Maxillary incisors and first primary molar
Surface involved:	
• Incisor: Circular pattern on incisal edge	• Commonly involved lingual, facial and proximal surface.
• Molar: Circular pattern along developmental line.	• Minimal or no involvement of incisal edge.
Symmetry of lesion:	
• Usually bilateral symmetric lesion	• May be symmetric or asymmetric
Child age when notice lesion	
• At the time of eruption of teeth.	• Average 20 months of child
• Medical condition associated with dental lesion, cerebral palsy or premature birth.	• None

Dentinogenesis Imperfecta

It is a hereditary dentinal defect that may or may not be associated with osteogenesis imperfecta. The color of the teeth in dentinogenesis imperfecta varies from gray to brownish blue. The crown is bulbous and constricted cervically. The enamel is normal and poorly supported by defective dentine. High attrition occurs in exposed dentinal surface. Radiographs showed that teeth have short thin root and obliterated pulp chambers and root canals. All teeth of both dentitions are affected.

Treatment

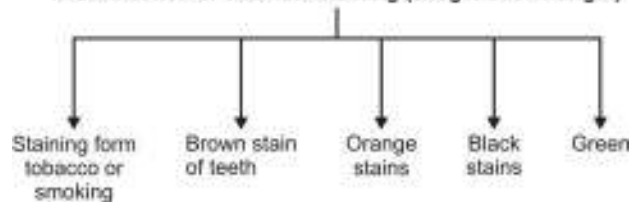
1. Stainless steel crown for both primary and permanent molars showing dentinogenesis imperfecta
2. Acrylic crown may be made for anterior teeth having dentinogenesis imperfecta.

A specific problem associated with dentinogenesis imperfecta is that the teeth are often unsuitable for crowning because they are poorly supported by short thin roots and defective dentine. An assessment must be made of their suitability for crowning, but eventually it may become necessary to extract the teeth and provide normal denture.

Staining of Teeth

Teeth may become discolored by variety of intrinsic and extrinsic stains. Those stains which are incorporated into tooth structure are known as intrinsic tooth stain. Example- Porphyria, tetracycline and erythroblastosis fetalis. The exogenous substance may stain teeth known as extrinsic staining.

Classification of extrinsic staining (exogenous in origin)



- Stains from tobacco smoking:** On the teeth of children and adolescence, who smokes stain very often occur as yellowish brown to black deposits, as a result of collection of tobacco tars and resins. The deposit is harmless to the teeth although it should be removed because of unesthetic appearance and acts as a nidus for calculus deposition.
- Brown stains:** A delicate dental plaque known as 'mesenteric line' was termed by Pickerill and appears to be plaque of brown or black dots which may mingle to form a thin dark line and the enamel at the cervical margin of the tooth.
- Black stains:** The black stains are caused by bacteria *actinomyces sp.* in the plaque.
- Green stains:** Heavy gray green stains frequently have been seen on the gingival 3rd of maxillary anterior teeth in children and adolescence and rarely in adult. This stain is soft or furry in nature and is difficult to

remove, suggesting its association with the enamel cuticle. It has been suggested that coloration of remnant of nysmyth's membrane, possibly by blood pigment may be responsible for the stains.

- e. *Orange stain*: Rarely a light thin deposit of a material which has a brick red to orange color is seen on teeth. The etiology is not known, but it is suggested that chromogenic bacteria's may be the cause.

INTRINSIC STAINING (MOTTLED ENAMEL OR TETRACYCLINE STAINING)

The white or black brown discoloration is usually associated with hypomineralisation or with dental fluorosis. This discoloration is often located in superficial enamel and it can be easily eliminated by careful removal of surface enamel.

Management of Staining

There are four possible approaches to treatment:

1. Etching and abrading
2. Bleaching
3. Veneering
4. Crowning.

Technique: Etching and Abrading (Crool and Cavanaugh, 1986)

1. Clean the affected tooth surfaces with pumice water slurry.
2. Prepare two thick pastes:
 - a. Pumice powder added to 18 percent HCl.
 - b. Sodium bicarbonate added to water.
3. Isolate the teeth with rubber dam. Copal varnish may be flowed around gingival margin to improve seal.
4. Place some of sodium bicarbonate paste on rubber dam around the teeth to be treated to neutralize any acid that may inadvertently be misplaced
5. Apply the pumice – HCl. Paste with a wooden tongue blade or cotton wool swab stick. Spread the paste over the discolored area and rub it gently over the enamel surface with a wooden applicator. Place a cotton wool roll close to the tooth to absorb any acid that may drip from the tooth. A prophylaxis brush or rubber cap is not used because it would be difficult to avoid splatter, since the acid is very caustic.
6. After 5 seconds, thoroughly rinse with water for 10 second while using high volume suction.

7. Apply the pumices HCl paste for further 5 second period, rinsing thoroughly after each application. Usually improvement is noted after a few applications; the method is not pursued beyond 12-15 application.
8. Finally, rinse thoroughly and apply fluoride gel to treated surfaces for 3 min., polish with a fluoride prophylaxis paste and finish with a super fine aluminum oxide polishing disk.
9. Neutralize the remaining pumice HCl paste with the sodium bicarbonate paste before discarding it.

Technique: Etching and Bleaching (Boksman and Jordan, 1983)

1. Clean affected surfaces with a pumice water slurry or with an oil free prophylaxis paste.
2. Isolate the teeth with rubber dam.
3. Etch with 30 to 37 percent phosphoric acid for 1 min, wash and dry.
4. Bleach with a solution of 30 percent hydrogen peroxide (5 Part) and ether (1 Part).
5. Place the tips of a suitable heating instrument on cotton pledged in turn and increase the temperature until the patient reports slight sensitivity. Maintain the highest temperature that patient can comfortably tolerate for 2 to 3 min.

Technique: Etching, Bleaching and Abrading, (Chandra and Chawla, 1975)

1. Clean the affected teeth with a pumice water slurry or with an oil free prophylaxis paste.
2. Isolate the teeth with rubber dam.
3. Dry the labial surface by applying absolute alcohol and using an air syringe for 1 minute.
4. Etch and bleach with a solution made up of 30 percent hydrogen peroxide (5 parts) 36 percent HCl (5 parts) and ether (1 part).
5. Keep the tooth surface wet with solution while removing superficial enamel with a sand paper disk fitted to a slow speed hand piece.
6. Neutralize the solution on the teeth with 5.25 percent sodium hypochlorite solution.
7. Polish the teeth with prophylaxis paste.

A Newer Concept: Removal of Dental Fluorosis Strains

Teeth with various degrees of fluorosis which were extracted for prosthetic reasons were stored in a 10

percent formalin solution. Every tooth underwent the following procedure:

1. *Pumicing*: Cleaning the surface of the tooth with a nylon brush and a mixture of pumice and water.
2. *Enamel etching with 12 percent HCl (one part 36% HCl and 2 part distilled water)*: This solution is applied to the enamel surface for one minute and then washed off. A second acid application is needed for one minute, the so called double etching technique.
3. Copious rinsing to eliminate acid residues and thorough drying.
4. Application of alcohol 95 percent to dehydrate enamel surface.
5. Application of pure sodium hypochlorite for five minute during which, it can be repeated to the tooth surface. The removal of the staining molecules can be accelerated by scraping the highly discolored areas with sharp pointed probes.
6. *Thorough rinsing*: At this point, a spectacular stain removal is observed in most cases. If there are any remaining stain then stage 2 to 5 repeated once or twice.
7. Filling the microcavities produced by chemical action with a light cured adhesive.
Two types adhesive have been introduced are:-
 - a. Scotch bond and enamel and dentine adhesive by 3 M Co.
 - b. Enamel bonds an enamel adhesive by Bayer.To improve the esthetic of severe discolored tooth it is possible to use a variety of tints available in several composite resin kits such as esthetic design system by 3 M Co. A thin material layer can mask a dark area particularly on the cervical level. Esthetic is improved by mixture of some tints. Blue and gray tints are used for Incisal edge where as white and yellow ones match the general aspect of crown.
These masking and tints are easily bonded with dental adhesive, yet they posses weak mechanical qualities and have to be protected by second adhesive layer. These various layer applied successively may cause an over thickness. Hence, we must be very prudent mainly on the cervical level so as not to create any dental plaque trap.

Development of Dentition

PRENATAL EFFECT ON FACIAL DEVELOPMENT

The focus here is on the events in prenatal development that are particularly pertinent to future orthodontic problems.

Embryonic Development

Nearly all the tissues of the face and neck originate from ectoderm. This includes the muscular and skeletal element that elsewhere in the body are derived from mesoderm. Most of these tissues developed from neural crest cell that migrate downwards besides the neural tube and laterally under the surface ectoderm. Facial growth is dominated by regional growth centers as organ systems are formed and final differentiation of facial tissues occurs. There are five principal stages in craniofacial development (Table 10.1):

1. Germ layer formation and initial organization of craniofacial structure.

2. Formation of neural tube and initial oropharynx.
3. Origin, migration and interaction of cell population.
4. Formation of pharyngeal arches and primary and secondary palate.
5. Final differentiation of tissues.

Late Fetal Development

The human fetus weight about 1000 g at 3rd trimester of intrauterine life. They can survive at premature birth. Dental development which begins in the 3rd month proceeds rapidly thereafter. During last 3 months of IUL, continued rapid growth results in tripling of body weight to about 3000 g.

- At birth, the head is still nearly half the total body mass and represents the largest impediment to passes of the infant through the birth canal. Making the head longer and narrower obviously would facilitate birth, and this is accomplished by lateral distortion of its shape.

Table 10.1: Embryonic craniofacial development stages and related congenital defect that may create future orthodontic problem

Stages	Post fertilization time	Related syndrome
Principal stage 1	17 Day	Fetal alcohol syndrome
Principal stage 2	18-23 Day	Anencephaly
Principal stage 3	19-28 Day	1. Hemifacial microstomia 2. Mandibulofacial dysostosis 3. Limb abnormalities
Principal stage 4		
• Primary palate	28-38 Day	Cleft lip, palate
• Secondary palate	42-55 Day	Cleft palate
Principal stage 5	50 Day to birth	Achondroplasia
	Synostosis syndrome	

- This change in shape is possible because at birth, relatively large unclassified fontanelles are present between the flat bones of brain case. As the head compressed within the birth canal, the calvarium can increase in length and decrease in width, assuming the required tubular form and easing delivery of infant through birth canal. The lack of mandibular growth prenatally also makes birth easier.
 - After birth; for a short period, growth decreases and there may be a small decrease in weight during the 1st 7 to 10 days. Such an interruption in growth pattern produces a physical effect in both bony and dental tissues. This can be evident by developmental line in dental (neonatal line) tissues.
 - Permanent as well as primary teeth can be affected by illness during infancy and early childhood.
2. The gingival groove separates the gum pad from the palate and floor of the mouth by a transverse groove between the canine and first deciduous molar segment is known as lateral sulcus.
 3. The lateral sulcus in 70 percent of newborn of the mandibular arch is more distal to that of maxillary arch.
 4. The upper and lower gum pads are almost similar to each other except the maxillary gum pad is slightly wider and longer than the mandibular gum pad. Thus, when the upper and lower gum pads are approximated. There is a complete overjet all around.
 5. Contacts occur between the upper and lower gum pads in the posterior region and space exists between upper and lower arch in the anterior region.
 6. The infantile open bite is considered to be normal for certain period and it helps in sucking.
 7. First primary tooth erupts at 6-7 months after birth. Eruption of primary teeth is completed by 2½-3 years of age.

Gum Pad (Figs 10.1A to B)

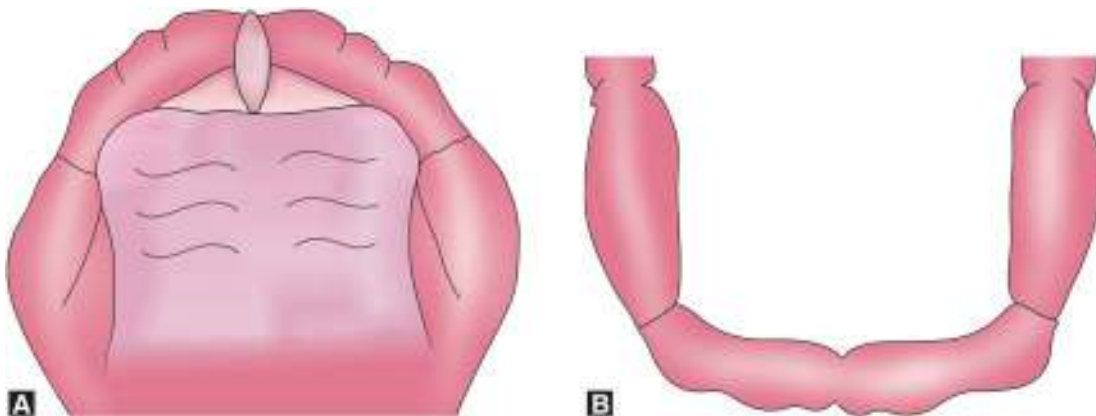
The alveolar process at the time of birth are known as gum pads. They are pink, firm and covered by dense layer of fibrous periosteum and gingiva.

They are horse-shoe shaped and developed in two parts:

- Labiobuccal position
 - Lingual position.
1. The two parts are separated from each other by a groove known as dental groove. Each gum pad is divided into ten segments by transverse grooves. Each of these segments consists of one developing primary tooth sac. The initiation of primary tooth buds occurs during the first 6 weeks of intrauterine life.

Eruption of the Primary Teeth (Table 10.2)

The 1st primary teeth usually erupt after 6 months of age. Occasionally a natal tooth may present at the time of birth. The timing and sequence of eruption of primary teeth are shown at above table. Spacing is normal throughout the anterior part of the primary dentition but it is significant in two locations, known as primate space (Fig. 10.3). In maxillary arch, the primate space is located between the lateral incisors and canine, where



Figs 10.1A and B: (A) Maxillary gum pad, (B) Mandibular gum pad

Table 10.2: Chronology of tooth development

Tooth	Beginning of calcification in utero		Crown completed		Root completed		Eruption schedule	
Primary	Max.*	Man.**	Max.	Man.	Max.	Man.	Max.	Man.
Central	14 wks	14 wks	1.5 months	2.5 months	1.5 yrs	1.5 yrs	10 months	8 months
Lateral	16 wks	16 wks	2.5 months	3.0 months	2 yrs	1.5 yrs	11 months	13 months
Canine	17 wks	17 wks	9 months	9 months	3.25 yrs	3.25 yrs	19 months	20 months
1st molar	15 wks	15 wks	6 months	5.5 months	2.5 yrs	2.25 yrs	16 months	16 months
2nd molar	19 wks	18 wks	11 months	10 months	3 yrs	3 yrs	29 months	27 months
Permanent								
Central	3 months	3 months	4.5 yrs	3.5 yrs	10.5 yrs	9.5 yrs	7.25 yrs	6.25 yrs
Lateral	11 months	3 months	5.5 yrs	4 yrs	11 yrs	10 yrs	8.25 yrs	7.5 yrs
Canine	04 months	4 months	6 yrs	5.75 yrs	13.5 yrs	12.7 yrs	11.5 yrs	10.5 yrs
1st premolar	20 months	22 months	7 yrs	6.75 yrs	13.5 yrs	13.5 yrs	10.25 yrs	10.5 yrs
2nd premolar	27 months	28 months	7.75 yrs	7.5 yrs	14.5 yrs	15 yrs	11 yrs	11.25 yrs
1st molar	32 wks	32 wks in utero	3.75 yrs	6.25 yrs	10.5 yrs	10.7 yrs	6.25 yrs	6 yrs
2nd molar	27 months	27 months	7.75 yrs	7.5 yrs	15.75 yrs	16 yrs	12.5 yrs	12 yrs
3rd molar	8 yrs	9 yrs	14 yrs	14 yrs	22 yrs	22 yrs	20 yrs	20 yrs

* Max. → Maxilla

** Man. → Mandible

as in the mandibular arch, the space is between the canines and 1st primary molars.

The primate spaces are normally present from the time, teeth emerges into the oral cavity.

- Developmental spaces (Fig. 10.2) between the incisors are often present from the beginning and it grows as alveolar processes expand. Spacing in primary dentition is essential to accommodate larger permanent incisors.

Eruption of Permanent Teeth

Eruption of permanent teeth can be divided into two stages:

- Pre-emergent eruption:** When the crown of the tooth is being form within the bone, during this period, there is very slow labial or buccal drift of the tooth follicle occurs. At this time, tooth follicle can be used as a natural marker in the X-ray studies of bone growth.
 - An eruptive movement begins soon after the roots begin to form. There are two processes required for pre-emergent eruption.
1. There must be resorption of bone and primary tooth roots overlaying the crown of the erupting tooth.
2. The eruption mechanism itself then must move the tooth in the direction where the path of eruption has been easy and cleared.



Fig. 10.2: Three and half-year-old child was showing developmental space in lower primary central incisors

- Post-emergent eruption:** Once a tooth pierced into the oral cavity, it erupts rapidly until it reaches the occlusal level and is subjected to the occlusal forces. At that point, its eruption slows and then it reaches the occlusal level of other teeth but eruption potential remains for lifetime.
 - The stage of relatively rapid eruption from the time a tooth 1st penetrates the oral cavity and reaches to the occlusal level is known as postemergent spurts.
 - Slower stage phase after postemergent stage, is known as juvenile occlusal equilibrium.
 - The total path of a 1st permanent molar is about 2.5 cm, of that distance, about half is traversed

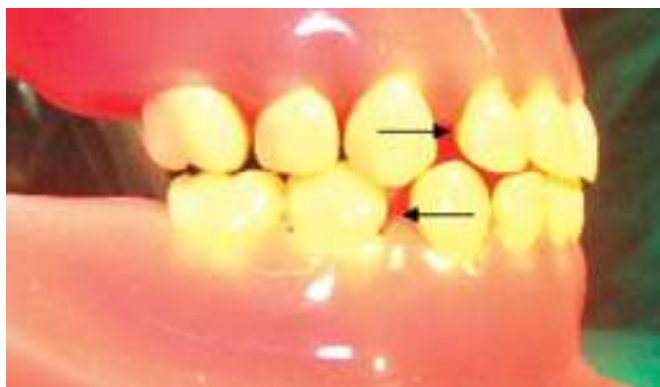


Fig. 10.3: Primary dentition shows primate space mesial to the maxillary canine in maxilla and distal to the canine in mandible

after the tooth reaches the occlusal level and is in function.

- Since, the rate of eruption parallel to the rate of maxilla and mandible growth so any disturbances in coordination between jaws growth and tooth eruption often contribute to development of orthodontic insufficiency. When the pubertal growth spurt completed, a final phase in tooth eruption is achieved and known as adult occlusal equilibrium.

Space Relationship in Replacement of the Deciduous Incisors

Spacing between the primary incisors is not only normal but it is critically important because there will not be enough space for the comparatively larger incisors when they erupt. Spacing in the primary region is normally distributed among all anterior, not only in the primate space. In maxillary arch primate space (Fig. 10.3) is mesial to the canine while in mandibular arch it is distal to the canine.

All spacing found in the primary dentition has been used by the eruption of central incisors only. With the eruption of lateral incisors, the space situation becomes tight in both arches. The maxillary arch has enough space to accommodate the permanent lateral incisors when they erupt due to labial positioning of related primary tooth. In mandibular arch, when lateral incisors erupt, there is on average 1.6 mm less space available for the four mandibular incisors than would be required to perfectly align them. This difference between the amount of space needed for the incisors and the amount available for them is known as incisor liability.

- At 8-9 years of age, when the mandibular incisors are slightly over crowded is a normal developmental stage. Continuous arch development and eruption of canine improves the spacing situations. The extra space comes from three sources.

1. A slightly increase in the width of the dental arch (2 mm on average).
2. Labial positioning of permanent incisors relative to the primary incisors (1-2 mm of space is provided).
3. Repositioning of the canine in the mandibular arch. It provides extra millimeter of space.

Note: It is important to note that all above three changes occurs without significant skeletal growth in the front of the jaws.

- As a general guideline, 2 mm or less maxillary diastemas will probably closed spontaneously, while total closure of diastemas initially more than 2 mm is unlikely.

Space Relationships in Replacement of Deciduous Canine and Molars (Fig. 10.4)

Permanent premolars are smaller than the deciduous teeth they replace. The mandibular arch is containing

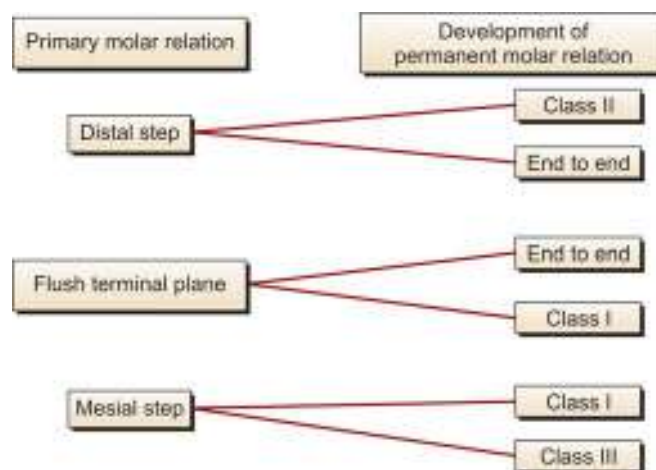


Fig. 10.4: Occlusal relationship of primary and permanent molar. The flush terminal plane relationship is the normal relationship in primary dentition. When the 1st permanent molars 1st erupt, their relationship is determined by that of the primary molars. The molar relationship tends to shift at the time the second primary molar are lost and adolescent growth spurt occurs. Development of permanent molar relationship also depends on the Leeway space availability and differential forward growth of the mandible

about 2.5 mm of available space on each side, known as leeway space, while in the maxillary arch it is about 1.5 mm on average.

A normal occlusal relationship of primary molar teeth is the flush terminal plane relationship. The distal step of occlusion is equivalent to Angle's Class II, and mesial step relationship corresponds to Angle's Class I. At the time of birth, mandible is relatively deficient than maxilla to facilitate birth. This deficiency can be overcome by differential growth of mandible in relative to the maxilla. It also contributes to the molar transition. This differential growth of jaws carries the mandible in slightly forward relative to the maxilla during the mixed dentition period.

1. *Flush terminal planes*: Both maxillary and mandibular planes are at same level.
2. *Mesial step relationship*: Mandibular terminal plane is more mesial to maxillary terminal plane.
3. *Distal step relationship*: Mandibular terminal plane is more distal to maxillary terminal plane.
 - 'Straight terminal plane of primary occlusion with primate space; an early shift of mandibular molar into the primate space allows proper 1st permanent molar occlusion'.

- Straight terminal plane without primate space; proper 1st permanent molar occlusion is not achieved until the mandibular second primary molar exfoliate, which then allows the required mesial shift of mandibular 1st permanent molar. This is known as late mesial shift.

Non Spaced Primary Dentition

Sometime primary anterior teeth have no space. This loss of space may be due to the narrowness of the dental arches or wider primary teeth than usual. This type of dentition usually indicates to crowding in the developing permanent dentition but it is not always the case.

BIBLIOGRAPHY

1. Lundeen, et al. Advances in occlusion. Boston, J Wright-PSG, 1982.
2. Moorrees, et al. Available space for the incisors during dental development. A growth study based on physiologic age. Angle Ortho 1965;35:12-22.
3. Steedle, et al. The pattern and control of eruptive tooth movements. Am J Orthod 1985;87:56-7.

Growth and Development of Nasomaxillary Complex and Mandible

Term growth usually refers to an increase in size or number. It is largely an anatomic phenomenon, whereas development denotes physiologic and behavioral complexity.

Theories of Growth Control

Three theories in recent year has been attempted to explain the determinants of craniofacial growth.

1. Bone is the primary determinant of its own growth.
2. Cartilage is the primary determinant of skeletal growth, while bone responses secondarily and passively.
3. The soft tissues matrix in which the skeletal tissues are embedded is the primary determinant of growth, and both bone and cartilage are secondary followers.
 1. *Level of growth control*: Site Vs center of growth theory (discarded theory)
 2. *Cartilage as a determinant of craniofacial growth*: Mandibular condyle can be compared with diaphysis of long bone, bent into horse shoe with epiphyses removed. If this were the true situation, then indeed the cartilage at the mandibular condyle should acts as a growth center, representing epiphyseal growth cartilage.

Growth of maxilla; Since there is no cartilage in the maxilla itself, but there is cartilage in the nasal septum, and nasomaxillary complex grows as a unit. Cartilage theory hypothesizes that cartilaginous nasal septum serve as a key point for other aspect of maxillary growth. If sutures of the maxilla acts as growth center, as they seems to do, then they would response to this translation

by forming new bone when the sutures were pulled apart by forces from the growing nasomaxillary cartilage.

3. *Functional matrix theory of growth*: This is most accepted theory of growth control. Neither bone nor cartilage was the determinant of growth of craniofacial skeleton but it would appear that the control would have to lie in the surrounding soft tissues. This view was given by Moss in 1960s. He theorizes that growth of the face occurs as a response to functional needs and is mediated by the surrounding soft tissues in which the jaws are embedded. In other words, it can be summarized that soft tissues grow, and embedded bone and cartilage react. Moss theorizes that main determinant of growth of maxilla and mandible is the enlargement of nasal and oral cavities, which grow in response to functional requirement. But this theory fails to explain how functional requirement are transmitted to the tissues around the mouth and nose. This theory predict that the cartilage of the nasal septum and mandibular condyle are not important determinant of growth, since loss of septum and condylar cartilage would have little effect on growth, if proper function could be obtained.

Growth of Maxilla (Figs 11.1 and 11.2)

The maxilla develops entirely by intramembranous ossification. Maxilla grows by two ways:

1. By apposition of bone at the suture that are directly attached to the cranium and cranial base.
2. By surface remodeling.

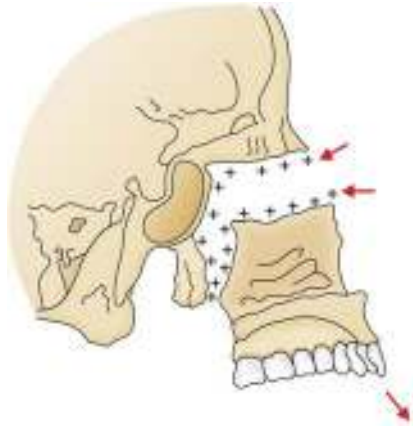


Fig. 11.1: Growth of soft tissue around the maxilla, translates the maxilla in downward and forward direction leading to opening of space at its superior and posterior suture attachments. New bone is added on both sides of the suture

The sutures directly attaching the maxilla posteriorly and superiorly are responsible for the downward and forward movement of maxilla. As the downward and forward movement of maxilla occurs, a space is developed by opening of the sutures. This space is filled by proliferation of bone at this site. The sutures remain the same width and various process of maxilla become longer. Some part of the posterior surface of the maxilla having free surface in the tuberosity region. Bone is added at this surface providing additional space into which the deciduous and permanent maxillary molar would successively erupt.

Passive displacement of maxilla is important growth mechanism during the deciduous dentition period but become less important as synchondrosis of the cranial base, slows with the completion of neural growth at 7 years of age.

- The overall growth changes in the maxilla are the result of both a downward and forward translation and simultaneously surface remodeling.
- Almost all anterior surface of maxilla is an area of resorption during downward and forward movement of maxilla.
- At 7 to 15 years of age, about one-third of the total forward movement of maxilla can be accounted for on the basis of passive displacement. The rest is the result of growth at maxillary sutures in response to enveloping soft tissues.

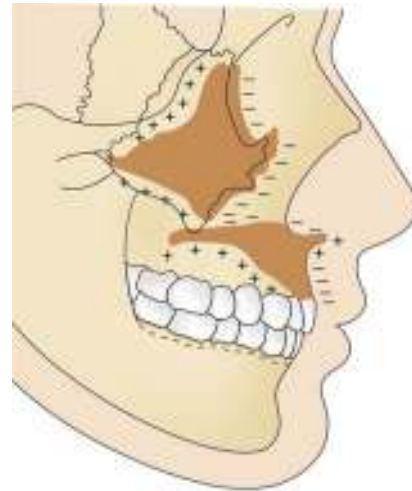


Fig. 11.2: As the maxilla is translated downward and forward, the bone is added at the sutures and in the tuberosity area posteriorly, at the same time, the surface remodeling remove bone from the anterior surface of the maxilla. This results the amount of forward movement of anterior surface of maxilla is less than the amount of the displacement. The bone is added on the roof of the mouth and bone is resorbed on the floor of the nasal cavity

- As maxillary displacement occurs, the primary and permanent tooth bud are also moved downward and forward.
- Nasal growth is produced by in part by increase in size of the cartilaginous nasal septum, play a definite role in the growth of the maxilla, (Functional matrix theory of maxillary growth).

Rotation of Maxilla

In normal growth, maxilla usually rotates a few degrees forward and frequently rotates slightly backward. The eruption path of teeth in rotating maxilla is downward and somewhat forward.

Mandible (Fig. 11.3)

Endochondral and periosteal both activity are needed for the growth of mandible. Cartilage covers the condyle at the TMJ. Since, this cartilage is not like the cartilage at epiphyseal region and endochondral replacement do occurs there. All other site of mandible is formed and grows by direct surface apposition and remodeling.

- The vital staining data showed that principal sites of growth of mandible are the posterior surface of

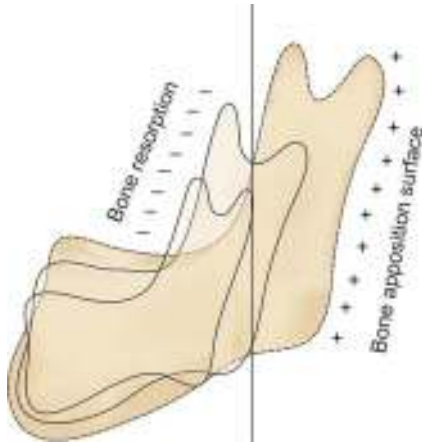


Fig. 11.3: Endochondral bone formation takes place on the condylar region as a major mechanism for growth of mandible. In mandibular growth, ramus is extensively remodeled. Anterior surface of ramus shows resorption and posterior surface bone deposition

ramus, condylar and coronoid processes. There are little changes along the anterior part of the mandible.

- The chin area is almost inactive. It is translated downward and forward as the growth occurs at the condylar and along the posterior surface of the ramus.
- The body of the mandible grows longer by periosteal apposition of bone on its posterior surface and ramus grows in height by endochondral replacement at the condylar region with surface remodeling.
- Mandible is translated downward and forward, while at the same time increasing in size by growing upward and backward.

- The mandible grows longer by apposition of new bone on the posterior surface of the ramus. At the same time bone is also removed from anterior surface of the ramus.
- Mandibular growth is continuous and relatively at steady rate before puberty.

Part of mandible	Growth rate/year
1. Ramus height	1-2 mm
2. Body length	2-3 mm

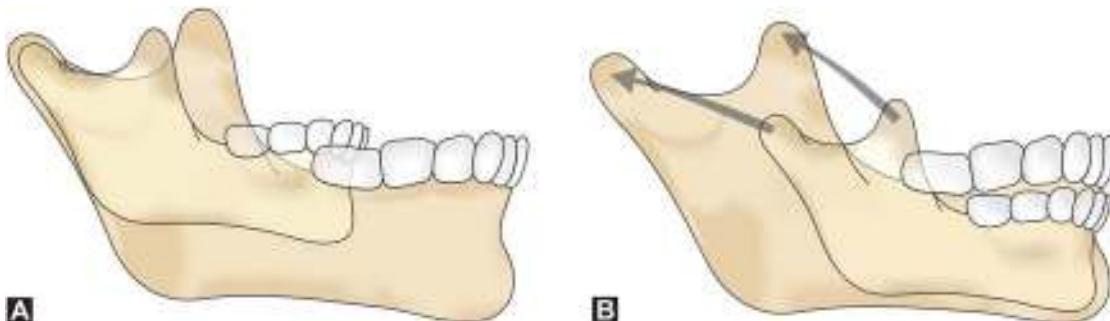
Timing of Growth in Width, Length and Height

There is definite sequence of growth pattern in maxilla and mandible both. Growth in width completed then growth in length and finally in height.

- Growth in width of both the dental arches tends to be completed before the adolescent growth spurt.
- Inter canine width does not increase much after 12 years of age.
- Growth in length of the both jaws continue through the period of puberty (2-3 years after first menstruation of female, up to 18 years of male).
- Growth in vertical height of the jaws and face continue longer in both gender than growth in length (17 to 18 years in female and early twenties in male).

Jaws Rotation During Growth (Figs 11.4A and B)

The over all change in the orientation of each jaws can be observed by the palatal plane and mandibular plane resulting from a combination of internal and external rotation.



Figs 11.4A and B: (A) Growth of the mandible, as viewed from the perspective of a stable cranial base: the chin moves downward and forward; (B) Mandibular growth, as viewed from the perspective of vital staining studies, which reveal minimal changes in the body and chin area, while there is exceptional growth and remodeling of the ramus, moving it posteriorly. The correct concept of mandibular growth is that the mandible is translated downward and forward and grows upward and backward in response to this translation, maintaining its contact with the cranium

Mandibular Rotation

It is easier to observe internal and external rotation in the mandible. The mandible is divided into core and several functional processes. The core of the mandible is the bone that surrounds the inferior alveolar nerve. The functional processes are alveolar process, muscular process (mandibular bone to which muscles of mastication attached), and condylar process. If implants are placed in area of stable bone away from functional process, it can be observed that the core of the mandible rotates during growth in a way that would tend to decrease the mandibular plane angle. Total rotation of

the mandible include 25 percent by matrix rotation (rotation around the condyle), and 75 percent by intramatrix rotation (rotation centered within the core of the body).

- There is about 15 degree of internal forward rotation and 11 to 12 degree of external backward rotation producing the 3 to 4 degree decrease in mandibular plane angle can be seen in individual during childhood and adolescent.
- The eruption path of mandibular teeth is upward and somewhat forward along with rotation of mandible.

Use of Preventive and Interceptive Orthodontics in Pediatric Dentistry

Term preventive orthodontics refers to the action taken to preserve the integrity of what appears to be normal occlusion at a specific period. Interceptive orthodontic, may be defined as that phase of science and art of orthodontics employed to recognize and remove potential irregularities and malpositions of tooth in the developing dentofacial complex.

Concepts of Preventive Orthodontics

The concepts of prevention/or early interception is based on a belief that some, if not many, minor dental developmental problems in the younger age groups become major orthodontic needs as age advances. The concept includes a belief that early treatment will often be all that is required, that early treatment may reduce the severity of a malocclusion that will not be fully treated later or that early treatment may reduce the severity of a malocclusion that will be fully treated later reducing the time and possibly the treatment cost. The concepts of preventive orthodontics also includes the belief that such early examinations of child patient development of longitudinal records, and early interventions in many cases by general dentist or specialist will provide an experience and clinical data base from which society and our profession will benefit.

The development of malocclusion depends on the growth factors like, genetic size and shape differences, and dental patterns resulting from heredity, congenital occurrences, and the extraoral and intraoral environment, it should be apparent that some aspects could have been prevented, could have been reduced in severity or fully corrected much earlier. The fully developed malocclusion can be seen in those cases

where unattended premature loss of tooth in young children, unattended oral habits pattern, unattended ectopic eruption or unattended occlusal disharmonies etc. It is an established fact that early preventive treatment to many problem in dental development of children can be helpful in reducing the severity of malocclusions.

Use of Preventive Orthodontics

The successful use of preventive orthodontics depends upon the following steps:

1. Preparation
2. Having knowledge of possibilities and limitations
3. Avoiding drawback.

Preparation: Preparation involves a working knowledge of at least five basic subjects. These are as follows:

1. Growth and development
2. Etiology
3. Records and examinations
4. Classifications
5. Specific preventive measures.

Growth and Development

Pedodontist must have the knowledge of growth and development at a specific age. The knowledge of growth and development implies the discretionary awareness of the expectation of normal occlusion at a specific age. For example, majority of primary molars are ends in a straight terminal plane (Fig. 12.1).

At the age of 8 to 9 years, the ugly duckling stage with diastemas between the incisors are the self correcting anomalies (Fig. 12.2).



Fig. 12.1: Straight terminal plane or end on position of primary molar 37 percent, mesial step terminal plane 49 percent, and distal terminal plane 14 percent respectively

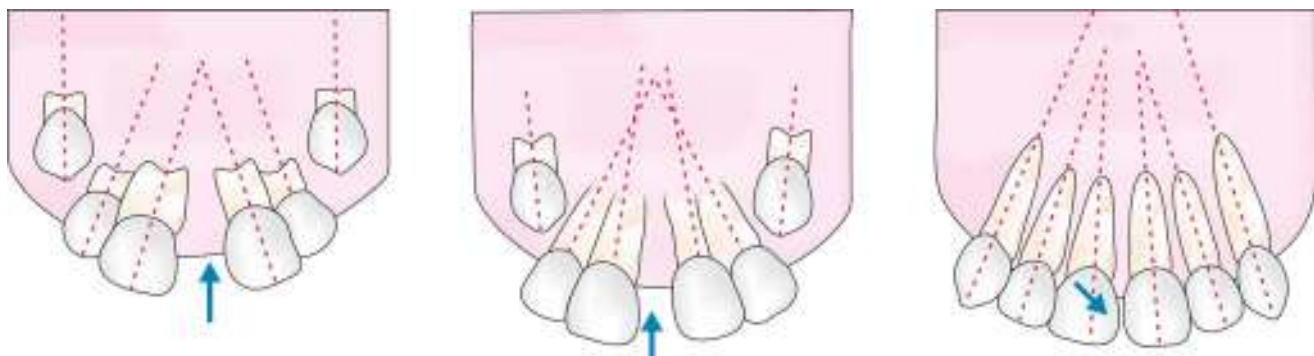


Fig. 12.2: Ugly duckling stage of occlusal development (see the development of root and position of canine. Arrow shows diastemas and closure of diastemas)

As the age advances, the diastemas may require an extensive orthodontic treatment. Diastemas are not normal for adult age. The age of the patient and stage of development should preclude the expectation that such a space would close with time. This example represents a small sample of the importance of understanding the implications of growth and development of the dentofacial complex.

Etiology

The etiology of malocclusion is broadly classified into prenatal and post natal. The prenatal causes of malocclusion may be congenital or hereditary. The congenital malocclusions are present at birth. Hereditary condition may be recognized at birth or may not be seen until sometime later in life. Malocclusions seen 1st time in a family are considered as congenital. If this characteristics passes to the succeeding generations, it might be considered as hereditary. The post natal causes of malocclusions are as follows:

1. Premature loss of primary teeth
2. Loss of premature teeth (cystic degeneration of tooth crypts)
3. Ankylosis of primary teeth/ or prolong retention of primary teeth
4. Disharmony of tooth material and bone size
5. Sequence of tooth eruption
6. Faulty fillings and crowns
7. Habits: mouthbreathing, finger sucking, lip and cheek biting, tongue thrust, etc.
8. Trauma (Ellis class 1 #, 2#, class 5 and 7# of tooth)
9. Abnormal labial frenum
10. Enlarged tonsils (causes of open bite, and mouth breathing)
11. Congenitally missing teeth
12. Genetically or abnormal functioning of endocrine glands
13. Mental attitude
14. Idiopathic causes.

Case History, Examinations and Records

Case history of the patient should be recorded, before starting oral examinations. It may reveals clue regarding familial or congenital pattern of the diseases.

Oral Examination

1. Conduct a closed mouth examination for profile of the face, position of the teeth, lips, cheeks overbite, overjet, molar and cuspid relationship. The Pedodontist should check the path of mandibular

closure for the possible midline shift either in the wide open position or in the rest position.

2. Count the teeth; examine the radiographs for missing teeth, supernumerary teeth.
3. Examine the oral functions such as swallowing pattern, tongue thrusting or mouth breathing and pronunciations of certain words and records position of each tooth in the dental arch and occlusion.

Study Model

Study models are positive replicas of the dentition. It is one of the most informative records of the arrangement of the teeth and of the occlusion available to the Pedodontist or dentist. Each study models must be finished nicely and labeled. This study model reflects an ethical means of letting the patient or people know that you can take pride in the work you have finished.

Photograph

Pedodontist must ask the patient, if possible, to bring the facial photograph of various age groups, beginning from childhood to adulthood. These photographs help us in observing and predicting facial changes during growth.

Radiograph

Facial radiograph reveals many diseases of hard tissues like teeth and bone. Bitewings, IOPA, OPG X-ray are usually used by the dentist.

Classification

Pedodontist must have thorough knowledge of angles classification and its proper application to avoid a chaotic stage in the preventive therapy. The best chances of success in preventive orthodontics are limited to angles class 1 malocclusion. It does not mean that preventive measures can not be used in an early or developing class-2 and class-3 malocclusion, however, it is the responsibility of Pedodontist to let the parent know ahead of time that definitive orthodontic treatment will be needed in near future.

Headgear and chin caps are not preventive appliances. They are orthopedic appliances and can be used by Pedodontist or orthodontist only. Pedodontist also knows the Deway Anderson modification of angles class 1 and its type.

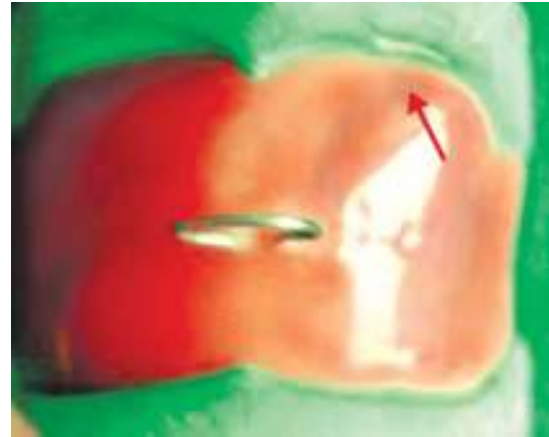


Fig. 12.3: Oral screen (see the margins of oral screen that should be smooth and extend up to mucobuccal fold)

Class I, Type I Malocclusion

This type of malocclusion is characterized by anterior teeth crowding towards the front. Etiology is usually hereditary in nature. Most of the cases are not amenable to the preventive measures. Very mild cases of Class 1, Type 1 can be treated by slight to moderate slicing of the primary teeth adjacent to the erupting and crowded permanent teeth (Fig. 12.4).

Class I, Type II Malocclusion

This type of case may be treated by preventive orthodontic measures. The Class 1, type II has a correct jaw relation, if the molars are in their correct positions. Maxillary incisors are protruded and spaced. Digit sucking is often the cause, either sucking habit operating now or sometime in the past. Open bite may also be seen and tongue may have taken the place of the digit. Various removable appliances may be used to correct it for example oral screen (Fig. 12.3).

A fixed or semi fixed lingual arch with prongs is a good way to remind the child if they truly want to stop finger sucking habit. Parent must advise to apply the unharmed bitter tasty things over the digit of the child to prevent digit sucking.

Class 1, Type III Malocclusion

The anterior cross bite in a Class 1 malocclusion is easy to treat. The successful preventive treatment of Class 1, type III malocclusion is done when following conditions are met.



Fig. 12.4: Diskling of mesial surface of primary cuspid to alleviate slight crowding of permanent incisors. Diskling mesial surface of second primary molar to allow space for permanent canine to erupt (line shows plane of diskling)



Fig. 12.5: Anterior crossbite (Preoperative)

1. Usually one or not more than two upper anterior teeth should be involved in the occlusal position.
2. The early contact position should find the mandible slightly posterior to the fully closed position. The incisors meet edge to edge at initial contact.
3. Carefully evaluate that part of history which suggests that other family member have anterior cross bites. We may be dealing with a beginning true Class III malocclusion.
4. There must be interdental space for the tooth to move. Almost all simple method involves some trauma. Do not inflict the added burden of trying to make the tooth itself into the position.
5. The correction of any cross bite will leads to an open bite, therefore deep bite is preferred for self retention.

Methods of Crossbite Correction

1. The crossbite correct itself by diskling the labial surfaces of the lower canines and lingual surfaces of upper canine sometimes can allow full closure without mesial or lateral translation of the lower jaws.
2. Tongue blade or wooden spatula may be used for correction of crossbite. The patient cooperation is needed to make this treatment successful.
3. An acrylic plate (upper or lower as needed) inclined at 45° angle to the occlusal plane engages the linguoincisor edge of the malposed incisor. Biting and swallowing process involves a forward vector which may correct the crossbite (Figs 12.5 to 12.7).



Fig. 12.6: Acrylic inclined plane to correct the anterior crossbite (Operative)



Fig. 12.7: Corrected anterior crossbite (Postoperative)

4. A metal inclined such as a long protective stainless steel crown can be reinforced with solder and cemented onto the tooth in crossbite.

5. Removable acrylic plate with Z spring can be used to correct the anterior cross bite. The Z spring is gradually adjusted to follow the tooth as it moves labially. An acrylic plate extension over the occlusal portion of the posterior teeth will disocclude the anterior teeth for movement.
6. By use of fixed appliances, such as lingual arch, labial arch or bands on upper and lower incisors with color coded cross bite elastic.

Class 1, Type IV Malocclusion

Class 1, type IV malocclusion represents the posterior cross bite involving single or more teeth in the arch. The midline may or may not be shifted. Study showed that more than 7 percent of children have a posterior crossbite. Posterior crossbite in primary dentition leads to posterior crossbite in mixed dentition. Crossbite, if corrected in the mixed dentition period leads to normal buccolingual relationship in the permanent dentition.

If a maxillary and mandibular molar both contribute to crossbite, color coded elastic usually may be used to treat it. A molar band with lingually placed hook seated onto the upper molar and another molar band with buccal hook seated onto the mandibular molar. Color coded cross elastic is placed onto the hooks. The teeth in crossbite are tipped into correct buccolingual relationship, and occlusal forces have tendency to upright them.

Posterior crossbite may be the faulty position of one molar only. In this case, fixed or removable appliances can be used to reinforce the anchorage in the opposite arch. The mandibular path of closure is important in Class 1, type IV malocclusion because patient may demonstrate a lateral shift. At initial occlusal contact however, the buccal cusp upper and lower arch are in an end-to-end relationship. Such cases are treated by bilateral expansion of upper arch with fixed or removable appliances.

Class 1, Type V Malocclusion

Class 1, Type V malocclusion showed posterior crowding. A typical Class 1, Type V case will showed the lower second premolar slanting lingually without sufficient space. There is a theory behind it that initially there was a space but early loss of primary posterior teeth has led

to drift. If early loss takes place in the mandible there is a tendency for the anterior teeth to drift distally and lingually. If early loss takes place in maxilla, there is a tendency for maxillary 1st permanent molar to drift mesially.

Space maintainers are used to maintain the space, created by the early loss of primary tooth. If there is a loss of space at this stage active appliance can be used to regain the space either by distal movement of a lower 1st premolar or mesial movement of an upper 1st molar.

Early loss of primary anterior teeth may leads to impaction, crowding, or ectopic eruption of permanent central incisors. The insertion of a space maintainer which allows for possible physiologic widening of the arch will prevent expensive and time consuming orthodontic treatment.

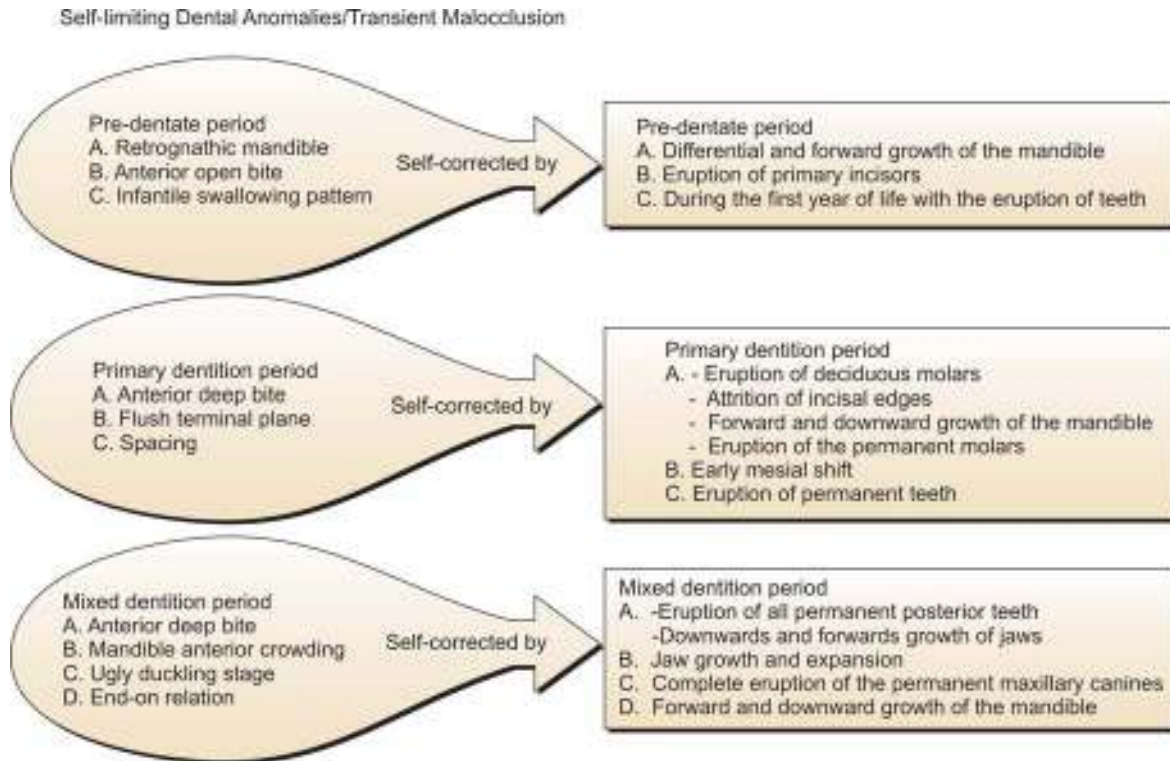
Clinical Preventive Procedure

The following are some of the procedure undertaken in preventive orthodontics which helps in correction or reducing the severity of malocclusion:

1. Predental procedure
2. Care of primary dentition
3. Preventive education program
4. Management of supernumerary teeth
5. Management of early loss of primary teeth
6. Management of retained primary/ ankylosed teeth
7. Maintenance of quadrant wise tooth shedding time table
8. Check up for oral habits and habit breaking appliances if necessary
9. Occlusal balancing in case of any occlusal prematurities
10. Use of space maintainers
11. Management of abnormal frenal attachment.

Note:

1. Diastemas closure by means of rubber band, wrapped directly around the teeth may leads to tipping of the central incisors. A safer way in the diastemas closure is to have a tract on which the teeth can control slide by means of a rubber band over a wire secured to bands.
2. Patients may lose their confidence during treatment. Often the preventive measures we use are not enough and complete treatment with full appliances



may be needed later. Since, patient had braces for two to three years both patient and parents are discouraged at the prospects of 2 more year of treatment in the hands of the specialist.

3. The orthodontist himself can not do as good a job without the cooperation of the patient.

SUMMARY

About 25 percent of malocclusion is preventable by space maintenance and other about 7 percent prevented by early correction of posterior cross bite. There are still anterior cross bite to correct and procumbent (and

spaced) incisors to retract. There is more class 1 malocclusion than any other.

BIBLIOGRAPHY

1. Anderson. Practical orthodontics, 9th ed. St Louis, CV Mosby Co. 1960 p.144.
2. Broadbent B. The face of normal child. Angle Orthodontics 1937;7:183-208.
3. Graber M. Orthodontics; principle, policies, 2nd ed. St Louis, 1969.
4. Kutin, et al. Posterior crossbite. American Journal of Orthodontics 58:191-501.
5. Owen D. The incidence and nature of space closer. American Journal of Orthodontics 1971;59:37.

Space Maintainers

INTRODUCTION

When occlusion develops from the primary dentition through the transitional (or mixed dentition) to the permanent dentition, a sequence of events occurs in an orderly and timely fashion. These events establish a functional esthetic and stable occlusion. When this orderly and timely sequence is disrupted, it may affect the ultimate occlusal status of permanent dentition. When such disruptions do occur, appropriate corrective measures are needed to restore the normal process of occlusion development. Such corrective procedures may require some type of passive space maintenance, active tooth guidance, or combination of both, depending on the existing problem.

Premature loss of primary teeth can cause drifting of the adjacent teeth into the space. It can result in abnormal axial inclination of teeth, spacing between teeth and shift in the dental midline. Premature loss of primary anterior leads to very little orthodontic changes. If the primary first molars are lost prematurely, lateral shift of anterior takes place. In case of premature loss of primary second molar, the permanent first molars migrate mesially, thereby leaving insufficient space for the erupting second premolar which can get impacted within the jaw or get deflected the path of eruption and erupt in an abnormal location. To prevent the above situation some kind of appliance is needed that maintain the space created by premature loss of primary tooth.

Definition

Space maintainer is a device used to maintain the space created by the premature loss of primary tooth.

Classification of space maintainer: Several author classified space maintainers as follows:

- A. Hitchcock
 1. Removable or fixed or semi-fixed
 2. with bands or without bands
 3. Functional or non-functional
 4. Active or passive
 5. Certain combinations of the above.
- B. Raymond C Thurow
 1. Removable
 2. Complete arch
 3. Lingual arch
 4. Individual tooth.
- C. Hinrichsen
 1. Fixed space maintainers.

Class I

- a. Non-functional types
 - i. Bar type
 - ii. Loop type.
- b. Functional type
 - i. Pontic type
 - ii. Lingual arch type.

Class II

1. Cantilever type (distal shoe, band and loop)
2. Removable space maintainers.

Example- Acrylic partial dentures.

D. Classification of space maintainer is also based upon available anchorage and support

1. *Semi fixed type space maintainer*
 - a. Crown–distal shoe space maintainer

- b. Crown- loop space maintainer
- c. Band and loop space maintainer.
- 2. *Fixed type space maintainer*
 - a. Lingual holding- arch space maintainer
 - b. Nance's holding arch.
- 3. *Removable type space maintainer*
 - a. Acrylic partial denture
 - b. Complete denture.

An Ideal Requirement of Space Maintainer

A space maintainer should fulfill the following requirements:

1. It should maintain the entire mesiodistal width created by a premature lost tooth.
2. It must restore the function as far as possible and prevent over eruption of opposing teeth.
3. It should be easy and simple in construction.
4. It should be strong enough to withstand the functional forces/occlusal forces.
5. It should not exert excessive stress on adjacent teeth.
6. It must permit maintenance of oral hygiene.
7. It must not restrict normal growth and development and natural adjustment, which take place during the transition from primary to permanent dentition.
8. The space maintainer should not come in the way of other functions.
9. It should be biocompatible.

Removable Space Maintainer

A removable space maintainer is like a partial denture. Not only mesiodistal space is maintained, but vertical space maintenance is also assured. In addition, masticatory function is also restored to some extent. In the anterior region, it improves esthetic considerable, and also prevents speech defect as is the development of poor oral habits due to loss of anterior teeth.

Indications

1. Removable space maintainer are indicated when esthetic is prime importance in anterior region.
2. Loss of more than two primary molars unilaterally.
3. Loss of more than one primary tooth bilaterally.
4. Loss of anterior teeth.
5. In case the abutment teeth cannot support a fixed appliance.
6. Patient with oral cleft is sometime requiring obturation of the palatal defect along with teeth.

7. If the radiograph of dentoalveolar region reveals that the unerupted permanent tooth is not going to erupt in less than 6th months time, a removable functional space maintainer may be indicated.
8. Multiple losses of primary teeth, which may require functional replacement in the form of either partial or complete dentures.

Contraindications of Removable Space Maintainer

1. Lack of patient cooperation.
2. In patients who are hypersensitive to acrylic materials.
3. Epileptic patients.

Commonly used removable space maintainers are:

Acrylic Partial Denture

Acrylic partial denture has been used successfully after the multiple loss of teeth in the mandible or the maxillary arch. This appliance, which is indicated when there has been bilateral loss of more than a single tooth, can be readily adjusted to allow for the eruption of teeth. A partial denture space maintainer of the contoured clasp type is acceptable from the standpoint of simplicity of fabrication, functional requirement and cost to the patient.

Technique and Fabrication

1. Impression is taken with alginate and makes a stone cast. Occlusal registration is done with the help of occlusal registration wax strip.
2. Drawing of the outline on the model cast is a sound principle in the construction of acrylic partial denture. Draw the outline on the patient cast with pencil, which is shorter at the buccal and labial sides and much wider on the lingual side. This design takes into consideration the lateral expansion of the jaws with growth, which involves the process of resorption on the internal surface and apposition on the external surface of the jaws. If there is a tooth present on the distal end of the appliance, the distolingual end of the appliance should be extended to the center portion of that tooth. So that second primary molars or 1st permanent molar will provide better stability and maintenance. The anterior lingual aspect of appliance, where it contacts the permanent incisors, should be designed such a way that it should have

space about 1 to 2 mm from the lingual surface of the anterior teeth, thus avoiding unnecessary movement of erupting teeth.

3. *Attachment of clasp and cribs:* It is usually unnecessary to attach clasps and cribs for stabilizing the appliance in cases where there are teeth present on the distal end of the edentulous saddle. A case where there is no tooth, exists on the distal end or where there is unilateral loss of the primary molars, it is better to enhance the stability of the appliance by bow design or simple clasps such as the adam's clasp on the molars.

Complete Denture

It is occasionally necessary to recommend the extraction of all the primary teeth of a preschool child. Although, this procedure is indicated only when all methods of primary tooth prevention have been failed. Preschool children can wear complete dentures successfully before the eruption of permanent teeth.

The fabrication of dentures will result in an improved esthetic appearance, restored function and may be effective to some degree in guiding the first permanent molars into their correct position. The technique, though similar to that of complete denture fabrication for adults, is somewhat less complicated. A non-pressure alginate impression technique is recommended for complete denture fabrication in children. Casts is poured and mounted after centric relationship has been obtained. Primary maxillary anterior teeth and posterior teeth are fabricated for partial or complete dentures. Lower anterior denture teeth may be prepared from a set of small acrylic permanent teeth. The posterior border of the denture should be carried to an area approximating the mesial surface of the unerupted first permanent molar. The denture will have to be adjusted by a portion of it cut away as the permanent incisors erupt, and the posterior border contoured to guide the first permanent molars in to correct position. When the permanent incisors and first permanent molars have erupted, a partial denture space maintainer or a lingual arch can be constructed to, serve until the remaining permanent teeth erupt.

Removable Distal Shoe Space Maintainer

An immediate acrylic partial denture with an acrylic distal shoe extension has been used successfully to guide the

first permanent molars into position when the primary second molar is lost shortly before the eruption of the first permanent molar. Impression is taken with the alginate and stone model are fabricated. After radiographic analysis, a depression is cut near the mesial surface of the erupting 1st permanent molar up to the level of mesial contact area. The acrylic extension has two bars vertical and horizontal. The end of the vertical bar should contact in the mesial contact area of the erupting tooth. The extension may be removed after eruption of permanent tooth.

Fixed Space Maintainer

Space maintainer which are fixed or fitted on to the tooth and cannot be removed by the patient himself are called fixed space maintainer.

Advantage of Fixed Space Maintainer

1. Bands and crowns are used which require minimum or no tooth preparation.
2. They do not interfere with passive eruption of abutment teeth.
3. Jaw growth is not hampered.
4. The succedaneous permanent teeth are free to erupt into the oral cavity.
5. They can be used in uncooperative patients.
6. Masticatory function is restored if pontics are placed.

Disadvantage of Fixed Space Maintainer

1. Elaborate instrumentation with expert skill is required in fabrication of fixed space maintainer.
2. There may be decalcification of tooth material under the bands so fluoride application and careful oral hygiene is needed.
3. Supra eruption of opposing teeth can take place if pontics are not used.
4. If pontics are used it can interfere with vertical eruption of the abutment tooth and may prevent eruption of replacing permanent teeth if the patient fails to report.

Crown and Loop Space Maintainer (Fig. 13.1)

Crown loop space maintainer consist of a loop made from a metal wire (0.9 mm) that is soldered to a primary metal crown to maintain the space which has been lost because of early loss of a primary molar tooth. The bow



Fig. 13.1: Design of crown and loop type of space maintainer

part of the loop lies below the contact area of the tooth adjacent to the space. The width of the loop should be sufficient to allow eruption of permanent tooth without any interference.

Indications

1. Premature loss of a first primary molar.
2. Premature loss of a second primary molar after the adjacent first permanent molar has erupted.
3. In cases where other types of space maintainers may not be suitable such as in cases of the premature bilateral loss of the primary molars.

Technique and Fabrication

1. Reduction of the abutment tooth and proper fit and adaptation of the stainless steel crown should be assured before impression. The alginate impression is taken with the crown in situ and stainless steel crown is subsequently removed from the abutment tooth and to be seated into the negative replica of the abutment and stabilize it with metal pin. Make stone cast along with stainless steel crown.
2. Adopt one or two adhesive seats on the edentulous part of the working model, so that the fabricated wire loop does not directly contact the soft tissues.
3. Draw the out line of loop on the working model. The buccolingual width of the loop should be wide enough to allow the eruption of succedaneus tooth. The contact point of the loop on the distal surface

of the primary canine should be just gingival to the contact area of the primary canine while the contact point on the 1st permanent molar should be as high on the mesial contact surface area as possible.

4. A stainless steel wire (0.9 mm diameter) is bent and adapted on the drawn line. The soldering spot to the stainless steel crown is at the corner angle. After soldering, finishing and polishing will be done in the usual manner.

At the next visit, the prepared crown loop is tried in the mouth to check the contact relationship between the loop and the adjoining tooth, as well as to the soft tissues. It is then cemented to the abutment primary molar with the help of GIC or phosphate cement.

Band and Loop Space Maintainer (Fig. 13.2)

The function of a band and loop is similar to that of the crown and loop, but anchorage to the abutment tooth is via the band. This is only indicated with cases in which the period of space maintenance is short and the abutment tooth is intact and in the posterior segment when a single tooth is lost. The tooth distal to the extraction space is banded and a loop of thick steel wire is soldered to it with its mesial end touching the tooth mesial to the extraction space. It is a unilateral fixed appliance. Fabrication procedures and method of placement are similar to those used for the crown and loop.

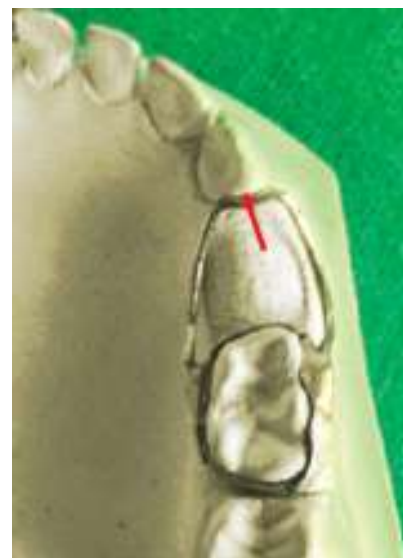


Fig. 13.2: Band and loop type of space maintainer. Arrow shows the rest position of the loop wire



Fig. 13.3: Lingual holding arch. Anterior part of wire should rest on the cingulum of lower anterior teeth

Lingual Holding Arch Space Maintainers (Fig. 13.3)

This appliance helps to maintain the dental arch circumference by fixing both ends of a lingual arch to the farthest distal tooth, such as the second primary molars or the first permanent molars.

Indications

1. Indicated when second primary molars or the first permanent molars are present bilaterally in lower arch.
2. In cases with eruption of the succedaneous tooth expected within a short time.
3. In cases with space management carried out by the "timed" extraction of the primary teeth.
4. In cases with poor cooperation and non compliance in the use of a removable space maintainer.

Technique and Fabrication

1. The molar bands are fabricated on the abutment tooth and the impression taken along with bands. The plaster of paris working model is made with the bands correctly placed in the impression.
2. The outline of the appliance should be drawn on the working model. The anterior part of the lingual arch is designed to contact the lingual surface of the anterior teeth in the lower dental arch. Sometimes, a spur can be attached to the distal surface of the mesial tooth, present in the mesial aspect of the edentulous space.
3. A wire of 0.9 mm in diameter should be bent with a loop and soldered to the molar bands.

Note: Two important considerations related to the use of lingual holding arches require emphasis.

1. The appliance, when used as a space maintainer, should be made completely passive to prevent undesirable movement of the abutment teeth.
2. The bands must be well adapted and cemented carefully. Abutment teeth must be polished, free of plaque, dried, fluoridated and maintained in this state during cementation. The manufacturer's directions must be followed during the mixing, and the cementation of bands to ensure a strong bond to the tooth structure.

NANCE HOLDING ARCH (MAXILLARY) (FIGS 13.4A AND B)

This is used in the maxillary dental arch in a manner similar to which the lingual holding arch space maintainer is used for the mandible. The anterior part of the



Figs 13.4A and B: (A) Nance palatal holding arch out side the mouth and (B) Nance holding arch seated inside the mouth



Fig. 13.5: Transpalatal arch fixed type of space maintainer; see the red line representing unilateral tooth loss

appliance should not be in contact with the Incisal edge of the lower teeth when occluded. Nance holding arch are design to prevent mesial migration of maxillary molars. It is also used for getting anchorage from the vault in fixed orthodontic treatment.

Fabrication

The anterior portion of the maxillary Nance holding arch passes through the vault of the anterior part of the palate. An acrylic button is placed on the anterior portion of this wire to prevent the wire from becoming buried in the palate; otherwise slight movements of the teeth may occur.

Placement

Same as for the lower lingual holding arch type space maintainer.

Transpalatal arch (Fig. 13.5): More recently, the Transpalatal arch has been recommended for stabilizing the maxillary first permanent molars when the primary molars require extraction. The Transpalatal arch consists of a thick stainless steel wire that spans the palate connecting the first permanent molar of one side with the other. The best indication for Transpalatal arch is when one side of the arch is intact, and several primary teeth on the other side are missing.

Distal Shoe Space Maintainer (fixed type, Fig. 13.6)

Distal Shoe appliance is also known as the intra-alveolar appliance. This appliance guides the eruptive path of

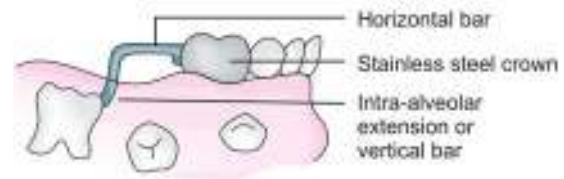


Fig. 13.6: Sketch diagram of distal shoe space maintainer

the first permanent molar to the normal position in cases where the second primary molar has been prematurely extracted or lost before the eruption of the first permanent molar. The appliance which is used in practice now is Roche's distal shoe or its modifications using crown and bands appliances with a distal intra-alveolar extension.

Indications and Contraindication

The premature loss of a second primary molar before the eruption of the first permanent molar provided that the first primary molar can be used as the abutment tooth. It is a contraindicated in blood dyscrasias or uncontrolled diabetes patient, immunocompromised patient or allergic to any component of appliance.

Technique and Fabrication

1. **Try in** the preformed stainless crown to the prepared abutment tooth (primary 1st molars). After taking the impression of this site with occlusal registration, a radiograph should also be taken. A working model will be made after the stainless steel crown is seated into the impression. The second primary molar is usually not extracted at this time.
2. **Measurement on the radiograph**
The outline of the distal-shoe is designed on the prepared cast model with the help of radiograph. The mesiodistal length of the horizontal portion of the distal shoe should be as long as the maximum width of the second primary molar and the vertical height should be about 1mm under the mesial contour of the unerupted first permanent molar.
3. **Fabrication of the distal shoe**
A prefabricated palatal bar of cobalt chromium alloy, size 3.8 mm in width and 1.3 mm in height, comprises the material to be use. The surface of the bar is bent into the shape as designed marked on the cast model, making sure that the vertical relationship of the horizontal portion of the distal shoe does not contact

the opposing tooth. The distal shoe is then soldered to the stainless steel crown and is polished and finished in the usual manner.

Placement

At the next visit, the second primary molar is extracted and the hemostasis is controlled by pressure. Then the crown distal shoe, which has already been disinfected, is tried in the mouth. A radiograph should be taken to confirm the right location of the distal shoe in relation to the developing first permanent molar. Finally, the shoe is cemented onto the first primary molar in the correct position.

Band and Bar Type Space Maintainer (Fig. 13.7)

This is a fixed space maintainer in which the abutment teeth on either side of the extraction space are banded and connected to each other by a bar. Alternatively stainless steel crowns can be used on the abutments. This type of space maintainer is called as crown and bar space maintainer or band and bar type space maintainer.

Esthetic Anterior Space Maintainer

It was described by Steffen, Miller and Johnson in 1971. Its method of construction is simple and also provide esthetic component. The Space Maintainer consists of a plastic tooth fixed on a lingual arch which in turn, is attached to Molar Band.

Gerber Space Maintainer (Fig. 13.8)

This type of appliance may be fabricated directly in the mouth during one relatively short appointment and requires no laboratory work. A seamless orthodontic band or crown is selected for the abutment tooth and fitted, and the mesial surface of the band or crown is marked for placement of U" tube, which may be welded or soldered in place with silver solder and fluoride flux.

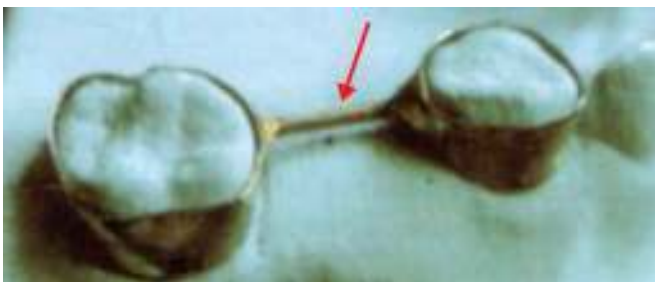


Fig. 13.7: Band and bar type SM, arrow shows horizontal bar and metallic band surrounds the teeth



Fig. 13.8: Gerber space regainer in active form and it acts as maintainer in passive form

The wire "U" section is fitted within the tube, the appliance placed and wire section extended to contact the tooth mesial to the edentulous area. A marking file or pencil is used to establish proper position on the wire. The device is removed and welded or soldered at this point. Occlusal rest may be added to wire section or U wire to reduce cantilever effect.

Mayne Space Maintainer (Fig. 13.9)

This is a nonfunctional type of space maintainer that permits minor adjustments for space control, while the tooth is partially erupted. Using either an orthodontic band or a full metal crown for the 1st permanent molar, a 0.036 inch mesially extending cantilever arm initially engages the 1st primary molar. When it is lost, it can



Fig. 13.9: Design of Mayne space maintainer. See the half loop unilateral bar (Arrow)

be bent to contact the erupting 1st premolar and to guide it mesially to create adequate space. Minor adjustments may be made on the erupting second premolar, moving it lingually or distally.

Advantage

Design does not interfere with eruption of permanent successor.

Disadvantage

Retainer is nonfunctional, but this is of no concerns if occlusion prevents over eruption of opposing tooth.

BIBLIOGRAPHY

1. Drinkard C, Oldenburg TR. Appliance for Guiding 1st Permanent Molar eruption. In Mc Donald Re and others: Current Therapy in Dentistry Vol. 7, St. Louis, Mosby.
2. Finn. Preventive Orthodontics, Clinical Pedodontics, WB Saunder's Company, 4th Edition 342, 345 to 358.
3. Graber, Space Retaining Appliance, Orthodontic Principle and Practice, WB Saunder's Company. 3rd Edition 650 to 652.
4. Mc Donald. Managing Space Problem, Dentistry for the Child and Adolescent Mosby, Sixth Edition 707 to 743.
5. Nakata Minoru. Treatment Plan in Occlusion Guidance, Occlusion Guidance in Paediatric Dentistry Euro, America, Inc., 1988;38-50.

Pediatric Oral Habits

A habit can be defined as the tendency towards an act that has become a repeated performance, relatively fixed, consistent and easy to perform by an individual. It is well proved that sucking habit begins at intrauterine life. At birth the neonate's survival depends on instinctive sucking when the lips and tongue are stimulated. Soon after birth, the mouth is used as the primary device for exploring the environment. For example, when an object is placed in a child's hands or within his/her reach, the 1st thing it does is, put the objects into it's mouth, to explore this new environment. When Pedodontist deals with a deleterious oral habit, one should consider the following questions:

1. Find out the cause of oral habit
2. Can the habit be considered normal for a specific age or stage of development?
3. What are the psychological causes of allowing the child to continue the habit?
4. Is the habit harmful or potentially harmful to the mouth or related oral organs?
5. If the habit harmful, will it damage the mouth and disappear or persist when the habit is discontinued.
6. What techniques are appropriate in discouraging the habit?

Classification of oral habit: Oral habits, usually seen in the children are:

1. Digit sucking
2. Mouth breathing
3. Tongue thrusting habit
4. Finger nail biting
5. Lip habit
6. Bruxism
7. Self destructive oral habits.

DIGIT SUCKING

Digit or finger sucking habit of a child receives attention from the parents and family during practices. It is therefore, most important for the Pedodontist who cares for children to understand this habit well, to be able to help the guardians and child related rationally to it and to manage the child's dental conditions.

Studies showed that 13 to 15 percent of children have digit sucking habit. All children who eventually take up the habit do so during the 1st year of life and in most cases few months. The majority of these children have it in infancy. The habit discontinues spontaneously by reaching the age of 3½ to 4 years. There is equal distribution of digit sucker between males and females.

Sucking phenomenon is essential in infants, because it fulfills both the psychologic and nutritional needs. During feeding infants not only seek nutritional satisfaction but also experience pleasurable stimuli from the lips, tongue and oral mucosa and learn to associate these with other joy able feelings. Therefore, digit sucking for food and for psychologic satisfaction should be considered normal in infancy. Children suck their digit under various condition like - when child is falling asleep, during sleep, during stressful condition and when child is hungry etc.

Etiology

Etiology of digit sucking has been explained by two theories.

Psychoanalytic Theory

This theory suggests that habit is associated with pleasurable stimuli early in life (intrauterine life) but it

is not discarded at the usual time due to some underlying psychologic disturbance.

Behavioral Theory

This theory suggests that digit sucking is merely a learned pattern of behavior with no underlying cause and no more emotional or psychologic problems that are found among non digit suckers. When the habit is eliminated, the child is expected to experience no more emotional or psychologic problem or to substitute another more objectionable habit. Pedodontist should recognize the individual variations and their sucking habits. Pedodontist will be able to determine the degree of emotional involvement with the habit and the time when this psychologic factor is no longer an important factor for this habit.

When thumb is sucked, it usually rests at rugae area of hard palate. The index finger may be touching over the bridge of the nose. Thumb sucker placed his thumb at different area of the palate during sucking and demonstrate a variety of patterns and style to the habit. The severity of the malocclusion related with the digit sucking depends on the intensity, frequency and duration of the habit.

Clinical Feature of Digit Sucking

A. Dentoalveolar effects

1. Labial flaring of maxillary anterior teeth with lingual collapse of mandibular incisors.
2. Increased over jet and decreased over bite.
3. Anterior open bite.
4. Posterior bilateral cross bite may be seen.
5. High palatal vault.
6. Hypotonic upper lip and hyper active lower lip.
7. Compensatory tongue thrusting.

B. Effect on digit: Digit used in sucking showed distorted figure and callus formation on ventral surface of the digit.

Preventive measure of digit sucking habit:

1. Proper feeding of the child.
2. Apply non palatable substance to the digit or
3. Apply bandage to the digit or
4. Put thumb guard to check the digit sucking.
5. Use psychologically designed nursing nipple.
6. Use proper designed pacifier to enhance normal functions and deglutition pattern.

7. Explain the child with the help of audiovisual system, i.e. that he/she will develop dentoalveolar problem if habit is continued.
8. Parent ask the child to sit in front of mirror with thumb placed inside the mouth and explained the esthetic problem.

CORRECTIVE APPLIANCES

- a. Removable appliances
 - I. Reminder appliances- acrylic plate with tongue guard
 - II. Use of oral screen plate.
- b. Fixed appliance with cribs, palatal bar or rakes.

At the end of three successful weeks without digit sucking, the habit will usually be broken and the child is rewarded with a favorite new toy or special tour as they wish.

Mouth Breathing

Mouth breathing can occur only with failure of nasal function. An important function of the nose is to prepare and modified inspired air to a more physiologic condition before it enters the lungs. Inhaled air is cleaned by the nasal hair and nasal mucosa. This air is also warmed and moistened in the nose before it enters the lungs, while in a mouth breather unclean air directly enters the lungs.

Causes of Mouth Breathing

1. Partial nasal obstruction
 - a. Deviated nasal septum.
 - b. Narrow nasal passage (due to narrow maxilla).
 - c. Nasal turbinate become engorged and swollen, obstructing nasal air flow (allergic hypersensitivity of nasal mucosa).
 - d. Nasal polyp
 - e. Habit persists during presence of etiology or habit may persists after removal of etiology.
2. Systemic cause
 - a. Children with heart disease may require additional air oxygen during exercise or running.
 - b. *Adenoid facies*: Adenoid facies is a term used to describe a special type of facial configuration frequently associated with mouth breathing habit. This condition is characterized by long, narrow face with accompanying narrow nose and nasal

passage, flaccid lips with the upper lip being short with dolico-facial skeleton pattern. The nose is tipped superiorly in front so clinician can see directly into the nostrils. The long, narrow face is somewhat expressionless.

Clinical Feature

- A. Oral soft tissue imbalance
 1. Mouth breather holds the tongue low and forward to keep the oral airway open (open mouth during sleep).
 2. Cheek exerts a pressure against the buccal surface of the maxillary posterior teeth that is not balanced by the pressure of the tongue in the palatal area.
 3. The lack of tonicity in the lips and the possibility of short upper lip decreases labial support to the maxillary anterior teeth.
- B. Dentoalveolar imbalance
 1. Narrow maxillary arch
 2. Labial flaring of the maxillary incisors
 3. Open bite
 4. Mouth breathing may develop into a Class II molar relationship
 5. Dry mouth: dryness of mouth may cause mouth breathing gingivitis and high dental caries risk.

Treatment (Fig. 14.1)

1. Elimination of underlying pathological condition.
2. Appliance therapy-oral screen
3. Tapping of lips.

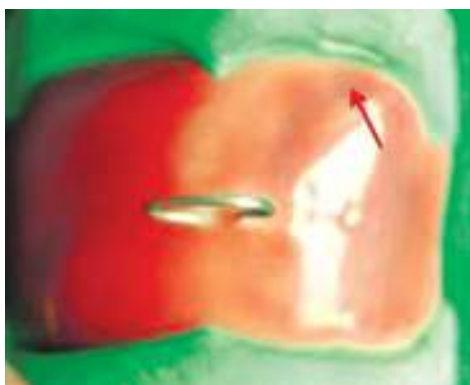


Fig. 14.1: Simple design of oral screen on model cast

Tongue Thrust Habit

It is a deleterious oral habit in which tongue makes contact with any anterior teeth or premolars during swallowing. This habit is clinically characterized by anterior open bite and anterior teeth proclination.

Classification of Tongue Thrust

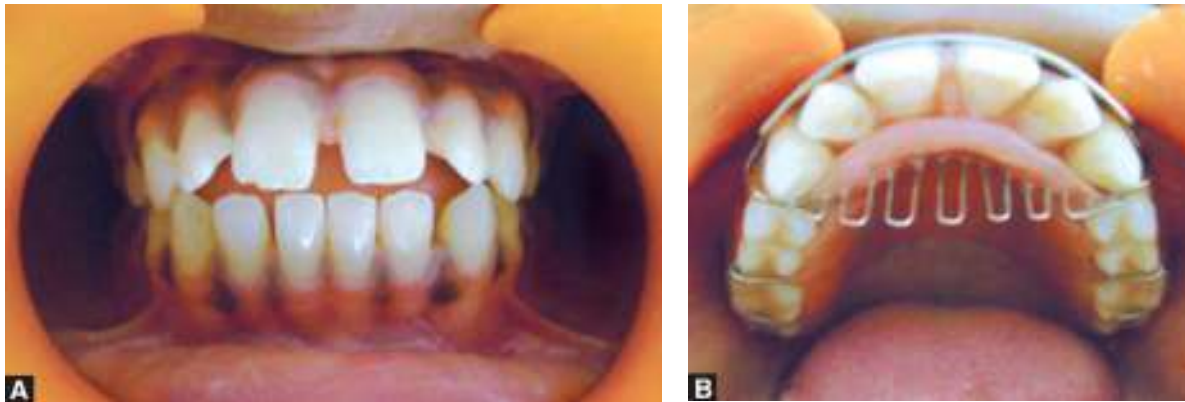
1. Braner and Holt Classification
 - Type I: Non deformity tongue thrust
 - Type II: Deformity tongue thrust.
 - Subgroup I: Anterior open bite
 - Subgroup II: Procumbency of incisors
 - Subgroup III: Associated with posterior crossbite.
 - Type III: Lateral tongue thrust deformity
 - Subgroup I: Posterior open bite
 - Subgroup II: Posterior crossbite
 - Subgroup III: Deep overbite.
 - Type IV: Anterior and lateral tongue thrust deformity
 - Subgroup I: Anterior and posterior open bite
 - Subgroup II: Associated procumbency of anterior teeth.
 - Subgroup III: Associated posterior cross bite.
2. Moyer's classification:
 - a. Normal infantile swallow
 - b. Normal mature swallow
 - c. Retained infantile swallow
 - d. Simple tongue thrust swallow
 - e. Complex tongue thrust swallow.

Note: A careful differential diagnosis must be made among the following thrust.

1. Simple tongue thrust
2. Complex tongue thrust
3. Fatty posture of tongue
4. Retention of infantile swallowing patterns.

Simple tongue thrust (Figs 14.2A and B): It is defined as tongue thrust with teeth together, when child swallows. It is characterized by open bite in the anterior region with no cuspal interference in posterior segment of teeth and presence of perfect occlusion in posterior segment. Intercuspalation is firm but anteroposterior relationship is not necessarily correct.

The simple tongue thrust is associated with abnormal functioning of circumoral facial muscles. As the patient swallows anterior lip seal is made partly with the teeth and partly with lips. The teeth are in contact prior to and through out swallowing. The prognosis of simple tongue thrust is excellent.



Figs 14.2A and B: (A) A case of tongue thrust habit, see the flaring of incisors because, tongue makes contact with any anterior teeth or premolars during swallowing and pressurized them, (B) Howley's appliance with cribs seated inside the tongue thrust patient, which repositions the tongue posture on their normal position and helps in habit breaking

Treatment

Pedodontist must observe the exact position of tongue by pointing with patient's own index finger and ask the patient to swallow by holding the tongue in that position.

Appliance Therapy

1. Hawley's appliance with cribs or rake
2. Fixed appliance/tongue guard.

Complex tongue thrust: it can be defined as, tongue thrust with teeth apart during swallowing. The malocclusion associated with complex tongue thrust has following features:

1. Proper occlusion is not found
2. There is a anterior open bite
3. Absence of temporal muscle contraction during swallowing
4. There is dropping of mandible and strong contraction of circumoral muscle.

Treatment: Same treatment as in the case of simple tongue thrust with correction of occlusion.

Retained infantile swallow: Sometimes infantile swallow reflex may be persist at the adult age. It is characterized by the following feature:

1. Teeth occlude on only one molar in each quadrant.
2. It demonstrates severe contraction of seventh cranial nerve musculature during swallowing and tongue is markedly protruded between all the teeth during initial stages of swallows.

3. Since, facial muscles are used for stabilizing the mandible, it results in an expression less face.
4. In edentulous patients, satisfactory denture prosthesis is almost impossible.

Management of Tongue Thrust

Factors to be considered before starting tongue thrust treatments are:

1. Types of malocclusion present.
Example:
 - a. Class I malocclusion with overjet
 - b. Class II malocclusion with overjet
 - c. Open bite
 - d. Deep overbite.
2. Degree of malocclusion
3. Maturity of child
4. Attitude and cooperation of parent
5. Anatomical considerations
 - a. Extremely narrow palatal arch
 - b. Nasal blockage, example- nasal polyp
 - c. Macroglossia or ankyloglossia
 - d. Maxillary posterior teeth are in extremely lingual positions.

Preventive exercises for tongue thrust habit:

1. Assure molar relation.
2. Ask the patient to hold the tip of the tongue on rugae area during swallowing.

3. Tongue sucking habit.

- Exercise for anterior position of tongue
 - a. Tongue lifting exercise
 - b. Positioning the blade of the tongue
 - c. Molar occlusion exercise.
- Exercise for middle 1/3rd and posterior part of tongue
 - a. Two elastic swallow: Place elastic on the tip of the tongue and another on the middle 1/3 of the tongue and ask the patient to raise it against the palatal vault and swallow.
 - b. Three elastic swallow: Place elastic on tip, middle and posterior part of the tongue and raise it against the palatal vault and swallow.

Finger Nails Biting Habit

Finger nail biting is another digital habit found commonly among children. Children often begin nail biting during period of perceived rejection, when learning school learning school lesson or during examination or stressful conditions.

Very few children showed nail biting before the age of 3 years. Studied showed that 40 percent of adolescent are nail biters and incidence of nail biting begins to fall and continue to decrease steadily into adulthood. The incidence of nail biting among male: female ratio is relatively equal.

On oral examination, nail biter showed anterior crowding, rotations and sharp incisal edges of mandibular incisors. On finger examination, usually index finger showed irregular, sharp nails.

Treatment

1. Provide emotional support to the child
2. Keep the nail soft with oil so there will be fewer ragged edges.

Note: It is usually seen that finger nail biting habit of children and adolescent converts into the pencil biting, lip biting and cigarette smoking as age advances to the adulthood.

Lip habit: Normal anatomy of the lip helps us for speaking, eating, and maintaining the anterior teeth into correct position. There are three types of lip habit.

1. Frequent wetting of lip with tongue
2. Putting the lips between the anterior upper and lower teeth
3. Lip sucking.

Lip sucking can be characterized by reddened irritated and chapped area below the vermillion border. Mentalis habit is a variation of lip sucking. The difference between a lip sucking and mentalis habit is that, in lip sucking case, the entire lip involving vermillion border, is pulled into the mouth whereas in case of mentalis habit, the vermillion border of the lower lip is often everted and sub labial contracture line develops between the lip and chin.

Clinical Feature (Dentoalveolar)

1. Maxillary incisors, labially protruded with interdental spacing
2. Mandibular incisors collapse lingually with crowding
3. In class II div. I malocclusion, the existing overjet may be increased
4. Open bite.

Treatment

1. Emotional therapy: involves self discipline, not to perform the habit again in near future.
2. Appliance therapy: Lip bumper appliance (Fig. 14.3) may be used to correct the habit.

Bruxism: Term bruxism is given by Marie and Pietkiewicz in 1907. Bruxism can be defined as, gnashing and grinding of teeth for nonfunctional purposes. There are two types of bruxism:

1. Nocturnal grinding of teeth
2. Habitual grinding of teeth in a day time.

Etiology

1. Emotional stress
2. Discrepancy between centric relation and centric occlusion.
3. Occlusal interference may leads to hyper tonicity of masticatory muscles and initiate abnormal jaw movement.



Fig. 14.3: Conventional basic design of lip bumper

Clinical Features

1. *On primary teeth:* The moderate amount of occlusal wear on primary teeth may be considered as normal or physiologic, as child move from the primary dentition to permanent dentition through mixed dentition period. But in bruxing children, the occlusal wear of primary teeth is considerably more than what can be considered normal or physiologic. Cuspal enamel and dentine has been worn away and there will be chance of pulp exposure. At times the existing dentine will be so thin as to show the redness of dental pulp.
2. *On permanent dentition:*
 1. Occlusal or incisal attrition pattern do not coincide with normal wear pattern.
 2. Presence of reverse curve of spee
 3. Unexpected fracture of teeth or restorations
 4. Hypertrophy of masticatory muscle
 5. Patient usually complain of jaws pain or locking of jaws when they wakeup in the morning
 6. TMJ pain
 7. Audible occlusal grinding.

Diagnosis: Diagnosis can be made by following grounds:

1. Clinical examination
2. History
3. Electromyography
4. Occlusal analysis: To detect any prematurities
5. Use of occlusal splint to achieve muscle relaxation required for diagnosis of the occlusal trigger factors of bruxism.

Treatment

- a. Psychotherapy: Provided by the clinical psychologist.
- b. Physiotherapy: Massage of masticatory muscle, heat and other form of physiotherapy will provide some



Figs 14.4A and B: (A) Conventional night guard, and (B) Acrylic maxillary cap splint respectively

relief from pain of masticatory muscle originated by bruxism or postural origins but it does not cure the bruxism.

- c. Elimination of TMJ and masticatory muscle discomfort.
- d. Occlusal therapy:
 1. Occlusal balancing
 2. Night guard or caps splint (Figs 14.4A and B).

Self destructive oral habits: Children with this habit demonstrate picking at the gingiva with the fingers or chewing, inside of the cheeks, tongue and lips. This habit can be checked by diverting the child's attention each time the habit is observed.

Gingival Health Considerations in Children and Adolescents

NORMAL PERIODONTIUM (FIG. 15.1)

The periodontium is made up of gingiva, periodontal ligament or membrane, cementum of teeth, and the alveolar bone. Gingiva is a part of oral mucosa (Fig. 15.2) that is keratinized and covers the alveolar process and teeth. The gingival tissues are usually light pink in color but color may be varying in relation to complexion of the person, thickness of gingival tissues and degree of keratinization. Gingival surface has a stippled appearance. Stippled surface of gingiva may vary from fine to coarsely grain.

- Gingiva may be divided in to two parts. First from gingival margin to free gingival groove and free gingiva comprises the lingual and buccal gingiva and interdental papilla. The shape of interdental papilla is determined by the contact relationship between two adjacent teeth and morphology of teeth in the

same arch. If the spaces found between the teeth, the papilla has become a saddle shaped and is more keratinized. When milk teeth are in contact, the interdental papilla completely occupies the interdental space.

- The attached gingiva is a band of gingiva extending from the free gingival groove to the lining mucosa, being firmly attached to the under laying alveolar bone and cementum of the root by connective tissues fibers. The cementum of the root provides surface for the attachment of the periodontal ligaments. The periodontal ligament is composed of connective tissues fibers that surrounds the root and are attached to the alveolar bone and on the cementum of root.
- The normal distance between alveolar crest and cemento-enamel junction is $1 \text{ mm} \pm 0.5$ and 1 mm or 2 mm , in primary dentition and permanent dentition respectively.

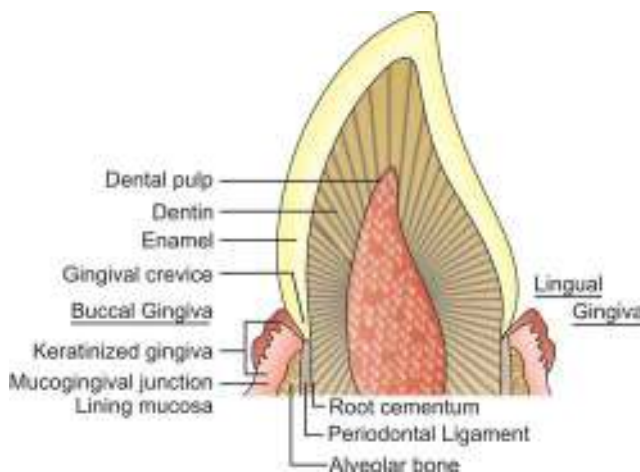


Fig. 15.1: Sketch diagram of dentogingival unit

Effect of Growth and Development on Periodontium

Growth and development significantly influenced the periodontium. The following characteristics of periodontium are changed by growth and development.

- Gingival color:** The relative amount of blood vessels and connective tissues in gingiva changed as age advances. The blood vessels decreases as age advances; therefore the normal color of the gingival tissues changed from red pink (younger age) to dark pink (older age), because melanocytes which are responsible for the production of melanin, are normally present in oral epithelium of black patient.

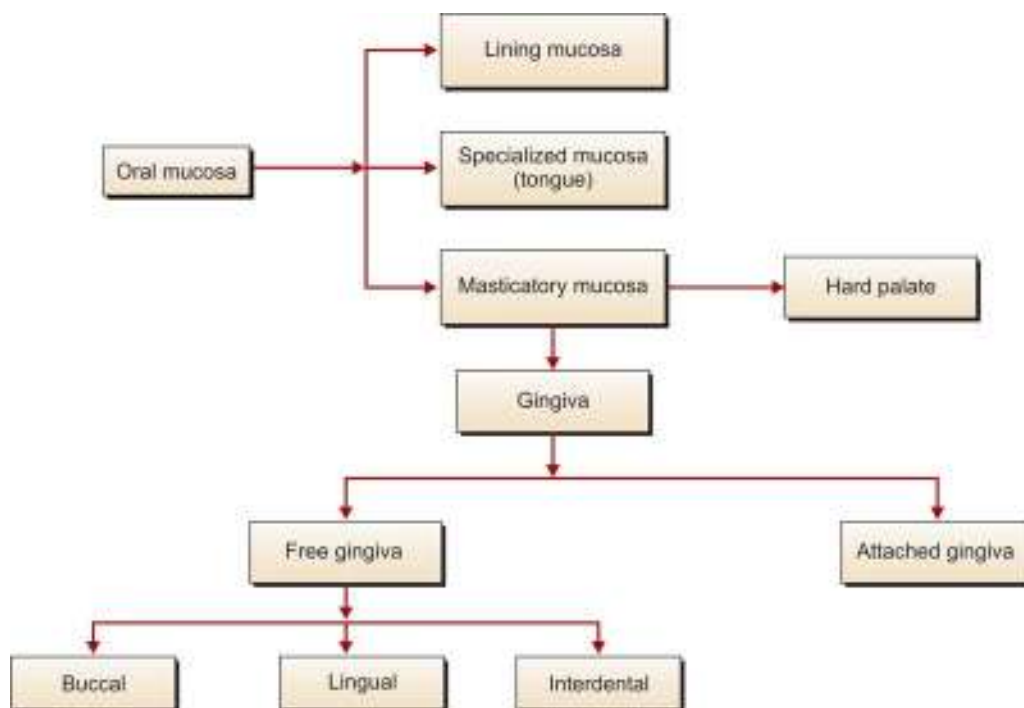


Fig. 15.2: Sketch diagram of oral mucosa's classification

2. *Stippling of gingiva*: The attached surface of the gingiva shows stippled appearance of an orange peel. The stippling starts to be evident between the age of 2 and 3 years.
3. *Width of attached gingiva*: Width of attached gingiva is wider in adults than in children. This widening is not a linear process. The width of attached gingiva in newly erupted permanent successor is narrower than one of their primary predecessor and it takes more than 5 to 8 years before the attached gingiva of permanent tooth reaches to the width of attached gingiva of its primary predecessor.

Gingivitis in young children: The marginal gingivitis is the most common type of periodontal disease begins in early childhood. Investigators have found gingivitis 2 - 34 percent in 2 year young child and 18 to 38 percent in 3 year old children.

Gingivitis in young children is usually less severe than adult with similar plaque microorganism and plaque levels. Gingivitis rarely progress in to periodontitis in preschool children because of immunologic and microbiologic factors as compared to the adult.

- Chronic gingivitis in young children usually stops at the early stage of disease because T- lymphocytes

histologically and easily infiltrate the lesion or soft tissues, while in adult chronic gingivitis histologically infiltrated by plasma cell and B lymphocytes. A mature periodontal micro-organism occurs soon after the complete eruption of the primary dentition. Developments of antibodies to these microorganisms follow their colonization pattern, as the body recognizes antigens, produced by pathogens. Therefore clinical sign of the body response to microbial colonization are delayed.

- The aim of treating gingivitis at this age is to instill in young patient is the importance of periodontal health. So establishment of good oral hygiene habit may carryover into adulthood.

Following types of gingivitis are present in young children:

1. Eruption gingivitis.
2. Gingivitis associated with poor oral hygiene.
3. Allergic gingivitis.
4. Chronic marginal gingivitis.
5. Gingivitis artifact.
6. Localized gingival recession.
7. Gingival hyperplasia associated with drug therapy.

1. **Eruption gingivitis:** This type of gingivitis associated with difficult eruption of tooth and usually subsides after teeth emerge in to the oral cavity. The highest incidence of gingivitis in children is often seen in the 6 to 7 years of age group when permanent teeth begin to erupt. This highest incidence of eruption gingivitis apparently occurs because the gingival margins receive no protection from the coronal contour of the tooth during the initial stage of active eruption and continuous impingement of food on the gingiva, causes the inflammatory process. This eruption gingivitis is most commonly associated with eruption of 1st and 2nd permanent molars. This condition may be painful and can develop into pericoronitis or pericoronal abscess.

Treatment

- For mild eruption gingivitis; improved oral hygiene.
- Painful eruption gingivitis; required irrigation with counter irritants like chlorhexidine or H₂O₂ 6 percent and antibiotic, anti-inflammatory drug therapy.

2. **Allergic gingival inflammation:** Matsson et al showed that enhanced gingival inflammatory reactions are found in the allergic children during the pollen seasons. He also showed that patient with complex allergies who have symptom for longer period, may be at higher risk for more significant adverse periodontal changes.

Treatment

- Antihistaminic drug therapy
 - Improved oral hygiene
 - Anti inflammatory drug therapy.
- Precaution:* Keep away the children from known allergic object.
3. **Gingivitis artifacta:** It is a self inflicted type of gingivitis, most commonly occurs on gingival margin and papilla. It is usually inflicted with a finger nail. The lesion may be localized stripping of gingiva or ulcerated margin of gingiva. Diagnosis of gingivitis artifacta can be made by asking the child to show the site of discomfort or pain, the offending finger of the child points directly to the lesion or site of discomfort.

Treatment

- A thorough examination for possible source of irritation and treat it, if necessary.
 - Inform the child and parent that the child's finger is aggravating the soreness and attempt to gain the cooperation in breaking the habit or placing a piece of adhesive bandage on the finger may serve as a useful reminder.
4. **Chronic marginal gingivitis:** This disease is characterized by marginal gingival inflammation without detectable loss of alveolar bone or connective tissues attachment. It is usually associated with erupting primary and permanent teeth, and with exfoliating primary teeth. It is usually disappear spontaneously. Most of the chronic gingivitis in children is associated with plaque and irritant like rough edges of carious tooth, over hanging restorative margin, etc. The prevalence of chronic gingivitis increases during puberty and pregnancy associated with commencement of sex hormone secretion.

Treatment

- Provide proper oral prophylaxis, hygiene instruction and procedure, dietary advice.
 - Remove local irritating factors like restoring carious tooth, smoothing over hanging restoration.
5. **Localized gingival recession:** The most common site for localized gingival recession in children is mandibular permanent incisors. This condition is also known as Stillman's cleft. The affected tooth usually positioned more labial in dental arch than other incisors. So there is very less or no supporting alveolar bone on the labial side. The main causative factors for the localized gingival recession are occlusal trauma associated with deep bite or cross bite (ant.). The other factor responsible for localized gingival recession is high labial frenum attachment into the free gingival margin, which may pullout the gingival margin away from the tooth during normal movement of the lips.

Types of gingival recession:

- Pseudogingival recession
- True gingival recession.

Pseudogingival recession: Occasionally, the marginal gingiva may have recession appearance because of an



Fig. 15.3: Rt. lower central incisors shows true gingival recession

irregular contour caused by inflammation of the interdental papillae. Since marginal gingiva is located coronal to the CEJ. This type of recession considered as pseudorecession.

True gingival recession (Fig. 15.3): Those cases in which gingival margin migrate apical to the CEJ should be considered as true recession. Minor degrees of gingival recession have no clinical significance until it is complicated by plaque and exposes root surface.

Treatment

- Advice proper oral hygiene.
 - Make a study model and photograph to record the existing degree of recession.
 - If pseudo gingival recession present then recall the patient every 6 months for check up.
 - In case of true gingival recession, usually periodontal surgery is required.
 - If the tooth is ectopic in position or traumatic occlusion, orthodontic treatment may be advisable.
6. **Phenytoin (drug) induced gingival hyperplasia:** Gingival hyperplasia is often seen in those children who are suffering from epilepsy and received drug Phenytoin. The prevalence of disease ranges between 36 to 67 percent (Livingston. et al. 1969). Nowadays, Phenytoin gingival hyperplasia is known as Phenytoin induced gingival over growth. It begins to develop within 2 to 3 weeks of drug initiation and reaches maximum overgrowth at 18 to 24 months. Initially, it develops as painless enlargement of the interproximal gingiva. Buccal and anterior segment are more commonly affected side than lingual and posterior segment. The gingiva appears coral pink, firm and does not bleed easily on probing, until it becomes secondary infection or inflammation.

Drug induced gingival hyperplasia forms pseudo pocket and covering more of the crown of a tooth. The epithelial attachment level usually remains constant. In few cases entire occlusal surface become covered. Problem associated with drug induced hyperplasia are:

- Difficulty in mastication
- Unesthetic appearance
- Speech impairment
- Delayed tooth eruption
- Tissue trauma
- Leading secondary inflammation.

Treatment

1. If less than a third of clinical crown is covered, give the child and parent detailed instruction about efficient plaque control methods and advice the use of chlorhexidine 0.2 percent mouthwash 10 ml /12 hrs.
2. If 1/3 to 2/3 clinical crowns is covered; meticulous oral home care with irrigating device and use of antiplaque rinses. If the growth is not controlled, consulting with patient physician concerning the possibility of using different anti-convulsant drug.
3. If more than 2/3rd of clinical crown is covered and not responding to the oral hygiene regimens then surgical removal is necessary (by periodontal knives, electro surgery, LASER, and internal bevel flap surgery).

Advantages of Electrosurgery

- Less time consuming, decrease blood loss.
- Improve visibility of surgical site and allows superior control for area of limited access.
- This method is self sterilizing and does not always required periodontal pack.

Disadvantages

- Contraindicated in cardiac pacemaker patient.
- Unpleasant odor due to burning of tissues.
- Delayed healing and potential for error in application that results in undesired bone or tissues loss.

Advantages of Laser Surgery

- Lesser surgical bleeding and provide dry field and better visibility.
- Sterilization of surgical area.
- Prompt healing

- Quick surgery
- Minimum postoperative discomfort.

Disadvantages of Laser Surgery

- Cost and size of the equipment
- Patient hospitalization is necessary
- Potential for delayed healing
- Required greater expertise for laser surgery.
- Loss of tactile feed back and eye protection is required.
- Ability of laser to ignite the plastic or rubber endotracheal tube and need to cover non surgical field with moist water sponge shield.

Note: Therefore the choice of surgical procedure must be left to the operator based on patient cooperation and compliance. After surgery some patient of drug induced gingival over-growth showed recurrence of fibrous tissues. In such cases a pressure appliance for phentoin induced gingival overgrowth is given immediately after the surgical removal of hyper-plastic tissues, an impression was taken and positive pressure splint was fabricated. Periodontal dressing was removed after one week of surgery and the positive pressure appliance was inserted. The pressure appliance wears usually at night only.

Periodontitis and Loss of Tooth in Young Children

Periodontitis is rare in young children. By bitewing radiograph, few investigators have found that 7.6 percent

of 4 years old child and 5.9 percent of 5 years old child showed periodontitis and bone loss. In most cases, periodontitis in preschool children is not clinically diagnosed except by probing for attachment loss. In young children periodontitis, recession, erythema of gingiva, and gingival edema usually not found except in neutropenic patient. Bitewing radiograph are useful for detecting alveolar bone loss and dental decay. The alveolar bone loss is most pronounced between the 1st and 2nd deciduous molars.

On bitewing radiograph, the height of alveolar bone can be measured from CEJ.

- If distance from CEJ to height of alveolar bone is 2-3 mm; questionable bone loss.
 - If it is 3 mm or more; definitive bone loss.
- Periodontal bone loss can be classified:
- According to location
 1. Localized
 2. Generalized.
 - According to the pattern of bone loss (Fig. 15.4A and B)
 1. Horizontal
 2. Vertical.

Prepubertal Periodontitis

Prepubertal periodontitis in primary dentition occurs usually in generalized form and rarely in localized form. The radiographic appearance of bone loss usually appeared around or before the age of 4 years.



Figs 15.4A and B: IOPA X-ray of maxillary anterior region shows; (A) horizontal and (B) vertical bone loss respectively

The onset of prepubertal periodontitis during or soon after the eruption of the primary teeth resulting in severe generalized attachment loss with alveolar bone loss resulting into premature exfoliation of the teeth. In initial stage of prepubertal periodontitis gingiva showed minimal inflammation with minimum of plaque material despite of abnormal probing depth. The microorganism of predominance in the gingival pocket include *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis* (bacteroid), *Fusobacterium nucleatum*, *capnocytophaga sp.*, *Prevotella intermedia*. Children with prepubertal periodontitis also showed leukocyte abnormality and impaired host response against bacterial infection. Alveolar bone destruction proceeds rapidly and primary teeth may be lost by 3 years of age.

Treatment

- Extraction of hopeless primary teeth.
- Restoration of decayed teeth
- Proper oral prophylaxis and hygiene instruction
- Chlorhexidine oral rinse and antibiotic therapy
- Recall visit every 3rd month of oral prophylaxis

The diagnosis of prepubertal periodontitis suggest the need for further investigation into probable underlying systemic disease like compromised host defense, neutropenia diabetes, hypophosphatasia, and Histiocytosis X. Referred the patient to the specialist for blood test and other investigation to rule out the probability of underlying systemic disease.

Juvenile Periodontitis

Juvenile periodontitis is an uncommon disease. It is characterized by severe destruction of alveolar bone around one or more permanent teeth. It is most commonly seen in adolescent but children 10 to 11 years may be affected. The prevalence of disease varies in different racial groups but it is more prevalent in Negroes. Etiology of juvenile periodontitis is *Actinobacillus actinomycetemcomitans*. Localized juvenile periodontitis most commonly affect incisors and 1st molar. It appear's self limiting retrospective data obtained from localized juvenile periodontitis patient suggest bone loss around the primary teeth. Radiograph showed a bilateral bone loss in a diverse geographically adolescent population. Progression of bone loss is 3 to 4 times faster than adult periodontitis.

The generalized form of juvenile periodontitis occurs at puberty and young adult. In the generalized form, the pattern of bone loss may be vertical or horizontal and usually involve most teeth in the dentition.

Treatment

Successful treatment of juvenile periodontitis depends upon prescribing antibiotic therapy after sensitivity test of bacteria, to provide infection free environment.

1. Prescribes 2 week course of doxycycline combined with metronidazole.
2. A non surgical approach may be done 1st by proper oral prophylaxis, hygiene instruction specially by the use of flossing.
3. Combination therapy-surgical removal of crevicular necrotic tissues and debridement of root surface with 14 days course of doxycycline. It is the best effective modality.
4. Recommend the oral hygiene maintenance procedure.
5. Recall visit every 3 months.

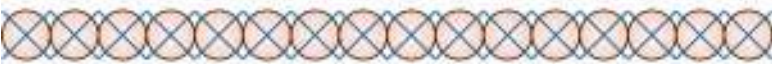
Precocious periodontitis (Papillon-Lefever syndrome): It is a rare disease. Etiology is unknown. Child with precocious periodontitis have a condition characterized by premature loss of primary and permanent dentition, along with hyperkeratosis of the palm, sole, elbows and knees. Periodontal inflammation begins soon after primary teeth erupt. Alveolar bone loss is severe in precocious periodontitis so that primary teeth are lost by 3 to 5 years of age. Patient with this syndrome showed depressed PMN chemotactic and phagocytic response.

Treatment

Conventional therapy with oral hygiene instruction, professional cleaning and frequent recalls and antibiotic therapy have failed to prevent tooth loss in Papillon-Lefever syndromic patient.

Tinanoff et al. treated a 9 years old Papillon-Lefever syndromic patient by extracting their all erupted permanent teeth and prescribing antibiotic so that periodontal pathogens could be eradicated enough to prevent infection of the patients 16 unerupted teeth. Similar treatment of primary dentition was done in a 4 years old child that was successful.

Oral hygiene record form:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
															
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
															

Patient name:----- Date of plaque record:-----

Oral hygiene index and periodontal disease: A simple method of recording the presence of plaque on individual tooth surfaces are developed by O leary et al. A suitable disclosing agent is painted on all the surfaces of crown (mesial, distal facial and lingual) and proper examination of each stained surface for soft accumulation at the dentogingival junction with the help of explorer. These accumulations are recorded with the dash being made in the appropriate space on the record form.

The record form should be completed at the 1st appointment for learning plaque control. No attempt is made to differentiate between varying degrees of plaque on tooth surface.

$$\text{Plaque control index} = \frac{\text{No. of plaque containing surface}}{\text{Total no. of available surface}}$$

The same procedure is carried out at next appointment to find out the patient progress in learning and carrying out the prescribed oral hygiene procedure.

BIBLIOGRAPHY

1. Addy V, et al. Risk factors in Phenytoin- induced gingival hyperplasia. J Periodontal 1983;54:373-7.
2. Albandar, et al. Clinical classification of periodontitis in adolescents and young adults. J Periodontal 1997;68:545-55.
3. Coccia CT, et al. Papillon-Lefever syndrome: Precocious periodontosis with palmer-planter hyperkeratosis. J Periodontal 1966;37:408-14.
4. Cohen MM. The gingiva at puberty. J Dent Res 1955; 34:679.
5. Goepfered SJ. Advanced alveolar bone loss in the primary dentition: A case report. J Periodontol 1981; 52:753-7.
6. Loe H, Listgarten MA. The gingiva: Structure and function: In Goldman, CohenDW, Editors: Contemporary Periodontics Mosby, 1990.
7. Steinberg SC, AD. Phenytoin-induced gingival overgrowth control in severely retarded children. J Periodontol 1982;53:429-33.

Dental Plaque

INTRODUCTION

The primary cause of gingivitis and periodontitis is plaque bacteria. The dental plaque was considered as homogeneous, complex bacterial mass that would lead to disease where it was permitted to over grow. The periodontal health results from host microbiota equilibrium that is compatibility with minimal tissues destruction and repair of damaged tissues. The alteration of this equilibrium may be due to local or systematic changes that minimizes host defense or from qualitative or quantitative alterations of periodontal microbiota that result in increased virulence. Therefore, complex interaction between oral microbiota and host defense factor can influence the role of plaque microbiota in periodontal disease.

Complexity of Plaque Bacteriology

The complex arrangements of oral bacteria are present over the periodontium. There may be as many as 200 to 400 species of oral bacteria in one individual site of periodontium. Sometimes, specific alteration in the oral environment may convert normal non-pathogenic bacterial species into pathogenic species.

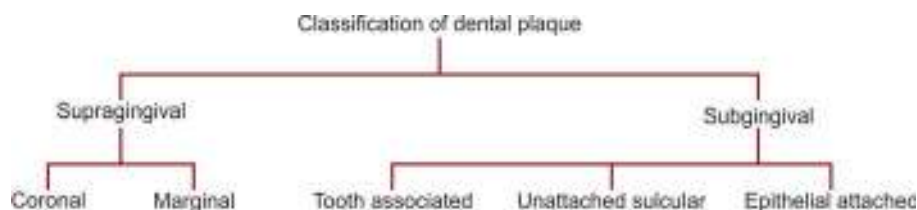
Clinical responses of periodontium to the plaque bacteria are varied. They are modulated by host defense

factors that result in disease progression during periods of exacerbation (disease activity). Failure to diagnose these periods of disease activity may cause clinician to underestimate the contribution of pathogens to a given lesion. Some bacteria have been identified as main pathogens in periodontal destructions (Fig. 16.1).

Criteria for Periodontal Pathogenicity of Oral Bacteria

Following criteria have been identified as pathogenicity of bacteria.

1. The number of etiologic bacteria in the pathogenic site or gingival sulcus must be increased, it results periodontal disease.
2. If the etiologic bacteria is eliminated or suppressed, the disease progression would stop.
3. The host response may provide an important guide to the role of certain bacteria in the development and progression of dental diseases. An increase or decrease in the host immunity to a given species in a specific form of periodontal disease suggest a role for those bacteria in the disease process.
4. Bacterial virulence is another criterion that play important role in the disease progression and to determine the potential oral pathogens.



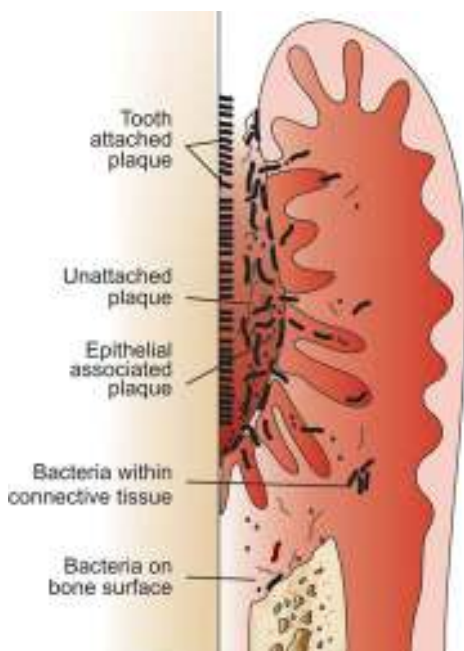


Fig. 16.1: Plaque bacteria association with tooth surface and periodontal tissues

- The term *materia alba* describes the bacterial aggregations, leukocyte, and desquamated epithelial cells accumulating at the surfaces of teeth. It is devoid of internal structure, which is usually observed in dental plaque.

Supragingival Plaque

Supragingival plaque (Fig. 16.2) can be detected clinically by use of disclosing solutions. The rate of dental plaque formation and location vary among individuals, on different teeth within mouth of same individual, and on different area of same teeth and are influenced by diet,



Fig. 16.2: Disclosed supragingival plaque with disclosing solution

salivary factor, age, tooth alignment, oral hygiene, host defense, etc. Dental plaque primarily made up of proliferating microorganisms, along with scattering of epithelial cells, leukocytes, and macrophages in an adherent intercellular matrix.

- Bacteria make up about 70 to 80 percent of dental plaque.
- 1 mg of dental plaque contains more than 10^8 bacteria.
- Dental plaque also contains other microorganism like, mycoplasma, yeast, protozoa and viruses.
- Interbacterial matrix (non-bacterial portion of plaque) makes up about 20 to 30 percent of plaque volume. The composition of interbacterial matrix are:
 - Polysaccharides protein complex- 30 percent
 - Lipid- 15 percent.
- The other components of dental plaque are extracellular product of plaque bacteria, remnants of cytoplasm, and cell membrane, food debris, and derivative of salivary glycoprotein.
- Dextran, is the chief carbohydrate present in the dental plaque. Another is mutan carbohydrate.
- The principal inorganic component of the supragingival plaque matrix are
 - Calcium, phosphorus
 - Mg^{++} , K^+ , Na^+

Development of Supragingival Plaque (Plaque Maturation)

Pellicle formation is the prerequisite for the development of plaque. It is an organic structure mainly formed by salivary glycoprotein. Salivary glycoprotein adhere with tooth surface by electrostatic ion interactions of Ca^{++} and PO_4^{---} in the enamel surface and oppositely charged salivary macromolecules.

- The transition from pellicle to dental plaque is extremely rapid. The 1st bacteria colonizes on the pellicle are mainly cocci. They form monolayer of bacterial cells over the pellicle, with time other types of microorganism colonizes and giving rise to different microcolonies. Mature dental plaque is characterized by its complexity. In the development of dental plaque two adhesive processes are required:
 - Bacteria must adhere to the pellicle surface and become sufficiently attached to resist the oral cleansing forces.
 - They must grow and adhere to each other to allow plaque accumulation.

- During adherence, interaction occurs mainly between specific bacteria and pellicle. The mechanism of bacterial adherence can be explained by:
 1. Electrostatic forces
 2. Hydrophobic interactions
 3. Organic solutes (bacterial lectins, recognizes specific carbohydrate in the pellicle).

Bacterial Growth and Proliferation within Dental Plaque

When pellicle surface is saturated with bacterial binding site, subsequent growth leads to accumulation of bacteria and increases plaque mass. The ultimate composition and pathogenicity of dental plaque depends on bacterial, environmental and host immunity.

- Many microorganisms such as *S. mutans*, *S. mitis*, *S. salivarius*, and *Lactobacillus* species produce an extracellular polymer as a byproduct of dietary carbohydrate. This polymer is water insoluble and results further bacterial adhesion. This polymer is known as Glucans and mutans, mainly produced by *S. mutans*. Glucans are being capable of entrapment of other microorganisms from the oral fluids, thus promoting accumulation of other bacteria.
- In the formation of supragingival plaque, most nutrients are provided by saliva while in the case of subgingival plaque, the nutrients are mainly supplied by sulcular fluid and epithelium.

Importance of supragingival plaque: Supragingival plaque, strongly influence the accumulation, growth, and pathogenic potential of subgingival plaque particularly in the early stages of gingivitis and periodontitis.

Subgingival plaque (Table 16.1): The basic difference between supragingival and subgingival plaque is nature of the microorganism, morphologic feature of sulcus and periodontal pocket makes them less subjective to the natural homeostatic cleansing activity of the mouth.

Subgingival microorganisms adhere with the tooth surface and epithelium of the sulcus and get their nutrients from sulcular fluid and directly from epithelial proteins. The supragingival plaque makes the marginal gingiva inflamed, providing lesser O₂ ecosystem in subgingival area, so anaerobic bacteria proliferate in it, if host defense systems are weak.

Table 16.1: Subgingival plaque microbiology

Tooth associated bacteria	Unattached bacteria	Epithelial attached bacteria
Gram +ve bacteria, predominantly rods and cocci. Ex. <i>S. mitis</i> , <i>S. sanguis</i> , eubacterium, actinomyces viscosus, and propionic bacterium	Gram +ve and -ve both	Both gram +ve and -ve, predominantly spirochetes, bacteroids, capnocytophaga and campylobacter etc.
Does not extends to junctional epithelium	Extends to junctional epithelium	Extends to junctional epithelium
May penetrate cementum	—————	May penetrate epithelium and connective tissues
Associated with root caries and calculus formation	Associated with gingivitis	Associated with gingivitis and periodontitis

Concept of Bacterial Specificity

It suggests that periodontal disease may be a group of disease with different causes and clinical courses but with similar symptom.

Oral Flora

Oral cavity is an ideal incubator possessing ecologic feature that facilitates the establishment and growth of a great variety of microorganisms, including bacteria, fungi, viruses and protozoa. The pH, O₂ tension required for microbial growth is optimum in oral cavity, permitting many facultative anaerobic bacteria to grow.

- The oral cavity is sterile at birth. The 1st facultative flora is established in the oral cavity within 6 to 10 hrs after birth. Anaerobes appear in the mouth within 1st-10 days after birth. The number of anaerobes increases with age but facultative type remains predominant.
- The salivary bacterial counts ranges from 43 million to 5.5 billion organisms per milliliter.
- The number of microorganism increases during sleep primarily as a result of decreased salivary flow, which occurs after eating and toothbrushing.

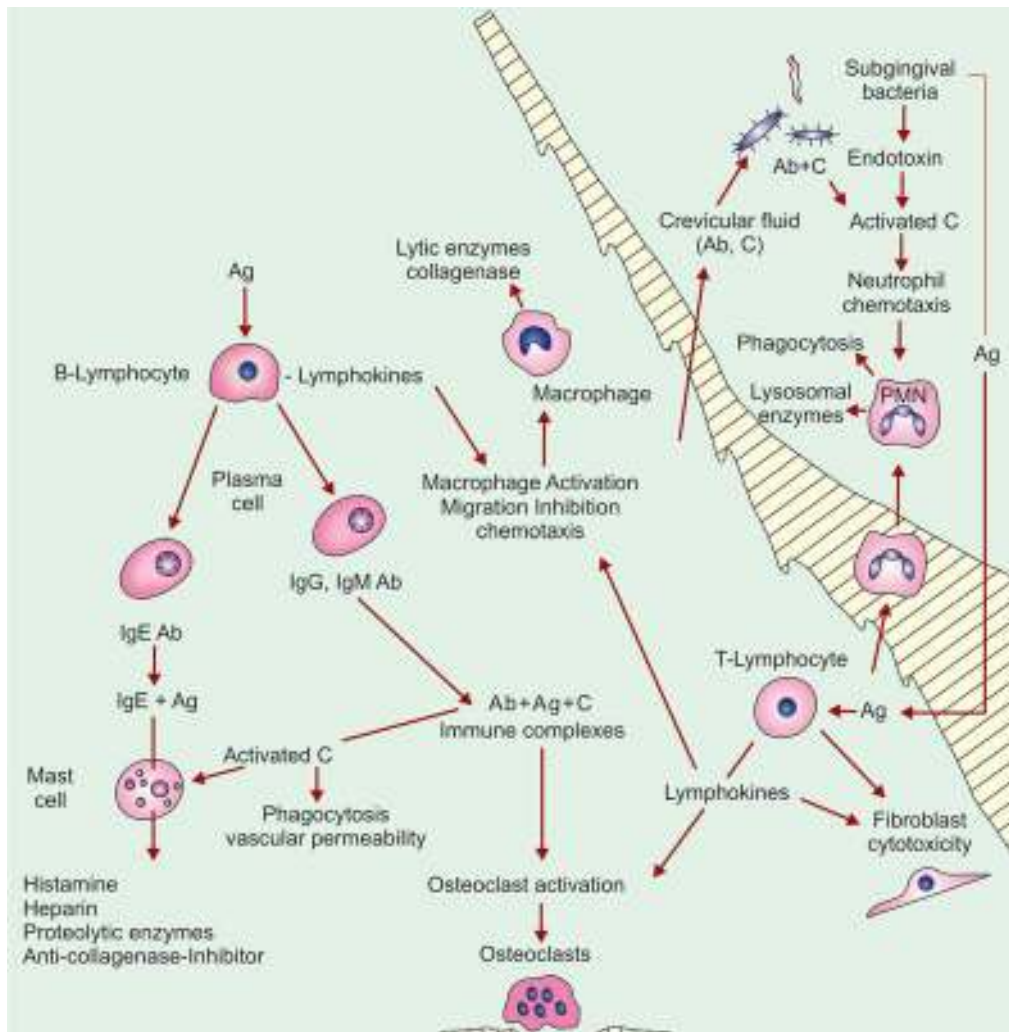


Fig. 16.3: Sketch diagram of immunologic response in gingivitis and periodontitis

- Microbiota entering in the mouth, 1st make contact with saliva or salivary coated surfaces owing to the abundant salivary flow, only bacteria that are able to adhere are retained in the mouth.
- **Bacterial succession:** As oral environmental condition changes, because of change either in the host defense or microflora itself, the organism must adopt or be superseded by new species better suited to survive in the new environment. This phenomenon is known as bacterial succession. Bacterial succession is important in the pathogenesis of oral infections particularly gingivitis and periodontitis. *S sanguis* and gram-positive cocci have shown to be the main

bacteria that initiate supragingival plaque. After supragingival plaque is initiated, secondary growth and maturation takes place. Bacterial shift occurs, and a filamentous gram negative bacterium increases in the plaque. Clinically plaque becomes more cohesive and compact. Microorganism encountered in such sites are *S mitis*, *S sanguis*, *Staphylococcus epidermidis*, *Actinomyces viscosus*, etc.

Immunologic Response in Gingivitis and Periodontitis (Fig. 16.3)

In early stages of gingivitis, the inflammatory infiltrate is predominantly lymphocytes with predominant of

T-cells. In advance gingivitis and periodontitis, the plasma cells are most common inflammatory cells. Lymphocytes found in periodontitis are usually derived from B cells. T-cells constitutes less than 6 percent of the lymphoid population. The periodontal lesional condition is controlled by both local and systematic factors. Active lesion is associated with increased proportion of pathogenic bacteria, bacterial invasion of the tissues and changes in host response. Crevicular bacterial antigen induces local and systematic host response. These immune responses have both protective and destructive functions.

BIBLIOGRAPHY

1. Bowen W. Nature of plaque. *Oral Science Rev* 1976;9:3.
2. Burnett GW, Scherp HW. *Oral Microbiology and Infectious diseases*, 3rd edn. Baltimore, Williumand Wilkins, 1968.
3. Cisar JO. Coagregation reactions between oral bacteria. In Genco RJ, Mergenhausen SE (eds): *Host parasite interactions in periodontal diseases*. Washington, DC, American society for Microbiology 1982;121.
4. Cowley G. Effect of plaque on gingival epithelium. *Oral Sci Rev* 1972;1:103.
5. Embery, et al. Some considerations on dental pellicle formation and early bacterial colonization 1984;73.
6. Loesche W. Oxygen sensitivity of various anerobic bacteria. *Appl. Microbiology* 1969;18:723.

Dentifrices

According to American Dental Association Council of Dental Therapeutics—A dentifrice is a substance used with a tooth brush for cleaning purpose and cleaning the accessible surface of teeth.

Webster- described the term dentifrices as derived from dense (tooth) and fricare (to rub). These are aids for cleaning and polishing the tooth surfaces. It may contain the following:

1. The therapeutic agent such as fluoride to inhibit dental caries.
2. Antimicrobial agent, such as chlorhexidine, centrimide to reduce microorganism.
3. An anti calculus agent such as ZnCl to dissolve calculus.

Composition of Dentifrices

A dentifrice contains a number of ingredient that serve a definite purpose in providing adequate plaque control thus preventing caries and periodontal diseases. The common ingredients of toothpaste are:

1. Polishing and abrasive agent:- calcium carbonate, dicalcium phosphate dihydrate, alumina and silica.
Functions: These agents have a mild abrasive action, which aids in eliminating plaque from the tooth surface. They remove stained pellicle from the tooth surface and also enhance enamel whiteness.
2. Binding/thickening agent is water soluble alginate.
3. Water insoluble agent is colloidal silica and sodium magnesium silicate.

Functions: It controls stability and consistency of a toothpaste. It affects ease of dispersion of paste in the mouth.

4. Detergents and surfactants: Sodium lauryl sulphate is used as detergents. It produces foam which aids in the removal of food debris and also dispensing, of the product within the mouth.
5. Sorbitol, glycerin and polyethylene glycol are aids in reducing the loss of moisture from the tooth paste.
6. Flavoring agents are peppermint oil, oil of wintergreen. They render the product pleasant to use and leaves a fresh taste in the mouth after its use.
7. Sweetener is saccharine
8. Antibacterial agents are triclosan, metallic ions and zinc citrate trihydrate.
9. Anticaries agent: Sodium monofluorophosphate, stannous fluoride, sodium fluoride.
10. Anti-calculus agents are mostly designed to inhibit the mineralization of plaque. They are also known as crystal growth inhibitors.
 - A. Pyrophosphate
 - B. Zinc citrate
 - C. Zinc chloride.

Desensitizing agents are sodium fluoride and potassium nitrate.

Recent Development in Dentifrices

1. Toothpaste for children
2. Herbal toothpaste
3. Whitening tooth paste: not recommended for regular use.
4. Sodium bicarbonate tooth paste: Some products contains peroxidase enzyme which irritate the gingiva and oral tissues.

Composition of typical toothpaste

<i>Ingredient</i>	<i>Percentage</i>	<i>Functions</i>	<i>Used chemicals</i>
Mild abrasive	15 to 45%	Mechanically clean the teeth	CaSO ₄ , calcium phosphate, silica oxide, aluminum oxide
Water	20 to 38%	As vehicle and solvent	Double distillation water
Humectants	25 to 40%	To maintain the consistency of paste	Sorbitol, Mannitol, Glycol
Detergents	1 to 5%	Helps in removing loose debris	Sodium lauryl-sulphate and sodium- N- lauryl sarcosinate
Binding agents	Up to 1%	Binds the solid to form homogenous substance	Synthetic cellulose
Flavoring agents	Up to 2%	To provide good flavor	Sorbitol
Therapeutic agents	Up to 2%	Provide specific therapeutic action of paste	Tetra sodium pyrophosphate
Preservative	Up to 0.5%	Prevent microbial growth	Benzoic acid
Coloring agent	0.5%	Provide good color to the paste	Depends upon manufacturer choice

Types of Dentifrices

- 1. Ammoniated dentifrices:** In the early 1930s, it was reported that rinsing the mouth with aqueous solution of ammonium hydroxide (.006%), effectively cleans the teeth. Many studies showed that contents of salivary ammonia were higher in caries resistant person than that of caries susceptible. This lead to the conclusion that tooth cleaning by ammonia was brought by solvent action on salivary mucine plaque. These products were thought to inhibit tooth decay by preventing breakdown of glucose by micro-organism. There is possibility that tooth paste having much greater amount of ammonia and urea may have value in inhibiting tooth decay (Discarded).
- 2. Penicillin dentifrices:** When patients with high Lactobacillus count in his/her mouth were placed on a dentifrices containing thousand unit of penicillin/ brushing, a marked reduction in salivary bacterial counts were obtained within a few weeks. It was

observed that after several hours of use of penicillin mouth wash fermenting ability of saliva to the carbohydrate was almost completely lost. This lead to the conclusion that penicillin dentifrices can inhibit dental caries in children provided that there use is supervised (Discarded).

Disadvantage: Prolong use of penicillin dentifrices has been shown to cause an increase in number of penicillin resistant bacteria in the oral cavity.

- 3. Chlorophyll dentifrices:** Sodium/copper chlorophyll in dentifrices can reduce dental caries. The use of chlorophyll dentifrices results in reduction of *Lactobacillus* counts in the oral cavity. Since, there is no substantial evidence that chlorophyll dentifrices have an inhibitory effect on human dental caries.
- 4. Fluoride dentifrices:** Several investigators concluded that fluoride have definite inhibitory effect on the human dental caries. Up to 1000 ppm fluoride content may be present in fluoridated toothpaste.

Age Specific Plaque Control

INTRODUCTION

Good oral hygiene is a foundation step in the development of disease free oral cavity of infants through adolescents. Many parents would not be aware of the facts that oral hygiene practices can be essential at early childhood. Specific home oral hygiene instructions are different at different age group. The cleaning of gum pad can be started as early as within the 1st week of birth with the help of moist gauze.

For infants (0 to 1 year): Plaque control activity should be started on eruption of 1st primary teeth. Infant's oral cleaning must be done by the parent. It can be accomplished by wrapping moist gauze or chlorhexidine wet gauze around the parent's forefinger and gently massaging the teeth and clean the gingival tissues (Fig. 18.1).



Fig. 18.1: Dental surgeon was demonstrating tooth cleaning in 8 months child. It can be accomplished by wrapping moist gauze or chlorhexidine wet gauze around her forefinger and gently massaging the teeth and clean the gingival tissues

Procedure: The oral hygiene procedure can be accomplished in numerous ways, but cradling the child in one arm while massaging the teeth with the hands of the other may be the simplest method to provide the infant with a strong sense of security.

- Hygiene procedure should be done once daily.
- The use of dentifrices is not advisable at this stage.
- Moistened soft bristle can be used, if parent feels comfortable.

For toddler (1 to 3 years): Soft tooth brush can be introduced at this age, if it was not accomplished previously. At around the age of two year the dentifrices can be introduced. Only a pea sized amount of tooth paste should be used because at this group, there is inability to expectorate and the chances for fluoride ingestion is more.

- Most children enjoy modeling after their parents practice their toothbrushing.
- Complete plaque removal by child alone is not accomplished although, the child should be encouraged to begin rudimentary brushing. The parent remains the primary caregiver in these hygiene procedures.
- The use of flossing aid can be introduced at this group, if any interproximal contacts are closed.

Positioning

Although, most children enjoy brushing their own teeth; many are resistance to allowing anyone else to do the brushing. Lap to Lap position allows one person to control the child's body movement and other person brushes the teeth (Fig. 18.2.)



Fig. 18.2: Lap to Lap position is used for brushing as well as oral examination of a child



Fig. 18.3: The child rests his/her head back into the parent's one arm and other hand is used to brush. This position is also appropriate for flossing

- The child's arm and legs are controlled with the hands and elbow of the adults responsible for the body movements. In single parent households, one adult position becomes necessary, in this situation the parent sits on the floor with his/her legs stretched out in front and the child is positioned between the legs. The child's head is placed between the thighs of the parent with the child's arm and legs carefully controlled by the legs of the parent.

For preschool (3 to 6 years): Although, the children in this age begin to demonstrate significant improvement in their ability to manipulate the toothbrush adequately but the parents remain the primary provider of oral hygiene procedure. Fluoride ingestion remains a concern for this age group; during this time, most children develop the skill to expectorate toothpaste adequately. Until this occurs, it is important for the parent to continue only pea-sized amount of toothpaste.

- In addition, flossing should begin at this age. The posterior contact may be the only areas where flossing is needed.
- Position: The most common method advocated is where the parent stands behind the child and their face are in the same direction. The child rests his/her head back into the parent's one arm and other hand is used to brush. This position is also appropriate for flossing (Fig. 18.3).

Methods of brushing at this age group: The most commonly advised technique at this stage is the Fones technique (Fig. 18.4). The toothbrush bristles are positioned perpendicular to the tooth crown. The procedure is as follows:

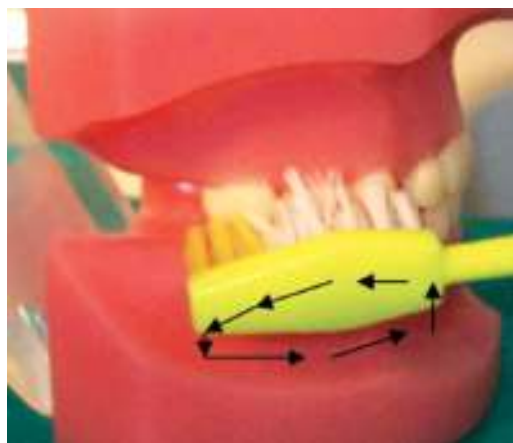


Fig. 18.4: Fone's technique of brushing

- On the buccal or labial surface of the tooth, wide circular strokes are given to include gingiva and tooth surface.
- On the lingual surface of tooth, horizontal back and forth motion is given.

Advantages

1. Easy to learn especially by children
2. It provides gingival stimulation.

Disadvantages

1. Possible trauma to the gingiva
2. Interdental areas are not properly cleaned.

For school age (6 to 12 years): The parental involvement is still required at this stage. Instead of performing oral hygiene they can switch to active



Fig. 18.5: Horizontal scrub technique of brushing

supervision. Parents provide assistance only when child feels difficulties in flossing or brushing in certain area. One useful adjunct for the parents to inspect the child's teeth is the use of disclosing agents.

- At this age, the children can expectorate well, thus the use of fluoridated dentifrices is essential, however, fluoridated gels and rinses can be reserved for those children at risk for caries.
- *Methods of brushing:* In this age group, the most commonly used technique is horizontal scrub technique (Fig. 18.5). The bristles of the tooth brush are placed perpendicular to the crown of the tooth. The brush is moved back and forth in horizontal movements on all the surfaces of teeth.

Advantage

1. Most convenient and effective for small children with primary teeth.

Disadvantages

1. Interdental spaces of permanent teeth of adults are not properly cleaned.
2. Cervical abrasion on lingual and buccal surfaces takes place in aged patients.

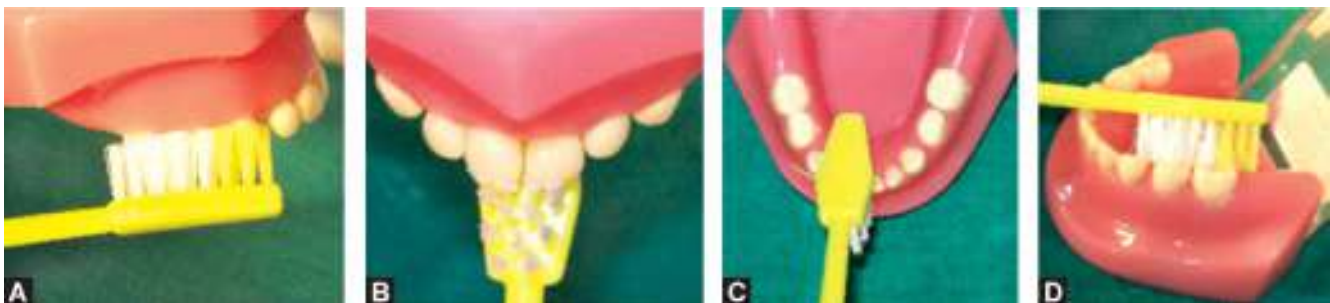
For Adolescents (12 to 19 years): Although the adolescent patient usually has developed the skills for adequate oral hygiene procedure, compliance is a major problem during this age group. At this stage, parents should be mentally prepared to adopt their child's changing personality and continue to reinforce the need for oral health care and hygiene. Therefore, it is important for the dentist and parent to continually help and guide the adolescent as they progress through this difficult stage.

Method of brushing: The most commonly used technique is Bass method. The bristles of the tooth brush which are soft in nature are positioned in the gingival sulcus at 45° to the long axis of tooth. The bristles are then gently pressed, so few bristles to enter inside the sulcus.

A vibratory motion, short back and forth horizontal with bristle ends remain inside the sulcus. This position of bristle and motion enables the sulcus clean along with interdental and buccal surfaces of teeth. Ten such strokes are advocated for each area including the interdental area. (Figs 18.6A to D).

Advantages

- Effective method for plaque removal adjacent to and directly beneath the gingival margin, cervical areas and sulcus.
- Provides gingival stimulation
- Easy to learn.



Figs 18.6A to D: Bass methods of toothbrushing at different quadrant of maxillary and mandibular teeth

Disadvantages

- Only small area are covered at one time, hence more time consuming
- Special quality of tooth brush is required.

Modified Bass Technique: Is similar in all ways to the simple Bass technique, except that when using this method to brush we additionally sweep the tooth brush occlusally along with sulcular brushing.

Oral hygiene program in dental office: It is the responsibility of dentist to make oral hygiene and preventive program, the core of their practice. Preventive practices will be successful if we provide facility of:

1. Adopting and motivating our patients and parents
2. Active listening and solving problem ability
3. Proper preventive education home program.

Oral Hygiene Aids in Children with Disabilities

Children with disabilities may have a mental, physical, medical or social condition that interferes with normal functioning. Effective oral hygiene is important for a child with disabilities because of the predisposing factor that makes dental care difficult when it is required.

- Home dental care in disabilities child should begin in infancy; the Pedodontist should instruct the parents to gently clean the incisors daily with soft cloth or gauze.
- Instruct the parents about dental fluoride regime properly.
- Older children with disabilities who are unwilling or physically unable to cooperate, the Pedodontist should teach the parent about brushing technique and methods that safely restrain the child when necessary.
- Wrapped tongue blade may be of benefit in helping to keep a child's mouth open while plaque is being removed.
- During brushing of disabled child, the parent should stabilize the child's head to prevent trauma from sudden movements.
- The brushing technique for patients with disabilities who have fine or gross motor deficiencies, limiting their ability to brush should be effective and yet simple for the person performing the brushing.
- The technique often recommended for disabled child is horizontal scrub method because it is easy and can

yield good results. This technique consists of gentle horizontal strokes on cheeks, tongue, and biting surfaces of all teeth and gums.

- Some modification can be made to the tooth brush to help person with poor fine motor skills to improve their brushing technique. Although, many types of grips are available, using the patients head to custom-design an acrylic handle has often had good results.
- Powered tooth brushes have also been used very effectively by children with disabilities.
- Disclosing agents and other oral hygiene aids like antiplaque chemical, floss are used along with above mentioned methods.

Powered toothbrush (Fig. 18.7): Electrically powered toothbrush were invented in 1939 and intended to make plaque control easier. The brushing movement in this brush is powered by battery or electricity.

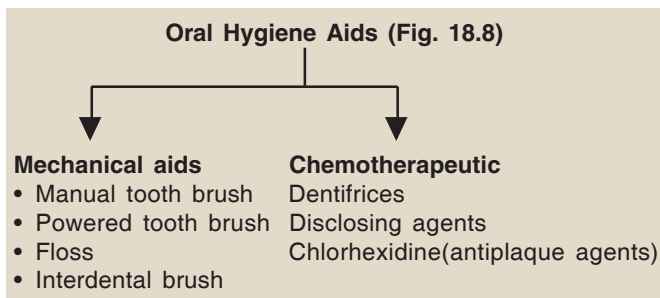
- All powered tooth brushes dependants on mechanical contact between the bristle and the tooth to remove plaque.
- The addition of low frequency acoustic energy generates dynamic fluid movements and provides cleansing slightly away from the bristle tip.
- The vibrations have also been shown to interfere with bactericidal adherence to oral surfaces.



Fig. 18.7: Design of powered tooth brush (Oral B Co.)

- Patient acceptance of powered tooth brushes is good. These brushes generate stroke motion automatically and required less operator effort. They are therefore widely recommended for children with disability.
- Few powered tooth brushes having additional feature like, sonic technology along with timer to remind the patient for adequate brushing time.
- The cleansing efficiency of the tooth brushes depends upon direction of the movement of bristle and the hardness, stiffness and firmness of the bristle and tufts.

Classification of oral hygiene aids: From the pre historic era, people have been using something drawn from the nature like small Neem stick to clean the oral cavity and teeth. Oral hygiene practices comprise of thorough daily removal of plaque and other debris by tooth brushing, flossing, mouth washing and rinsing etc. There are several oral hygiene aids available. They are basically of two types:



Mechanical aids: Tooth brushing and flossing are the essential elements of these mechanical aids.



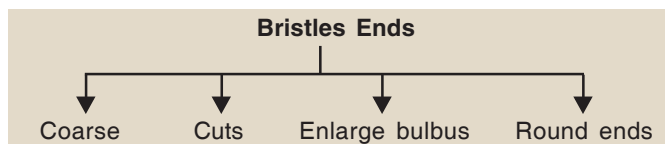
Fig. 18.8: Different oral hygiene aids including, interdental brush, tooth pick, floss, floss holding device, etc.



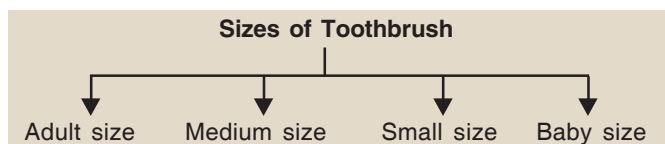
Fig. 18.9: Different shape and size of toothbrush

- **Manual toothbrush (Fig. 18.9):** Toothbrush is the most common method for plaque removal from the oral cavity. A manual toothbrush has got the following four part:

1. Handle is the part by which the brush is held in hand.
2. Head is the part of the brush to which the bristles are attached. It is further divided into **Toe** and **heel**. The Toe part is away from shank and heel presents towards shank.
3. Bristles are made up of fine nylon and directly clean the teeth. The bristles bunches are called as tufts. The normal length of bristle is 11 mm.



4. Shank is the constriction between the handle and the head.

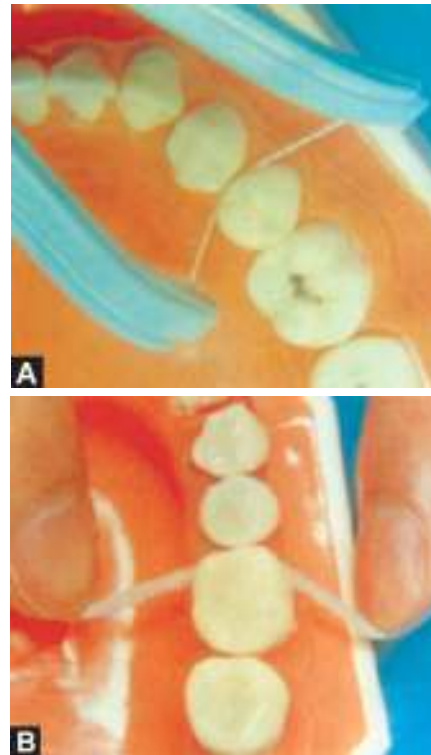


- Adult size tooth brush is the largest size of the tooth brush. It is used by the person after the age of 18 years.
- Medium size is little smaller than adult size tooth brush. it is used by children of 12 to 18 years.

- Small size is smaller than the medium size. It is used by the children during their mixed dentition period (6 to 12 years).
- Baby size is the smallest tooth brush. It is used by the parents for her/his child or children up to the age of 6 years.
- Tooth brushes can also be classified as soft, medium or hard based on the width of these bristles. The diameter of these bristles are as follows
 1. Soft; 0.16 mm to 0.22mm
 2. Medium; 0.23 mm to 0.29mm
 3. Hard; 0.30 mm or greater

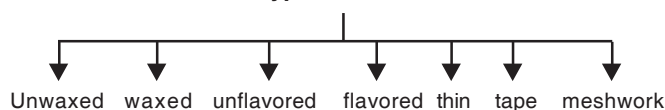
Floss is made up of Nylon thread, used for the cleaning of interdental and proximal surfaces of teeth by frictional forces. It is most widely recommended method for cleaning the proximal surfaces of teeth.

Method to hold the floss: Take about 18 inch long floss. About 4 inch of each end side is tied around the middle finger of each hand (Figs 18.10A and B). In this method the last three fingers are folded and both the hands are moved apart. In this way about 2 inch long floss is held between the index fingers of both hands.



Figs 18.10A and B: Methods of holding floss in fingers as well as in floss holder

Types of floss



Flossing Procedure

- Firmly hold the floss in the hands supported by both the index fingers, moving back and forth, the floss is gently slide between the teeth at contact areas of two adjacent teeth, avoiding trauma to the gingiva.
- After passing the contact areas, the floss is moved facially and lingually wrapping it around the complete proximal surfaces of a tooth. The floss is again moved apical into the free gingival sulcus and back to the contact area, repeats this procedure, till whole of the sulcular area and proximal area is cleaned.
- Flavored waxed floss with floss holding device is suitable for children.

Interdental brush: These are specially designed, cone shaped, thin and pointed brush used for cleaning the interdental spaces and interproximal surfaces of teeth. It is basically of two types:

1. Miniature bottle or spiral brush
2. Unitufted brush.

Dentifrices (see Chapter Dentifrices)

Disclosing agents: These are the chemical agents mainly used for visualization of the dental plaque and helps in patient motivation for plaque removal. These are as follows:

- Iodine
- Erythrosine
- Gention violet
- Basic fuschin
- Fort green
- Food dye
- Fluorescein.

These agents are especially helpful for children in toothbrushing technique, educating and motivating them regarding oral hygiene.

Chlorhexidine mouthwash is a positively charged organic antiseptic agent, has considerable antiplaque ability. It binds with anionic glycoprotein and phosphoproteins on the buccal, palatal and labial mucosa and dental pellicle. It also binds with the bacterial cell membrane, resulting in increase permeability of cell membrane and lysis of bacteria.

Prenatal Oral Health and Oral Health in Pregnancy

INTRODUCTION

Pregnancies change a woman's body and have some effect on fetal oral health. Prenatal counseling can improve the oral conditions of both mother and the offspring. Diet during pregnancy, self-care and lifestyle can lead to permanent changes in the child's oral health. The transmission of maternal oral microbiota and the use of fluorides are important in baby's oral health in early life of the child.

PHYSIOLOGICAL CHANGES IN THE BODY OF PREGNANT WOMEN

1. During pregnancy dietary intake increases.
2. Pregnancy itself does not increase the risk of caries, but increases the dietary carbohydrates, which provides suitable substrate for the growth of cariogenic organism in the mouth.
3. Since placenta produces higher amount of hormones, i.e. Estrogen and Progesterone during pregnancy. These hormones affect oral tissue and make oral tissue vulnerable for disease like gingivitis and epulis gravidarum, which usually regresses in one or two months postpartum.
4. Nausea and vomiting—It affects about 70 percent of pregnant women. It begins between 4th and 8th week and continues up to 14th to 16th week. Long-term vomiting also known as hyperemesis gravidarum, can produce erosion of maternal tooth enamel. The effect of maternal electrolyte imbalance on fetus or offspring; may alter the tooth formation, calcification and maturation of the fetal tooth.
5. In normal pregnancy calcium availability to the fetus for tooth formation is relatively stable. There is no

loss of mother skeletal calcium in pregnancy. Although, the rate of bone turnover and remodeling in pregnant women is twice that in non-pregnant women.

PSYCHOLOGICAL CHANGES IN PREGNANCY

Pregnancy is both an enjoyable and stressful period for women with continuous emotional changes.

- *In first trimester:* Psychological changes are unstable.
- *In second trimester:* Mother usually feels better and excited about the pregnancy. It is the ideal time for prenatal dental counseling and treatment of pregnant women's oral dental needs.
- *In third trimester:* Women feel some physical discomfort and she is careful about the health of the offspring.

MATERNAL DIET AND NUTRITION

It is well proved that maternal diet severely affects the health of offspring, like folic acid deficiency produces → Neural tube defects. In severe economically deprived communities, extreme maternal malnutrition can produce malformed enamel. The role of vitamins A and D in enamel formation is well established.

PRENATAL FLUORIDE

- It seems that fluoride passes through the placenta, but how much is available to the fetus after maternal excretion and deposition in fetal skeleton is still unknown.
- In few studies of prenatal fluoride use, the researchers found that the children born to the mother who

Table 19.1: Infections during pregnancy and its effect on oral cavity

<i>Infections in pregnancy</i>	<i>Effect on dental tissues</i>
1. Pregnancy associated events - Toxemia of pregnancy - Breech positioning - Rhesus factor mismatch - Difficult delivery.	- Enamel hypoplasia - Enamel hypoplasia - Tooth staining - Enamel hypoplasia.
2. Systemic disease in pregnancy - Diabetes mellitus - Tetracycline intake - Alcohol abuse - Hydantoin intake - Maternal hyperthermia.	Enamel hypoplasia Tooth staining Maximum hypoplasia Cleft lip/cleft palate Cleft lip/cleft palate
3. Infectious - Periodontal infections - Syphilis - Rubella - Cytomegalovirus - HIV infections.	} Enamel hypoplasia Increased caries risk and periodontal disease

received the supplement of 1 mg/day of fluoride during the last half of gestation had no better caries resistance than controls.

- Pregnancy can affect the entire orofacial complex as fetal hydantoin and fetal alcohol syndrome (Table 19.1).

Breastfeeding and Oral Health of Child

- American academy of Pediatrics supports breastfeeding to child and encourages its continuation as long as feasible and beneficial to the maternalchild bond. One study showed that breast feeding protects against malocclusion.
- Caries and Breastfeeding have a relation like bottle feeding and caries. When a child sleeps with mother and has open access to the breast during the night, showed increased risk of rampant caries.
- Human milk is not alone cariogenic unless others supportive things are present, like diet and plaque. Human milk differs from cow's milk in having more lactose, less minerals and proteins. Human milk have very low concentration of fluoride and it is well below that needed to provide recommended daily dose of fluoride.

Aim and Objective of Prenatal Dental Counseling

The primary aims of prenatal counseling in dentistry are to educate the parent about their own oral health and

to create behavior that will provide the good oral health of their unborn child. The propose of prenatal oral health counseling are:

- To educate the parent about dental development of child, dental diseases and prevention.
- To provide appropriate environment for child.
- To strengthen and prepare the child and the dentition for life.

Methods

- By educating on development, prevention and disease.
- By demonstration of oral hygiene procedure.
- Evaluation of learning, acceptance and needs.

Contents of Counseling

1. Parent oral health:

- Motivation of parents for oral hygiene maintenance to improve their own health and for the oral health of their expected child.
- Discuss about maternal oral health, risk factor for caries from carbohydrates, myths of pregnancy and needed dental treatment.

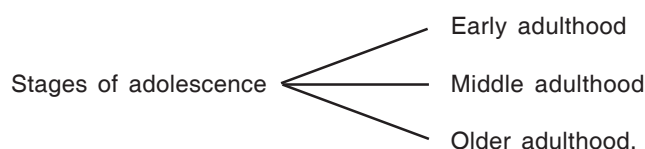
2. Child's oral health:

- Discuss about child development, involving oral, psychological and general development affecting oral health care.

- Discuss about lifestyle of the child, habits, substance abuse, sugar or sweet intake, maternal diseases and nutrition (including prenatal fluoride and breast-feeding).
- **Postnatal period:** Discuss about teething, tooth eruption pattern, non nutritive sucking, timing of 1st dental visit and bottle use.

Nowadays it is an established fact that parental oral health has become an integral part of prenatal care, because of recent studies linking the oral health of the mother to that of child. Usually preconception counseling may be an ideal vehicle to approach a mother, so as to benefits the oral health of her child.

STRATEGIES ASSOCIATED WITH LIFE STAGES OF FEMALE



Puberty and Adolescence

Young women begin producing sex hormones like estrogen and progesterone and experience the menstrual cycle. These sex hormones have capability to influence the periodontium and physiology of host microbiota and their interaction in the oral cavity. Sex hormone may increase the permeability of blood vessels of periodontium; also may increase the availability of hormone in the oral fluid. Due to the increased permeability of vessels, Gingiva showed exaggerated response to microbiota. The incidence and severity of gingival disease is increased at puberty. Some females may feels menstrual cycle gingivitis several days before the menstrual cycle period. This condition will usually subside after their period starts.

Treatment

Adolescent oral hygiene practice (see in chapter: Age Specific Plaque Control).

NUTRITIONAL STRATEGIES FOR ADOLESCENT GIRL (TABLE 19.2)

Most young girls require approximately 2200 calories/day and an active teenager requires additional calories. Micronutrients are as important as macronutrients. The

Table 19.2: Micronutrients nutritional strategies for adolescent girl. They are essential for the development of adolescent girl

Iron	Zinc	Calcium
Beef	Red meat	Milk
Cream of wheat	Whole grains	Yogurt
Dark meat	Shellfish	Cheese, Almond

most important micronutrients are calcium, iron and zinc. Eating regular meals specially breakfast will provide the required energy level, mood and a sense of wellbeing.

The women taking oral contraceptive are 2 - 3 times more vulnerable for localized osteitis following extraction of mandibular 3rd molar, possibly because of effects of estrogen on blood clotting factors.

Principle of Dental Surgery for Adult Women

1. *Antimicrobial and oral contraceptive:* Those women who use oral contraceptive should use an alternative form of birth control like condoms or female condoms if they need an antibiotic.
2. *Surgery and oral contraceptive:* Any dental surgery like periodontal surgery or extraction should be scheduled on day 23-28 of the contraceptive pill cycle, so as to reduce the risk of postoperative localized osteitis.
3. *Pregnancy vomiting and teeth:* Pregnancy vomiting patient is advised to rinse her mouth thoroughly with water and then brush the teeth with fluoridated, mineralized paste. Brushing the teeth first may cause erosion of the enamel.
4. *Ptyalism or sialorrhea:* It is a rare condition in pregnancy. Excessive secretion of saliva in pregnant women usually begins at 2-3 weeks of gestation and ceases after delivery.
5. *Oral hygiene during pregnancy:* A good oral hygiene is important during pregnancy because of the exaggerated response of the gingiva to the irritant. Oral prophylaxis and root planing can be done any time during pregnancy but 2nd trimester is the safest period. Mouthrinses with high alcohol content should be avoided.

Treatment During Pregnancy

Elective treatment should be avoided during the 1st trimester and last half of the third trimester. Since the

Ist trimester is the period of organogenesis and last half of the trimester is potential for premature delivery and also pregnant women feels very uncomfortable on the dental chair.

The second trimester is the safest period for the treatment and the basic aim to be controlling active disease and eliminating potential problems that could occur later in the pregnancy. X-ray should be avoided in first trimester. Physician should be consulted if there is a need of medication or general anesthesia.

Antibiotic Vaginitis

When pregnant women need the therapy with antibiotics it is advised that pregnant women should receive prophylactic suppositories of Nystatin (Antifungal).

Temporomandibular Disorders in Pregnancy

If the pregnant women complain about her TMJ problem, it is advised to eat soft food, apply heat or ice packs and use muscle relaxant and anti-inflammatory drugs.

Nursing Bottle Caries (baby bottle tooth decay)

It should be discussed with pregnant women. Baby bottle containing sweet liquid including milk, juices should not be kept in the mouth of infants for long periods of time. The common cause of nursing bottle caries is putting the bottle in mouth during sleep, where it remains for several hours at a time.

Nutrition During Pregnancy and Lactation (Table 19.3)

Normal calorie requirement for women is 2200 calories/day, however in pregnancy it is increased by 300 calorie and 500 calories during lactation. The most important micronutrients for pregnant women are Folate, Vitamin B₆, Vitamin B₁₂, Calcium and Zinc. The table showed nutrients necessary for healthy pregnancy and lactation.

During lactation, the aim is not to reduce the calorie needed and lose pregnancy weight, because women doing so might not be able to breast feed. A slowly weight loss is always advised through nutritious food choices, smaller and frequent meals and by increased physical activity.

Health history of pregnant, pre- and postmenopausal female

Adolescents	Pregnant patients	Peri- and postmenopausal patients
# Has your menstrual cycle begun?	# How for long is you? # Are you taking any medications?	# Have you noticed any changes in your menstrual cycle? # Have you talked to your gynecologist or nurse practitioner about these changes?
• When did it begin?	# Have you noticed any physical changes?	# Have you had any blood tests for menopause (serum FSH level)?
# Have you noticed any changes in your mouth? • Sores • Gums that are enlarged, red or bleeding.	# Have you noticed any changes in your mouth? • Sores • Gums that are enlarged red or bleeding • Loose teeth.	# When did your mother go through menopause? # Have you had a bone density test? # Are you experiencing any gingival bleeding or sloughing. # Are you on hormone replacement therapy?
# Do you smoke? • Do you use smokeless tobacco?	# Have you experienced morning sickness? # Is this a high risk pregnancy?	• Why are you on hormone replacement therapy? • Why are you taking hormones? • Have you noticed any changes in your mouth?
# Are you sexually active? • Are you practicing safe sex?	# Do you have any diabetic tendency?	# Are you sexually active? • Are you practicing safe sex? • Do you have multiple partners?
# How often do you eat sugary foods or candy? • How often do you drink carbonated drinks?	# Are you retaining fluid? # Do you have high B.P? # Have you experienced dizziness or fainting when you tie on your back?	

Table 19.3: Essential nutrients necessary for a healthy pregnancy

Nutrient/source	Recommended daily amount
• FOLATE and FOLIC ACID	400 µg
FOLATE – Lentils, cooked (1 cup)	358 µg
– Spinach, cooked (1 cup)	262 µg
– Orange juice (1 cup)	109 µg
FOLIC ACID	
– Ready to eat cereal (1 ounce)	100-400 µg
– Cooked pasta (1 cup)	100 µg
– Instant oat meal (1 cup)	80 µg
• VITAMIN B ₆	1.9 mg
– Banana, 1 large	0.8 mg
– Bran flakes (3/4th cup)	0.5 mg
– Steak (3 ounces)	0.5 mg
• VITAMIN B ₁₂	2.6 µg
– Steak (3 ounces)	2.1 µg
– Tuna (3 ounces)	0.99 µg
– Milk (8 ounces)	0.95 µg
• CALCIUM	1000 mg
Milk (8 ounces)	300 mg
Calcium fortified orange juice (6 ounces)	225 mg
Calcium fortified Soya milk (8 ounces)	250-300 mg
• IRON	30 mg
– HEME IRON (animal food)	2.5 mg
Steak (3 ounces)	0.9 mg
– Chicken breast (3 ounces)	2 to 9 mg
NON HEME IRON (plant source)	2.6 mg
– Fortified breakfast cereals (½ cup)	
– Kidney beans (½ cup)	
• ZINC	15 mg
– Steak (3 ounces)	4.7 mg
– Wheat germ, toasted (¼ cup)	5 mg
– Bran cereal (½ cup).	4.3 mg

Menopause and Oral Health

Menopause can be defined as the cessation of menstruation, resulting from the loss of ovarian activity. Menopause begins at the age of 45-55 years. Few symptoms that are frequently complained by menopausal women are:

1. Hot flashes and rapid rise in temperature with profuse perspiration.
2. Vaginal thinning, dryness and frequent vaginitis.
3. Frequent depression, irritability and inability to concentrate.

Oral Symptoms of Menopause

1. Xerostomia [T/t- Sugar free lemon drop or oral balance gel (ICP Medical Co.)]

2. Burning mouth syndrome [T/t- topical lignocaine gel; Topical Nystatin or Steroids]
3. Osteoporosis- (T/t- Estrogen therapy).
4. Other symptoms like Gingivitis, Periodontitis, dental caries and dental and hypersensitivity.

BIBLIOGRAPHY

1. Alexander GR, Korenbok CC. The role of prenatal care in preventive low birth weight. *Future Child* 1995;5:1-15.
2. Amar S, Chung KM. Influence of hormonal variation on the periodontium in women. *Periodontal* 1994;20006:78-87.
3. American Dietetic Association. *Pregnancy Nutrition: Good Health for you and your baby*. American Dietetic Association, 1998.
4. Brambilla E, Felloni A, Gagliani M, et al. Caries prevention during pregnancy: Results of a 30 months study. *J Am Dent Assoc* 1998;129:871-7.

5. Caulfield PW. Dental Caries- a transmissible and infectious disease revisited; A position paper *Pediatric Dent* 1997;19: 491-8.
6. Charney P, Walsh J, Nattinger AB. Update in women's health. *Ann Intern Med* 1999;131:1-11.
7. Cheney HG, Cheney VC. The dental hygienist as a health educator in prenatal care. *Dental Hygienist* 1974;48:150.
8. Chernoff R. Nutritional need of elderly women. In Krummel DA, Kris-Etherton PM (eds): *Nutrition in Women's Health* Gaithersburg, MD, Aspen Publishers 1996; 299-321.
9. Chung KC, Kowalski CP, Hyungjin MK, et al. Maternal cigarette smoking during pregnancy and the risk of having a child with cleft lip/palate. *Plast Reconstr Surg* 2000;105:485-91.
10. Covington P. Women's Oral Health issue. An exploration of the literature. *Prob* 30:173, 177, 196.
11. Cruikshank DP, Hays PM. Maternal physiology in pregnancy. In Gabbe SG, Niebyl JR, Simpson JL (Eds); *Obstetrics, Normal and Problem Pregnancies*, ed 2, New York Churchill Livingstone 1991; PP-125-46.
12. Darby ML, Walsh MM. Personal mechanical oral hygiene care and chemotherapeutic plaque control. In *Dental Hygiene Theory and practice* Philadelphia, WB Saunders, 1995, pp 435-60.
13. Dean MC, Fried JL. Comprehensive caries management in children. A case report. *Case studies in Dental Hygiene* 2000;1:1-5.
14. Erickson PR, Mazhari E. Investigation of the role of human breast milk in caries development. *Pediatr Dent* 1999;21:86-90.
15. Ferris GM. Alteration in female sex hormone-their effect on oral tissue and dental treatment. *Compendium of continuing education in Dentistry* 1993;14:1558-70.
16. Food and Nutrition Board: Dietary Reference intakes for calcium, phosphorus, Magnesium Vitamin D and Fluoride, Washington, DC, National Academy Press, 1997.
17. Gardner DE, Norwood JR, Eisensohn JE. At will breastfeeding and dental caries: Four case report. *ASDC J Dent Child* 1977;45:186-91.
18. Gusberti FA, Momelli A, Lang NP, et al. changes in sub gingival microbiota during puberty. *J. Clinical Periodontal* 1990;17:685-92.
19. Hallonsten AL, Wendt LK, Mejare I, et al. Dental Caries and prolonged breastfeeding in 18-month-old Swedish children *International Journal of Pediatric Dentistry* 1995;5:149-55.
20. Harvard Health publications: Tobacco smoke and women: a special vulnerability? *Women's Health Watch* 11:1-2, 2000. Available at; [www. Health. Harvard.edu/medline/w/wo_soa.html](http://www.Health.Harvard.edu/medline/w/wo_soa.html). Accessed December 5, 2000.
21. Hicks MJ, Flaitz CM, Carter AB, et al. Dental caries in HIV infected children: A longitudinal study. *Pediatric Dent* 2000;22:359-64.
22. Infant PF. Enamel hypoplasia in Apache children *Ecology and Food Nutrition* 1974;3:155-6.
23. Labbou MH, Hendershot GE. Does breastfeeding protect against malocclusion? An analysis of the 1981 child health supplement to the National Health interview, survey *Am J Prev. Med.* 1987;3:35-40.
24. Lai PY, Seow WK, Trudehope DI, et al. Enamel hypoplasia and dental caries in very low birthweight children: A case controlled longitudinal study. *Pediatr Dent* 1997;19:42-7.
25. Leverett DH, Adair SM, Vaughan BW, et al. Randomized. Clinical trial of the effect of prenatal fluoride supplements in preventing dental caries. *Caries Res* 1997;31:174-9.
26. Machuca G, Khoshfeiz O, Lacalle JR, et al. The influence of general health and sociocultural variables on the periodontal condition of pregnant women. *J Periodont* 1999;70:779-85.
27. Mattana D, Zarkowski P, Wyche C, et al. Perimenopausal women: Oral health status and preventive strategies. *Journal of women's aging* 1996;8:21-32.
28. National Research Council. Committee of Diet and Health food and nutrition board. Commission of life sciences: Diet and Health. Implication for reducing chronic disease risk Washington, DC, National Academy Press, 1989.
29. National Research Council. Recommended Dietary Allowances (ed 10) Washington DC, National Academy Press 1989.
30. Niessen LC. Overview of women's oral health: *Journal of Practical Hygiene* 2000;9:11-6.
31. Nowah AJ, Crall J. Prevention of dental disease. In Pinkham JR, Casamassimo PS, Fields HW, et al. (eds): *Pediatric Dentistry. Infancy through Adolescence*, ed 3. Philadelphia, WB Saunders, 1999, P 196-201.
32. Offenbacher S, Katz V, Fertik G, et al. Periodontal infection as a possible risk factor for preterm low birth weight: *J Periodontal* 1996;67:1103-13.
33. Olsen L. Answering the challenges of women's oral health: *Access* 1997;11:35-43.
34. Redford M. Beyond Pregnancy gingivitis: Bringing a new focus to women's oral health. *J Dent Educ* 1993;57:742-8.
35. Steinberg BJ. Production and origin of oral health issue *J Dent Educ* 1999;63:271.
36. Tonzetich J. Production and origin of oral malodor: A review of mechanism and methods of Analysis: *J Periodontal* 1997;48:13-20.
37. Van Dinter MC. Ptyalism in pregnant women. *J Obstet Gynecol Neonatal Nurs* 1992;20:206-9.
38. Watson MR, Gibson G, Guo I. Women's oral health awareness and care-seeking characteristics: A pilot study *J AM Dent Assoc* 1998;129:1707-16.
39. Wilkins EM. Oral infection control: Tooth brushes and tooth brushing, in *clinical practice of the dental hygienist* ed. 8 Philadelphia, Lippincott Williams and Wilkins, 1999; pp 350-67.
40. Zachariasen RD. Oral manifestations of menopause. *Compendium of continuing education in dentistry* 1993;14:1584-91.

Myofunctional Appliance Therapy

INTRODUCTION

Functional appliances have been known since the beginning of the 20th century. The first myofunctional appliance was presented at an orthodontic meeting in France in 1902 by Pierre Robin. The appliance was a one piece or 'monobloc' appliance fabricated to hold the mandible in a forward position. A series of modifications of this appliance have been done. The most commonly used functional appliances are Harvold activator, inclined planes, oral shields bionators, and Frankel appliance. In recent years functional appliances have also been used in combination with extraoral traction, e.g. with cervical head gear - a technique developed by Pfeiffer and Grobety, or in combination with high pull head gear as recommended by Tauscher.

Definition

Functional appliances can be defined as postural appliances that achieve their results through a combination of two treatment principles namely:

1. Growth adaptation
2. Tooth movement.

Functional jaw orthopedics is treatment with functional appliances making use of forces created by the head and neck musculature to bring about the desired dental, facial, and functional changes.

Functional appliances are removable or fixed [cemented] appliances that alter the posture of the mandible [lower jaw] and transmit the forces created by the resulting stretch of the muscles and soft tissues and by the change in the neuromuscular environment to the dental and skeletal tissues to produce movement

of the teeth and modification to the growth of the jaws and lower face.

I. Growth adaptation: Is defined as treatment that modifies the growth of jaws. Whereas tooth movement is the movement of the teeth within each of the jaws (intra arch). The typical tooth movements are in a distal direction in the upper arch and in a mesial direction in the lower arch in most class II malocclusions.

Mode of Action

The fabrication of functional appliances is based on a bite registration, made with a bite wax taken with the lower jaw in a protruded position. The forward positioning of the lower jaw activates the mandibular musculature to retract the mandible and the lower dentition. As the appliance locks the upper and lower jaw together, these muscle forces are also transmitted through the appliance to the upper dental arch and the upper jaw.

Functional appliances work through two types of force systems:

1. Passive forces
2. Continuous muscle forces.

The most important forces acting on the jaws and the dentition during sleep are passive forces, developed by the stretching of the mandibular muscles. Continuous muscle forces or intermittent forces are observed only during daytime wear, when the patient actively bites forward into the appliance and at night during the rapid eye movement sleep periods. This appliance, particularly activator, mainly works by increasing alveolar height,

controlling differential eruption of the teeth and reducing forward growth of the maxilla.

Classification

Myofunctional appliances can be classified in a number of ways:

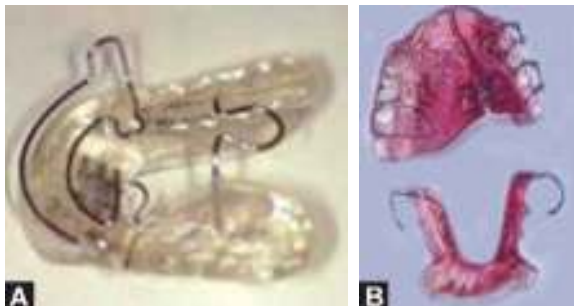
Group I: These appliances transmit muscle force directly to the teeth, e.g. inclined planes and oral screens.

Group II: It includes activator and its various modifications. Such appliances reposition the mandible downward and forward (except in Class III malocclusion), activating the attached and associated musculature. The resultant force that is created is transmitted not only to the teeth but also to other structures. Both the maxilla and mandible are involved.

Group III: This group works through mandibular positional changes by involving musculature only. Their major operating area is in the vestibule outside the dental arches. Supporting bone and teeth are influenced by changing the muscle balance through cheek shields and lip pads example Frankel FR (Function regulator) appliance.

All three groups may be considered interceptive appliances. The mixed dentition period is most frequently the optimal time for myofunctional therapy. Both activator and Frankel appliances may be used quite successfully during pubertal growth spurt periods.

1. **Passive tooth borne appliances (Figs 20.1A and B):** These appliances have no intrinsic force generating capacity from springs or screws and depend only on soft tissue stretch, and usual activity to produce treatment effects, example- Activator, Bionators, Herbst appliance and Twin bloc.



Figs 20.1A and B: Basic design of bionators and twin bloc

2. **Active tooth borne appliances:** These are largely modifications of activator and bionator designs that include expansion screws or springs to move teeth, e.g. expansion activator, orthopedic corrector.
3. **Tissue borne appliance:** The functional regulator (Frankle) is the only tissue borne appliance. The appliance has minimal contact with the teeth and is located in the vestibule. It alters mandibular posture and contour of the facial soft tissues.
 - I. *Myotonic appliances:* These depend on muscle mass for their action.
 - II. *Myodynamic appliances:* These depend on the muscle activity for their action.
4. **Removable:** These can be removed and inserted into the mouth by the patient example- activator and bionators
5. **Fixed:** These are fitted on the teeth by the operator and cannot be removed by the patient, example- inclined plane.

Advantages of Myofunctional Appliances

- Permit normal function of the lips and tongue in relation to dental arches.
- Normal oral hygiene can be maintained.
- Can be used in patients during the mixed dentition.

Disadvantages of Myofunctional Appliances

- Only effective in patients who are in active growth phase.
- The tooth movements are limited to simple tipping of the teeth only.
- Do not permit controlled individual tooth movements such as rotations and torque.
- Impractical in patients with pronounced crowding requiring both extraction and extensive tooth movements.
- These appliances cannot be used in patients with an increased lower face height; vertical growth pattern and proclined lower incisors.
- These appliances are often bulky and make it difficult for the patient to breathe through mouth.
- Speech is severely interfered by these appliances.

Differential Diagnosis: A careful diagnosis of the individual patient is an important basis for the decision

to treat a malocclusion with functional appliance. Emphasis should be given to the following point, before starting treatment for malocclusion by myofunctional therapy.

- a. **Facial morphology:** A particular concern is the anterior vertical face height. Patients with an increased lower face height generally have a posterior direction of condylar growth with very little vertical growth. This promotes a clockwise or backward rotation of the mandible during treatment resulting in an undesirable increase in anterior face height.
- b. **Dentoalveolar compensation:** In a patient with a class II malocclusion, dentoalveolar structures will often have attempted to compensate for the skeletal discrepancy which is mostly seen as a proclination of lower incisors whereas the maxillary incisors will be more upright with a decrease in the maxillary alveolar protrusion. Recognizing compensatory or dysplastic development is important, both for the timing of treatment and with respect to the treatment approach.
- c. **Growth pattern:** Patients with a normal or reduced anterior face height in most instances have a downward and forward growth pattern of the mandible. In contrast patients with an increased lower face height tend to grow more in a vertical direction.
- d. **Stage of maturation:** Functional appliances are most efficient in an active growth phase and should normally only be used in growing patients. The best time is either early around 7 to 8 years of age when the skeletal growth rates in most children demonstrate an early increase, or later during puberty.

Indications

- Patients who are in active growth phase
- Mild to moderate sagittal skeletal discrepancy
- Reduced, normal or moderately increased anterior face height.
- Anticipated downward and forward mandibular growth direction.
- No severely rotated or tipped teeth
- No missing teeth
- Lower incisors well aligned to the profile.
- Normal airways (nose breathe)
- Patient positively interested in treatment.

Contraindications

- Severely malposed teeth and severe crowding and spacing.
- Unfavorable facial morphology, i.e. increased lower anterior face height and with vertical growth pattern.
- Proclination of the lower incisors.
- Poor patient cooperation.
- Patient is a mouth breather, suffers from adenoids, allergies or has speech problems.

Timing of Treatment

1. Early or interceptive treatment is indicated in those patients who show mild to moderate skeletal discrepancy, if the malocclusion shows dysplastic dentoalveolar development, i.e. dentoalveolar changes that further aggravates the existing skeletal discrepancy. Patients with acceptable dentoalveolar compensation and with moderate overjet, overbite are best treated in late mixed dentition during the pubertal growth spurt. In patients with moderate to severe sagittal skeletal discrepancies with anticipated favorable growth pattern and minimal dysplastic dentoalveolar development, treatment is best conducted during the pubertal growth spurt. In boys treatment is usually initiated at the beginning of the growth spurt whereas in girls who usually have a less pronounced spurt, treatment should ideally be started 1 to 2 years before the pubertal growth maximum and not delayed until the onset of the spurt.

TYPES OF APPLIANCES

Inclined Plane

The inclined plane was first introduced by Catalan more than 150 years ago. It is the simplest of all functional appliances. Sufficient space is a primary prerequisite. All inclined planes have the characteristic of opening the bite by allowing the posterior teeth to erupt. Inclined plane is of great value in young patient whose permanent molar has not yet erupted, but who have had the primary molars extracted and have lost all molar occlusal contact. In such cases, it is impossible to get the anchorage for removable appliances carrying screw or spring. The Incisal capping or Catalan's appliance may be used to correct incisors relation.

Indications

Indicated in developing anterior crossbite along with good degree of overbite, deep bite case and where many primary teeth have been removed.

Contraindications

Inclined plane is contraindicated in crossbite due to true mandibular prognathism and less degree of overbite.

Duration of treatment: Time taken for correction of crossbite is 6 weeks.

Mode of action: When the appliance is cemented it contacts only the anterior teeth which are in crossbite. As the patient swallows, there is no contact in the posterior region and all the forces are transmitted to the region of contact, which guides the teeth to slide into normal position. The degree of inclination of the inclined plane is ranges in between 45 to 60 degrees. The steeper the plane, greater the forward pressure on maxillary incisors.

Oppenheim splint: A modification of the simple cemented inclined plane. It is Incisal capping with polished metal inclined in vulcanite covering mandibular teeth. The splint is fabricated with the upper premolars and molars occluding on the splint. The appliance is then activated by grinding posterior occlusal surfaces away approximately 1 mm, so that the only teeth that touch are the malposed incisors, which engage the inclined plane. With this appliance the force is minimal and is particularly desirable for teeth whose roots have not formed completely.

Vestibular or oral screen: The vestibular screen was introduced in 1912 by Newell. It has been widely advocated by Kraus, Hotz, Nord, Fingerroth and modified by Frankel. The vestibular screen has turned out to be a versatile and simple appliance in the early interceptive treatment of dental arch deformities. This is particularly true when the malocclusions are caused or aggravated by faulty muscle function producing excessive overjet.

Indications: Used for correction of:

- Thumb sucking
- Lip biting
- Tongue thrust
- Mouth breathing when the air ways are open
- Mild distocclusion with premaxillary protrusion and open bite in the deciduous and mixed dentition

- Flaccid, hypotonic orofacial musculature as muscle exerciser.
- Proclined maxillary anterior teeth.

Mode of Action

The lips exert pressure through the acrylic against the anterior part of the dentition and the bony support. Since, the buccal flange of the screen is wide enough to keep the pressure off to the posterior teeth (2 to 3 mm clearance on each side in the first deciduous molar area). The tongue's active function creates pressure to the posterior segments of the teeth and helps to expand narrow dental arches.

In the developing distocclusion, the appliance may be made with the jaws in a more nearly normal sagittal relationship. The working or bite registration is taken directly in the patient's mouth by moving the mandible forward 1 to 3 mm and the bite is opened 2 mm. This is maximum bite opening for screens. In case of an open bite there is often no need to expand the buccal segments and the appliance is allowed to rest on the tissues. In the premaxillary protrusion, the maxillary arch is narrow, thus the screen is fabricated so that it contact the maxillary incisors only and stands away 3 mm on each side from the buccal segment.

The vestibular screen should be worn by the patient every night and also during the day when possible, example- while doing school work or watching television. The patient is also instructed to perform lip exercises several times a day for a few minutes at a time, at least 30 to 45 minutes over a 24 hour period. The lips should be kept in contact all the time to enhance the effect of the appliance and to improve the lip seal. Patients are recalled every 2 weeks to motivate them and to insure optimal co-operation from parents in seeing that the appliances are worn as much as possible.

Modifications

1. **Hotz modification:** A 21-gauge wire loop is added to the anterior aspect of the oral screen. The patient then pulls the appliance forward by grasping the loop while simultaneously resisting the displacement of the screen with tightly closed lip musculature.
2. **Oral screen with breathing holes:** This modification of oral screen has been developed by Kraus, Fingerroth and others. A button with a string attached is placed on the lingual surface, and the

patient is instructed to perform exercises by pulling string through the breathing hole and resisting forward displacement.

3. **Double oral screen:** A smaller lingual screen is attached to the vestibular screen with two 0.9 mm wires that run through the bite in the lateral incisor area. This is useful in abnormal tongue posture and in tongue thrust and open bite cases. This modification has been developed by Kraus and Selmer-Olsen.
4. **Modification of Rehak:** Oral screen is combined with a nipple, which protrudes but is retained by the upper and lower lips. Thus, natural sucking movements are used to enhance the effect of the oral or vestibular screen.

Lip Bumper or Lip Shield: This is constructed for the lower arch. It is a labial appliance fitted to tubes on the molar teeth.

Uses

- Up righting molars.
- Increase arch length by moving molars distally when there is mesial drifting of teeth and causing the incisors to move anteriorly.
- Hyperactive Mentalis.

Mode of action: The appliance presses against the lip, which creates distal force through the lip bumper plate to tip the molars posteriorly. The appliance also alters the equilibrium of forces against the incisors, removing any restraint from the lip against these teeth. The result is the forward movement of lower incisors which increases the arch length and reduces the crowding and excessive overjet.

Denholtz appliance: It is a modification of lip bumper in which plastic shield or a lip bumper are used together with coil spring at the mesial surface of the horizontal buccal tubes, attached to the molar band fitted on the maxillary molar, to affect the maxillary molar retro positioning.

Activator: Andresen developed the activator to change the functional pattern of the Perioral and masticatory musculature, thereby correcting the malocclusion. The appliance is fabricated on a set of study casts that are oriented in the correct anteroposterior relationship with the help of bite registration sheet taken with the lower jaw forwarded to class I occlusion. Andresen

recommended that the maximum forward positioning of mandible should not exceed 4 to 6 mm with a vertical bite opening or occlusal clearance of 2 to 4 mm. If there is more than 6 mm of maxillomandibular discrepancy, a second appliance should be constructed after the initial correction has been achieved. This appliance seems to be like upper and lower base plate which are attached with each other, hence the name monobloc.

In the standard Andresen appliance (Activator), the lingual flanges of the appliance are extended below the level of the marginal gingiva in the lower jaw to prevent the appliance from falling out during sleep. The upper part of the appliance carries a labial wire that stabilizes it against the front teeth and rests against the teeth in the buccal segments. The appliance is loose fitting and has no anchorage elements. Selective trimming is done to permit guidance of tooth eruption of individual teeth, if the patient has used the appliance for 2-3 months.

Indications

1. *Class I, Div. I malocclusion:* The narrow V shaped maxillary arch needs to be expanded in class I div.I malocclusion. Usually expansion is achieved by incorporating an expansion screw in the palatal section of activator. Eruption of the posterior teeth is facilitated by grinding acrylic away from the occlusal aspects of the appliance touching to the teeth. The upper posterior teeth are guided distally and inferiorly by allowing contact with the acrylic only at the mesio gingival aspects of these teeth. The lower posterior teeth are relieved to erupt occlusally and sometimes mesially and are guided similarly. With moderate expansion of the buccal segments, the maxillary buccal teeth are stimulated in a distal direction where as the mandibular buccal teeth have a slight mesial directional vector. The eruption of the lower incisors is prevented at the same time by letting the acrylic contact them incisally. The upper incisors are retracted by grinding acrylic away lingually and by letting a stiff labial bow contact the teeth labially.
2. *Class II Div 2 malocclusion* after aligning the incisors.
3. *Open bite:* Activator is not indicated for the treatment of skeletal open bite. It is used for treatment of open bites caused by tongue thrust and finger sucking. The activator is fabricated so that eruption of the posterior teeth is prevented whereas extrusion of the anterior teeth is encouraged.

4. **Crossbite:** Activator is used in early treatment of unilateral cross bites. The maxillary teeth in cross bite are moved labially and the mandibular teeth moved lingually with separate wire loops on each tooth. The fabrication of bite registration is taken so that there is at least a 6 mm clearance in the molar region for cross bite correction.
5. **Class III malocclusion:** The results are best in pseudo class III malocclusions. The bite registration for class III is taken in most retruded position with the Incisal edges 2 mm or 3 mm apart. A mandibular labial bow is used to guide the mandible distally as the teeth occlude. The maxillary labial bow is kept at a slight distance away from the labial surface to relieve any lip pressure.
6. Growing patient
7. Class I deep bite cases
8. Retrognathic mandible.

CONTRAINDICATIONS

- Severe crowding
- Class II with severe maxillary prognathism
- High angle cases
- Uncooperative patients
- Increased lower facial height
- Skeletal open bites
- Adult patients
- Abnormal Perioral muscular contractions.

Limitations of Functional Appliances

1. Individual tooth movements are difficult with activator
2. 100 percent patient cooperation is needed.
3. These appliances are of very limited use in the correction of anteroposterior jaws discrepancy.

MODIFICATIONS

Harvold Activator

Harvold designed the activator to prevent eruption of the upper teeth by maintaining the acrylic over the occlusal surfaces and in most cases only removing it in the lower posterior segment. By controlling the eruption of the maxillary posterior teeth and only allowing the mandibular molars and premolars free eruption, the differential eruption of teeth aids in the correction of the class II molar relationship.

Herren Shaye Activator: Ideal for treatment of class II Div. 2 malocclusion. In this the construction bite is taken

in strong mandibular protrusion, reaching the feasible maximum.

The Bow Activator of AM Schwarz: In this the upper and lower halves of the bow activator are connected with an elastic bow. The transverse mobility was thought by Schwarz to provide an additional stimulus. This appliance is especially suited for the treatment of Class II Div. I, malocclusions in the primary dentition.

The reduced activator (cybernator of Schmuth):

The acrylic part of the appliance is reduced in a manner similar to that of the bionators. Saving time and labor is only one of the advantages of this fabrication. It can be combined with fixed appliances of different kinds that can be worn simultaneously. It has upper labial bow to hold the upper lips and protrusion wire loop for maxillary anterior teeth. Lower incisors are covered with acrylic extension to hold them in stable position. Coffin spring may be incorporated in palatal portion.

Karwetzky Modification: It consists of maxillary and mandibular active plates joined by a U bow in the region of the first permanent molars. In addition to acrylic covering of the lingual tissue aspects, gingiva, and teeth, the plates also extend over the occlusal aspects of all teeth. The basic appliance action may be enhanced by combinations of different types of sagittal or transverse screws, labial wires, and springs.

Bionators: The bionators described by Baiters in 1960 is probably the most commonly used modification of the activator. It is less bulky than activator. The reduced bulk of the appliance and its ability to reposition the mandible and modifies dental eruption have been important in its ready acceptance by both the parents and dental surgeons. As with the activator, vertical control is present and bionators can be used for class II, class III, deep bite and open bite cases. This appliance has deep lingual flange to hold the appliance in proper position.

Types of Bionators

1. **Standard bionator Appliance:** (a) It is used for the treatment of class II Division I condition in order to correct the backward position of the tongue and its consequences. (b) For the treatment of narrow dental arches of a class I malocclusion.
2. **Bionator for Class III cases:** It is used for the treatment of mandibular prognathism to compensate for the forward position of the tongue.

3. **Bionator for open bite cases:** It is used to close the open bite in the anterior or lateral dentition areas. It is also used in TMJ dysfunction cases.

The appliance resembles the activator with some exceptions. The labial wire across maxillary incisors is modified to act as a screen, reducing the pressure from the cheek musculature on the dental arches. The appliance also has a transpalatal wire that helps in stabilizing it when the tongue rests against the wire and adds more rigidity. The acrylic is reduced to minimum. The bionator is a loose fitting appliance and not anchored to the teeth by clasps. The appliance is constructed with a moderate vertical bite opening and with moderate forward posturing of the mandible. In order to increase the lower arch lengths, expansion screws are fitted in the lower part of appliance.

MODIFICATIONS

1. The acrylic body of the bionator is reduced in size, extending less along the alveolar process.
2. The original single labial bow with the buccinator's loops is no longer used. Its function has been divided into a maxillary buccal labial arch wire and a separate mandibular labial arch wire.
3. The transpalatal bar opens in a distal direction.
4. Sagittal anchorage is reinforced with wire spurs, located mesial to the maxillary first molars or canines.
5. A metal occlusal bite plane is incorporated into the bionator to facilitate the correction of deep overbite.

Function Regulator Appliance (Frankel)

Developed by Frankel in 1996 and is used for correction of Class I, Class II div. 1 and 2, Class III malocclusion as well as open bites. The functional components of appliance generate forces by altering posture of the mandible, changing soft tissue pressure against the teeth or both. The active component generates intrinsic force to move teeth.

The function regulator differs from other appliances in that it has no contact with the lower teeth or alveolar process when the patient holds the mandible in forward position. When the patient retracts the lower jaw, a lower lingual pad comes into contact with lingual mucosa below the level of marginal gingiva of mandibular anterior teeth. This elicits a slightly painful stimulus that motivates the patient to posture forward again. The forward posture tends to accelerate growth at the condyle and increases the vertical dimension so that tooth eruption is allowed or checked as desired. The appliance has large buccal

shields that extend into the sulcus and lip pads below the mandibular incisors that are placed deep in labial sulcus. The buccal shields are connected by the upper labial bow and a transpalatal arch mesial to the first molars. In the lower part of the appliance the lingual pad is connected to the labial shields by means of cross over wires. To stabilize the appliance against maxillary arch, it has canine loops mesial to the primary canines that act to guide permanent teeth during eruption. The main purpose of the appliance is to train the lip and cheek musculature to function normally and to relieve the pressure on the dental arch maximally, thereby promoting transverse arch development.

Herbst Appliance

It is a passive tooth born appliance. This appliance was reintroduced in 1970s by Pancherz. It can be either a fixed or removable appliance. The maxillary or mandibular arches splinted with frameworks that usually are cemented or bonded but can be removable, and connected with a pin and tube device that holds the mandible forward. Occasionally, the appliance is superimposed on traditional fixed appliances. The maxillomandibular position is controlled by a pin and tube apparatus that runs below the arches.

Twin Bloc

This appliance popularized by Clark consists of individual maxillary and mandibular plates with ramps that guide the mandible forward when the patient closes down. This is similar to Herbst appliance in that pressure against the teeth rather than mucosa is employed to bring the jaw forward. The relief or presence of blocs can control eruption of anterior or posterior teeth and extraoral forces can be applied to the maxillary portion of the appliance. The appliance has the advantage of allowing nearly a full range of mandibular movements, easy acclimation, reasonable speech and simple modifiability. The greatest disadvantage is that displacement of incisors may occur.

BIBLIOGRAPHY

1. Graber TM, Neumann B. Removable orthodontic appliances, 2nd Ed. WB Saunders, Philadelphia, 1984.
2. Graber TM. Orthodontics; Principles and practice, 3rd Ed, WB Saunders Company, Philadelphia.
3. Proffit WR. Contemporary orthodontics, 2nd ed. Mosby USA, 1993.
4. Wei SHY. Pediatric dentistry. Total patient care; Lea and Febiger, Philadelphia, 1998.

Cariology and Management

PART I: THEORIES OF CARIES ETIOLOGY

THEORIES OF CARIES ETIOLOGY

The following theories of caries etiology existed:

- i. Acidogenic Theory (Chemoparasitic Theory)
- ii. Proteolysis Theory
- iii. Proteolysis – Chelation Theory
- iv. Sucrose Chelation Theory
- v. Autoimmunity Theory.

Acidogenic Theory

This theory of caries etiology was proposed by W.D. Miller in 1890. He showed that many microorganisms have ability to produce acid from the fermentation of sugar. In one experiment he further showed that extracted human teeth can be demineralized by incubation in mixture of sugar with human saliva.

The acid produced in his experiments are all organic acids principally lactic acid. These acids are produced as end product of Embden-Meyerhof of glycolytic pathway or Krebs cycle of the microorganism. These organic acids are capable of producing exact histological replicas of initial carious lesion in human tooth enamel, when sound extracted teeth are placed in a sterile acidified gelatin gel medium *in vitro* test.

Proteolysis Theory

This theory is proposed by Gottlieb in 1944. According to this theory, the initial attack on enamel might be the destruction of organic material rather than demineralization

by acid. This theory proposed that proteolytic enzyme produced by oral bacteria, destroys the organic matrix of enamel, leading loosening of the hydroxyapatite crystal, so they are finally lost and tissues collapses.

Although, high organic content area of enamel like tufts and enamel lamellae do not show greater susceptibility to the dental caries. It is not possible to produce caries *in vitro* with proteolytic agents. It is well established fact that a variety of proteolytic enzymes are produced by plaque and capable of damaging soft tissues in the initiation and progression of periodontal disease. This theory has no significance in initiation of dental caries but its role in progression of more advance stage carious lesion cannot be avoided.

Proteolysis and Chelation Theory

Proposed by Schatz and Martin in 1955. He proposed that some of products of bacterial action on enamel, dentine and food with salivary component may form chelates with calcium ions of tooth. A chelates is a complex between calcium ion and two or more groups of complexing compound. Chelates formed at neutral or alkaline pH only. So, this proteolysis chelation theory proposes that demineralization of the enamel could arise without acid formation (without fermentation of food). Recent study showed that chelation is unlikely to be involved in the initiation of the lesion, it may play a minor role in the established lesion when the plaque pH becomes neutral.

Sucrose – Chelation Theory (Phosphorylating Theory)

This theory was proposed by Lura in 1967. Plaque bacteria utilizes phosphate in the plaque, causes a local disturbance in the phosphate equilibrium in the plaque and tooth enamel, resulting in the loss of inorganic phosphate from enamel. Soluble calcium-complexing compound produced by bacteria causes further tooth disintegration (Discarded theory).

Autoimmunity Theory

Burch and Jackson (1970) proposed that genes, partly inherited and partly mutational, determine whether a site on a tooth is at high or lower risk. Odontoblast cells may be the target in the development of dental caries

which may change the resistance of the enamel to the acid attack. This theory is based on the caries epidemiological data and partly inherited genes. Recent study rejects this theory.

Sulfatase Theory

This theory proposed by Pincus et al in 1950. This theory suggests that bacteria of plaque produces sulfatase enzyme which hydrolyses the Mucoitin sulfate of enamel and chondroitin sulfate of dentine resulting into formation of sulfuric acid which causes the decalcification of dental tissues. Since the very low concentration of Mucoitin sulphate in enamel which is not readily available as substrate for enzymatic degradation. Recent reinvestigator failed to confirm this theory.

PART II: CARIES

DEFINITION

Dental caries is a polymicrobial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth, resulting cavity formation.

Clinical Classification of Caries

- i. Based on location of lesion on the individual tooth:
 - a. Pit and fissure caries
 - b. Root caries (Adult caries).
- ii. Based on the rapidity of the caries:
 - a. Acute dental caries (Early childhood caries)
 - b. Chronic dental caries
- iii. If the lesion is new and attacking a previously intact surface of tooth:

Primary caries or virgin caries.
- iv. If the lesion is occurring around the restorative margin.

Secondary caries or recurrent caries.
- v. Based on age:
 - a. Early childhood caries
 - b. Teenage caries
 - c. Adult caries.

Types of Caries

Pit and Fissure Caries

It is also known as virgin caries because it develops in the occlusal surface of molars and premolars and buccal surface of molars and lingual surface of incisors (Previously intact surface of tooth).

Smooth Surface Caries

It is also classified as primary caries or Virgin caries. It develops on proximal surface of teeth or on gingival third of buccal and lingual surfaces (class V cavity). Since smooth surface of teeth have self cleansing property so seldom does caries occur in this area, except in case of malposed or malformed teeth. The retention of plaque microbiota and carbohydrate for long period of time in the smooth surface area which is not habitually cleaned, it may lead to subsequent organic acid formation by bacterial metabolism and hence, begins the demineralization of teeth.

Proximal caries usually begins just below the “contact point” it appears as yellow – brown or faint white opacity

of enamel, in early stage. Cervical caries is also a type of smooth surface caries. It is a “crescent shaped open cavity” and does not present the narrow point of penetration as in the cases of pit and fissure caries and proximal caries.

Acute Dental Caries

Acute dental caries are those form of dental caries that are rapid in progression and show early involvement of pulp.

Clinical Features

- Initial point is small.
- At DEJ, produces large internal excavation (Diffuse involvement of dentin at DEJ).
- Dentin is stained in light yellow color rather than darker brown color of dentin as in chronic caries.
- Early involvement of pulp and becomes painful, e.g. rampant caries (Nursing bottle caries and breast feeding caries).

Chronic Dental Caries

Chronic dental caries is characterized by slow progression of caries and much later involvement of the pulp than acute caries.

Clinical Features

- Large surface area are involved.
- Slow progression of lesion.
- Stained deep brown dentin.
- Shallow cavity and little or no undermining of enamel surface.
- Pain is not a common feature of chronic caries.

Recurrent Caries

This type of caries occurs at the margin of restorations due to inadequate finish of the restoration which favors retention of plaque. It also follows the pattern of primary caries or virgin caries.

Arrested Caries

Arrested caries are those caries in which progression is stopped or static or stationary and does not show any tendency for further progression. Both the dentition (primary and permanent) are affected by this disease.

Clinical Features

- Usually, associated with occlusal surface caries characterized by large open cavity and does not show food retention.
- Superficial softened and decalcified tissue is gradually burnished.
- Lesion appears as brown stained, hard and polished “eburnated dentin”.

Pre-eruptive Caries

Term preeruptive caries is given by “Muhler”. Sometimes a defect on the crown of permanent teeth is evident radio graphically while there is no carious lesion or infection found on the primary teeth. This lesions are very similar in caries lesion, if not restored, continuous demineralization occurs. In such cases the primary teeth are advised to extract and permanent tooth is restored with appropriate filling materials.

Radiation Caries

Salivary gland radiation therapy, usually associated with xerostomia. This condition facilitates the origin and initiation of caries, known as radiation caries.

Clinical manifestation of caries process:

- Incipient caries:* The earliest stage of caries is the demineralization of enamel starting when the plaque pH decreases below critical pH. The amount of demineralization cannot be detected clinically and radiographically and, can only be detected by experimental laboratory technique. Histologically the lesion has an apparently intact surface layer overlaying subsurface demineralization. Most of these lesions undergoes remineralization and needs not to be restored.

Chalky Whitespot Lesion

The first visual clinical manifestation of caries is the chalky white spot lesion. When lesion progress to a depth of 350 micron to 500 micron white spot lesion becomes visible. The loss of subsurface enamel, results in the loss of enamel translucency.

This white spot lesion must be differentiated from developmental defect of enamel by their position (away from gingival margin) their shape and symmetry (unrelated to plaque accumulation, usually effecting contra lateral tooth respectively).

White spot lesion formation is a reversible stage of clinical caries process. Under higher cariogenic environment this white lesion may undergo frank cavitations.

Occult or Hidden Caries

Such carious lesion which is not clinically diagnosed but detected only on radiograph known as Hidden caries. It is believed that Bitewing radiograph, OPG, Fiber optic transillumination and Electron resistance method are used for diagnosis of these hidden caries. The use of topical fluoride may have the effect of preserving the integrity of enamel surface which may prevent further demineralization.

Frank Cavitation

As the enamel caries progress, the subsurface of lesion showed more loss of content of the enamel and subsurface increases in size leading to the collapse of surface layer and formation of cavitations which may require restoration.

Arrested Lesion

When caries progress becomes arrested due to oral environmental factor, it is known as arrested lesion.

ORIGIN OF DENTAL CARIES (FIG. 21.1)

Previously students were taught that origin of dental caries needs susceptible host, cariogenic oral microbiota and fermentable carbohydrate. This concept is presented by three intermingled rings known as “Key’s ring” but now a days, these three rings were surrounded by a larger ring which represent the importance of saliva and salivary components in the development of the dental caries.

The interaction of factors like, bacteria, saliva and microbial product in the production of biofilm on the tooth surface is an area where much research needs to be directed. It is well known that plaque is a biofilm that is made up of polysaccharide matrix. Knowledge concerning the formation and structure of biofilm will help not only in the understanding of microbial colonization on the tooth surface but also in the long term prevention of dental caries.

Thus, depending on the environment like cultural, socioeconomic status in which diagrammatic representation of ring model for caries is being used. Equal rings showed equal importance of each factor in one origin of dental caries. Now a days, size of the caries rings may change depending upon the particular importance of caries, developing factor using this ring model to develop caries preventive strategies either for

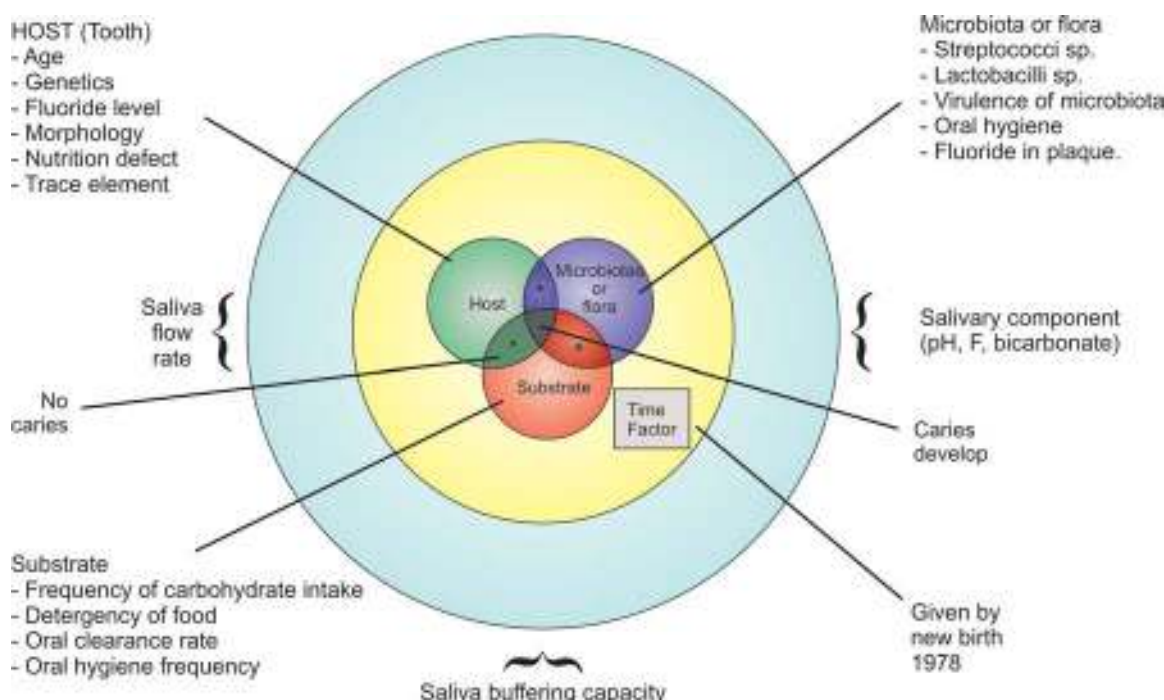


Fig. 21.1: Modified key's rings in the origin of the dental caries and associated secondary factors

the individual or as a public health measures (e.g. developed Vs developing countries).

Recent Concept of Caries Development

Caries develops due to prolong imbalance between factors favoring demineralization and that favors remineralization. To understand the caries development it is necessary to know the demineralization and remineralization process which is continuously going to happen on the surfaces of the tooth in the oral cavity.

Demineralization Process (Table 21.1)

The main mineral content of the tooth surface is hydroxyapatite crystal which is in equilibrium with saturated calcium and phosphate environment at neutral pH.

The hydroxyapatite crystal is reactive to hydrogen ions at the critical pH of 5.2 to 5.5. The Hydrogen ions reacts with the phosphate group in the aqueous medium immediately adjacent to the crystal surface with the conversion of phosphate to hypophosphate by addition of hydrogen ions being buffered at the same time. The hypophosphate is unable to contribute to the normal hydroxyapatite equilibrium because it contains phosphate not hypophosphate. Therefore, the hydroxyapatite crystal dissolves and the process is known as demineralization.

Remineralization

The demineralization process is a reversible reaction, when the pH of saliva is neutral and having sufficient calcium and phosphate ions. Either apatite crystal dissolution can reach neutrality by buffering capacity of calcium and phosphate ions in saliva can inhibit the process of dissolution through the common ions effect. This reaction starts rebuilding of partly dissolved apatite crystals and known as remineralization.

Factors Responsible for Dental Caries

- Primary factor
- Secondary factor.

Primary Factors

Caries is a multifactorial disease. Initiation and progression of caries requires three essential primary factors (Key's cycle, 1960). The three factors are as follows:

- A host tissues (teeth).
- Microbiota with cariogenic potential.
- A suitable local substrate.

Tetralogy of Dental Caries (New birth 1982)

Besides these three primary factors of caries, it includes a fourth factor, i.e. time, without sufficient time caries doesn't develop.

Caries Tetralogy:

- Host (Tooth)
- Microbiota (Cariogenic)
- Substrate
- Time.

The Tooth

Three aspect of the tooth are composition, anatomy of tooth and arch position of tooth to be considered for development of dental caries.

- Composition of tooth:** Tooth is made up of inorganic and organic content having various trace elements like zinc, lead and iron. It is observed that outer surface of enamel is more caries resistant than subsurface, i.e. inner surface of enamel. It is also seen that outer surface of enamel is highly mineralized and accumulates more amount of zinc, lead and iron than inner surface of enamel. It is observed that the fluoride content of enamel and dentine of sound tooth was found to be 410 PPM and 873 PPM respectively,

Table 21.1: Critical pH responsible for demineralization, and remineralization cycle

6.8 to 6.0	5.5 to 5.2	4.5 to 3.5
H ⁺ react with PO ₄ in saliva and plaque.	- Demineralization; Hydroxyapatite dissolve and fluorapatite formed in the presence of Fluoride ions - Remineralization	Hydroxy and fluoroapatite dissolves if H ⁺ exhausted or neutralized all ions retained
Demineralization Vs. Remineralization (Mc-Intyre et al 1998) Critical pH.		

but only 139 PPM and 223 PPM respectively in carious teeth. Any defect in mineralization or maturation process of enamel may acts as a predisposing factor for plaque accumulation and caries development.

- b. **Crown Anatomy of Tooth:** Developmental deep narrow occlusal, buccal and lingual pits and fissure predisposes to the accumulation of plaque and food debris resulting in caries development.
- c. **Location of Tooth in the Arch:** Teeth which are malaligned, out of position and normal contact area between adjacent teeth are not established or rotated tooth, may be difficult to maintain the routine oral hygiene procedure and tend to favors the accumulation of plaque and food debris. Besides certain teeth and in each tooth, certain surfaces are seen to be more susceptible to the occurrence of caries.

Role of Oral Microbiota

There is evidence that caries is an infectious disease. Various study have proved that *Streptococcus mutans* and *Streptococcus sobrinus* is the important cariogenic pathogen in the initiation of caries.

Microbiota of Enamel Caries

Pit and Fissures of enamel are the most caries prone surface and there is strong correlation between plaque level of *Streptococcus mutans* and caries have been established by different investigator at this site. The following microbiota found in enamel caries are:

- i. *Streptococcus mutans* (S M Serotype) initiation of caries
- ii. *Streptococcus sobrinus* (S M Serotype) initiation of caries
- iii. Lactobacilli sp. (Progression of caries).

Pathogenic features of Cariogenic microbiota

Pathognomonic characteristic of cariogenic microbiota are as follows:

- i. Rapidly transport fermentable sugars when in competition with other plaque microbiota and conversion of such sugar to acid.

Streptococcus mutans have several sugar transport system One of them is (P.E.P - P.T.S) system which are able to ferment sugar even at very low concentration.

- ii. They have ability to produce an extracellular and intracellular polysaccharides, like Glucans, Fructans. Glucans help in the plaque matrix formation and fructans are liable and can be metabolized under carbohydrate restricted condition. Intracellular polysaccharides are glycogen like storage compounds that can be used for energy production and converted to when free sugars are not available.
- iii. Maintains polysaccharide metabolism under extreme environmental conditions. *Streptococcus mutans* and lactobacilli both are Acidogenic and Aciduric (Acid loving) bacteria and can grow at low pH. This ability depends on:
 - a. The ability to maintain a favorable intracellular environment and pump out “protons” even under acidic conditions.
 - b. Having such enzyme system which requires more acidic pH for optimum enzyme activation.
 - c. The production of specific acid stress response proteins.

These three properties of cariogenic bacteria enable it potentially more competitive than most other plaque microbiota species under conditions of high sugar and low pH.

Microbiota of Root Surface Caries

In old age, gingival recession occurs and exposed cementum is vulnerable to the microbial colonization and subsequent demineralization by acid, released by plaque bacteria. The following microbiota associated with root surface caries are, *Actinomyces Sp.* Lactobacilli, *Fusobacterium* and *Streptococcus Sp.*

Current theory to explain the role of plaque microflora in the etiology of dental caries.

- i. **Specific plaque hypothesis:** Proposes that out of the different species of microflora of plaque, only a few species are actively involved in the disease. This hypothesis has been valuable because it focused efforts on controlling disease by targeting preventive measures and treatment against a limited number of microflora.
- ii. **Non specific plaque hypothesis:** This hypothesis suggests that caries is an outcome of overall activity of total plaque microflora. Since plaque mediated disease are essentially mixed culture, i.e. polymicrobial infection but in which only certain species are able to predominate.

- iii. *Ecologic plaque hypothesis* (Fig. 21.2): Suggest that microflora associated with disease may also be present at sound sites, but at levels too low to be clinically relevant. Caries is a result of a shift in the balance of the resident flora driven by a change in local environment. For example, Repeated condition of low pH in plaque following frequent sugar intake favors the growth of species that cause the caries.

Recent study shows that *S. mutans* produced a final pH in the region of 3.95 to 4.10, a range of other streptococci achieve terminal values of pH 4.05 to 4.50. These finding suggest that *Streptococcus mutans* are key causative microorganism in the initiation of enamel caries and other *Streptococcus sp.* can contribute to the strength of cariogenic challenge at a site.

Cariogenic bacteria are always found in dental plaque but at neutral pH these organisms are weakly competitive and produces no caries (an equal demineralization and remineralisation). If the frequency of cariogenic carbohydrate intake increases, then plaque pH goes down to critical pH 5.5 for enamel demineralization. The effect of this lower pH favors the proliferation of *Streptococcus mutans* and *Lactobacillus* which further enhances the demineralization process.

SLAVKIN SQUARES MODEL FOR ENVIRONMENTAL CARIES RISK FACTOR (FIG. 21.3)

The only difference between keys ring and slavkin square is that later is characterized by contemporary scientific

terminology used in the model. It suggests caries and its prevention into 21st century and molecular age. Caries prevention can be done by understanding molecular and biochemical concept of the caries and use of newer technologies (For example, Gene therapy, genetic marker, tissue regeneration and molecular biology).

The following slavkin risk factor contributing to the susceptibility to caries:

- Parental and child genetics
- Genetics of infectious organism
- Mucosal immunity and salivary antibodies
- Diet and nutrition
- Biofilm and microbial ecosystem
- Relative susceptibility of tooth
- Relative preventive measures
- Transmission of infectious organism
- Age of child
- Early detection of caries.

Role of Substrate

The development of carious lesion is a dynamic process during which the tooth surface is progressively demineralized to create a carious lesion. The frequent intake of sucrose between meals further enhances plaque bacterial metabolism results increase in organic acid production like lactic acid and citric acid which further enhances the demineralization process.

For determining food consumption (frequency) and food habits different kinds of nutritional analysis are used including diet history, diet record and weighing method.

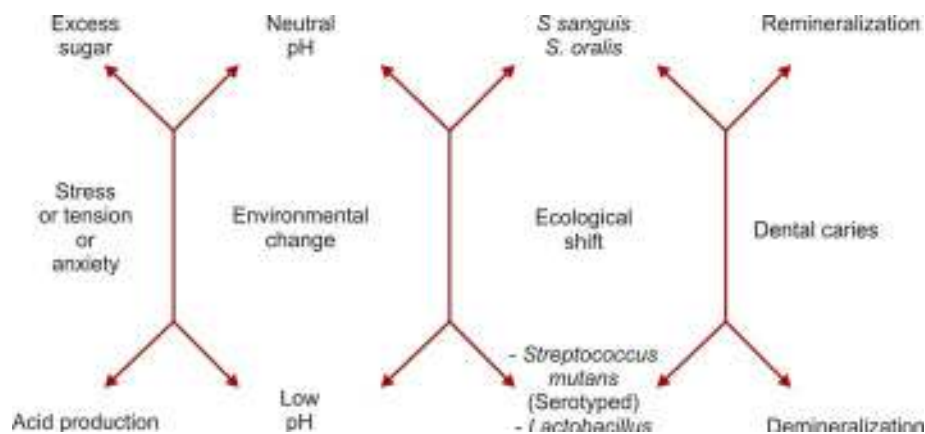


Fig. 21.2: Ecologic plaque hypothesis for development of caries

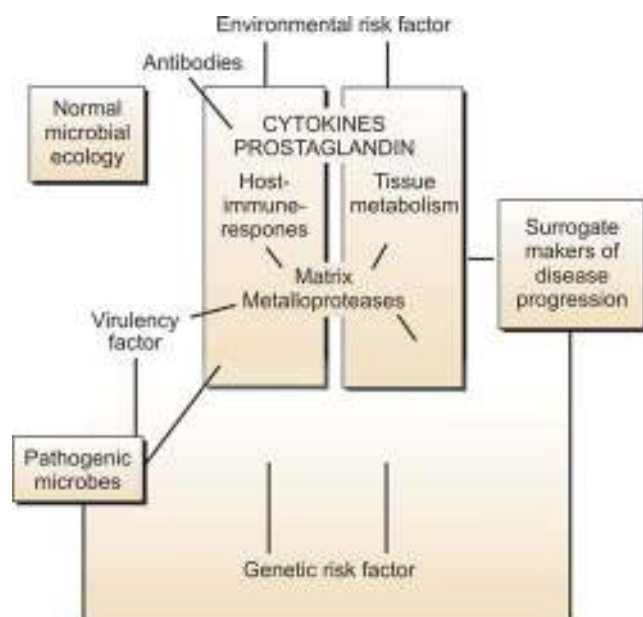


Fig. 21.3: Slavkin square model of environmental risk factors for development of caries

Weight-Watchers Phenomenon

A diet history, recording of food and beverages consumption during previous 24 hrs can be obtained. Most of the dental surgeons prefer a 5 day diet record in a week. The patient or parent is asked to write down each consumed food item and frequency and amount of food consumed.

Most dietary sucrose is refined from sugar cane and known as 'Arch Criminals' in dental caries formation. Sucrose is the most common sweetening agent in candies, cake, pastries, soft drinks etc. Sucrose have unique property because of the ability of *mutans streptococci* to produce both intracellular and extra-cellular storage polysaccharide like glucans that favor adherence and colonization of cariogenic bacteria.

The most important dietary source of polysaccharide is starch, because it is the most prevalent storage polysaccharide of plant. The cooking of polysaccharide food causes degradation and change in the form that increases the retention and allows amylase to provide metabolic substrate effectively maltose, dextrin and glucose. Starch product when combined with sucrose for sweetness, have been found to be more cariogenic in rats than sucrose alone.

Fermentable carbohydrate are cleared by the salivary rinsing, muscular activity of tongue lips and cheek if normal muscular activity of oral cavity fall down and salivary secretion decreased then their is increases in the risk of caries activity.

Food adhesiveness, consumption and dental caries; Physical property of food can be determined by:-

- Mechanical Property: Hardness, cohesiveness viscosity and Adhesiveness.
- Geometrical property: Particle size and shape.
- Moisture and fat content.

Detergent Food

It is believed that highly fibrous food has negligible adhesiveness and having mechanical cleansing action. Ex. raw fruits, vegetables, orange, celery, carrots, etc. These detergent foods have been recommended as between meals and snack food. Although, patient and parent both are advised to preferably eat detergent food over sticky food. These detergent foods are not a substitute for careful brushing and flossing of the teeth.

Dietary acid have ability to cause severe dental erosion when used frequently as a habit. Erosion is distinguished from cariogenic demineralization but may have transient effect on salivary and plaque pH. Citrus fruit like lemon, oranges, fruit juice and carbonated beverages can result in severe erosion when prolong contact with teeth occurs. Excessive use of beverages, lemon juice is to be highly discouraged to minimize the loss of tooth structure.

Caries Protective Component of Food

- The amount of free fluoride should be taken in diet counseling and therapeutic aspect of caries prevention. Ex: Green tea has 10 PPM fluoride.
- Phosphate (calcium Phosphate) component of food helps in the remineralization process and prevent demineralization of tooth surface.
- Arginine rich peptides and pyridoxine (B6) component of food have protective effect against caries by increasing plaque pH.
- Calcium lactate fatty acid occurs naturally in cheese and have some protective role, both physically and possibly by inhibition of microbial metabolism.

- Proteins and fatty diets are usually less cariogenic than carbohydrate or polysaccharide rich diet.

A number of other food components have been evaluated for caries protective effects. The food element like molybdenum, vanadium and strontium are thought to be cariostatic and selenium, magnesium and cadmium are thought to be cariogenic.

Secondary Factor of Caries Development

- Saliva (Table 21.2):** Salivary composition and flow rate are well recognized as important factor that modify the caries initiation and development. Salivary tooth protective mechanism including mechanical cleansing action, buffering of plaque organic acid, antimicrobial activity providing inorganic and organic component that help in remineralization and inhibit demineralization process.

Table 21.2: The mechanism of salivary component related to the dental caries

Salivary component	Effect on mineralization	Effect on plaque bacteria aggregation and adherence	Effect on capacity on plaque pH	Salivary buffering
Buffering factor HCO ₃ ⁻⁻⁻ Urea				Main buffer in saliva Releases NH ₃ (Ammonia) Releases NH ₃ (Ammonia)
Arginine rich proteins				
Antibacterial factors				
- Lactoferrin		• Binds with iron and inhibit independently of iron		
- Lysozyme		• Hydrolyzes plaque bacterial wall polysaccharide.	• May promote clearance through aggregation	
- Peroxidase		• Produces OSCN, inhibits glycolysis		
- Secretory IgA		• Neutralizes antigene toxins and enzymes	Binds to bacterial surface, prevents adherence of plaque bacteria	
• Alpha amylase		• Produces glucose and maltose	• Indirectly produces glucans	
<i>Factor Affecting Mineralization</i>				
Histatins	Binds to hydroxyapatite and aid in super saturation of saliva	Some inhibition of mutans streptococci	_____	
Prolin rich proteins	Binds to hydroxyapatite and aid in super saturation of saliva	_____		Bind to oral bacteria promote adherence in some cases
Cystatins	Binds to hydroxyapatite and aid in super saturation of saliva	_____		_____
Statherin	Binds to hydroxyapatite and aid in super saturation of saliva	_____		Binds to oral bacteria promotes adherence in some cases
Mucins	Provide physical and chemical barrier in enamel pellicle			Aggregation and clearance of oral bacteria

1. The critical pH for caries initiation or demineralization is about 5.2 to 5.5 depending on the phosphate concentration of the mixed saliva.
2. When tooth erupts into the mouth, it is not completely matured (Means tooth after eruption undergoes a process of post eruptive maturation). This process makes tooth more resistance to caries as compared to immature tooth. Saliva play important role in post eruptive maturation.

Plaque

Dental plaque term is to describe the biofilm found on the tooth surface. Dental plaque contains diverse range of microbes embedded in the matrix of polymers of bacterial and salivary origin.

- a. The most important part of plaque in the initiation of carious process is the plaque tooth interface.
- b. The organic acids (Lactic, citric acids) are released as a by product of bacterial metabolism on the carbohydrate substrate of plaque (By fermentation

process) and dental plaque acts as a reservoir for holding acid at a given point for relatively long periods.

OTHER FACTOR CAUSING CARIES

Hereditary Factor

Few study showed a racial tendency for high caries incidence proving that it follows the genetic pattern. Example- Black children and Eskimos exhibit less dental caries than a comparable group of white children. A high-risk caries parents produce a high-risk caries offspring. These examples seem to be following the genetic influenced pattern of the disease.

SYSTEMIC CONDITIONS

Xerostomia: Is defined as perception of oral dryness. It may be caused by various factor like drug induced, irradiation of gland, and diabetes mellitus, can cause an increase in the incidence of dental caries.

PART III: CARIES SUSCEPTIBILITY VS CARIES ACTIVITY

Term caries susceptibility pertaining to the number of new lesions that may develop in an individual over a period of time. Caries susceptibility varies in different patient, in different teeth of same individual, even; it is different in different surfaces of same tooth. While term caries activity pertaining to the number of lesions that an individual has at time of recording (i.e. new and old both). The susceptibility of teeth is arranged in descending order.

Deciduous Teeth: Second molar, 1st molar, canine lateral incisor and central incisors occlusal surface is more caries susceptible than, molar interproximal area and incisor interproximal area.

In Permanent Teeth: 1st molar, second molar, U 2 Pm, U 1Pm and L, 2 Pm, U C I, and LI, C, and L I Pm, LCI, LI, and LC.

CARIES RISK ASSESSMENT (TABLE 21.3)

Caries risk assessment is important part of the preventive dentistry. Caries could be controlled earlier if identified in susceptible individual or community. Caries risk assessment is important for the following reasons:

1. Prevention is better than cure. Prevention is economically less expensive than dental corrective treatment. Dental treatment is an on going procedure. When a course of dental treatment is completed, Dentist, patient or parent decide, when it could be wise to check that all is still well. This recall interval visits is partly based on an assessment of the risk of the caries progression and radiographic recall assessment.
2. Child and parent should be made aware of their risk status, it helps them to keep appropriate time interval recall visit.

The risk status of individual, groups or community for the purpose of caries control are presented in the table. Caries risk assessment can be based on social history, medical history, dietary habits, fluoride level, oral hygiene and saliva.

CARIES ACTIVITY TESTS

Since, caries is a multifactorial disease, a single caries test for prediction of the caries risk in an individual is impossible. An ideal caries test should possess:

Table 21.3: High caries risk vs low caries risk

<i>High risk caries individual or child</i>	<i>Low risk caries individual or child</i>
<i>Social history</i> • Low social and economic status • High caries in siblings. • Dental awareness is low. • Patient low motivation level. • Irregular attainer. <i>Medical history</i> • Compromised immunity. • Xerostomia. • Long term cariogenic drug. • Physically or mentally handicapped. <i>Dietary history and habits.</i> • Frequent sugar intake habit and history. • Refined sugar intake like sucrose, glucose, etc. in the form of candies, cake. • Prolong breast or bottle feeding. • Very less or no detergent food. <i>Saliva</i> • Low flow rate. • Thick consistency. • Low buffering capacity. • High MS and <i>Lactobacillus</i> counts. • Low salivary IgA • MS count $>10^5$, <i>Lactobacillus</i> $<10,000/\text{ml}$ <i>Use of fluoride</i> • Very low or no fluoride zone or area. • No fluoride supplements in the form of toothpaste. <i>Oral hygiene control</i> • If ineffective methods of plaque control is used. • Poor oral hygiene. <i>Clinical evidence</i> • New lesion arises. • Premature extraction may be necessary. • No fissure sealant used. • Partial denture may be present inside oral cavity.	• Middle class, individual. • Low caries in sibling. • Very conscious about esthetic and dental health. • Patient high motivation level. • Regular attainer. • No medical problem. • No physical or mental problem. • No salivary deficiency. • No history of carcinogenic drug. • Low or no sugar intake habit. • Less intake of refined sugar. • No such history. • History of detergent food intake. • MS $<10^5$ count. • <i>Lactobacillus</i> $<1000/\text{ml}$. • High flow rate. • Very dilute consistency. • Low MS and <i>Lactobacillus</i> counts. • High salivary IgA, high buffering capacity. Optimum fluoride level in the zone or area. • Fluoride supplement used in the form of milk fluoridation or topical or in form of toothpaste (if required). • If effective cleaning method is used. • Good oral hygiene. • No new lesion develops. • No extraction for caries. • Frequent fissure sealant used. • No appliances used.

1. Validity
2. Reliability
3. Feasibility
4. Sensitivity
5. Specificity.

Caries activity test should be simple, inexpensive, rapid and should accurately reflect the “component causes”. Factors that may be used in evaluation of caries risk assessment are:

1. **Anatomy, structure and chemistry of the teeth:** Example- retentive area (presence of deep fissure), form, arrangement of teeth, number of teeth, occlusion, enamel solubility, content of fluoride and distribution.
2. **Biological factor (bacteria):** Example- composition of plaque and its location (mutans streptococci, lactobacilli, trace element, fluoride), amount of dental plaque, rate of plaque formation,

microbial activity (acid releasing ability), extracellular and intracellular polysaccharides.

3. **Diet:** Example- amount and frequency of diet, intake of fluoride and other trace elements.
4. **Salivary factors:** Example- salivary flow rate, buffering capacity of saliva, and immunological factors of saliva.
5. **Systemic condition:** Systemic diseases that may influence the oral health directly or indirectly for example immunocompromised condition, like, diabetes mellitus, etc.
6. **Epidemiology and demography:** Example- localization and experience of carious lesion, family history regarding caries experience, caries experience pertaining to age, sex and socioeconomic status.

Uses

1. To determine the need and extent of preventive measures.
2. To determine the success of therapeutic measures.
3. To motivate and monitor the effect of education programs related to diet counseling and oral hygiene procedures.
4. To identify high risk groups and individuals.
5. To get a quantitative estimate of caries problem up to now.

Microbial Test

- A. Mutans streptococci test:** M. streptococci are acidogenic and aciduric in nature. It produces extracellular glucans which helps the bacteria to adhere with the tooth surface. The number of mutans streptococci in saliva is related to the number of colonized tooth surfaces. This fact is the basis for saliva test for mutans. A high count in saliva (>1 million cfu or 10^6 cfu per ml saliva) indicates that most teeth surfaces are colonized by these bacteria. High salivary count means high caries risk. If the salivary mutans count levels $<10^5$ cfu/ml means low caries risk.

Measurement of Mutans Streptococci in Saliva

1. **Laboratory test:** Saliva sample is collected from the patient, mixed with a proper transport medium and send to the microbiological laboratory. A common type of selected agar plate for mutans streptococci is the mitis-salivarius bacitracin agar (MSB agar) plate.

All types of *Streptococcus mutans* grow on this plate except serotype A. Bacitracin is the main selective ingredient. The self life of MSB agar plate is only one week. So, it is not convenient for chair side test. The salivary sample incubated on MSB agar plate for certain period. Colonies are counted with the help of colony counter and results are expressed as number of colony forming units per ml saliva.

Chair Side Method

- A. Strip mutans test (Figs 21.4 and 21.5):** This is based on the ability of mutans streptococci to grow on hard surfaces and the use of selective broth. The levels of streptococci mutans on mutans strip compared with the ideal chart expressing low (0) to high (3⁺, equivalent to $>10^6$ mutans cfu/ml in saliva) number in saliva.

- B. Lactobacillus count test (Figs 21.4 and 21.6):** The lactobacilli are also acidogenic and aciduric in nature. Lactobacilli are highly influenced by the carbohydrate contents and intake frequency. Lactobacillus count has been used to predict increment of new carious lesions.

Measurement

1. **Laboratory test:** The laboratory method of determining the number of lactobacilli includes the use of a selective medium Rogosa- S-L agar. Saliva

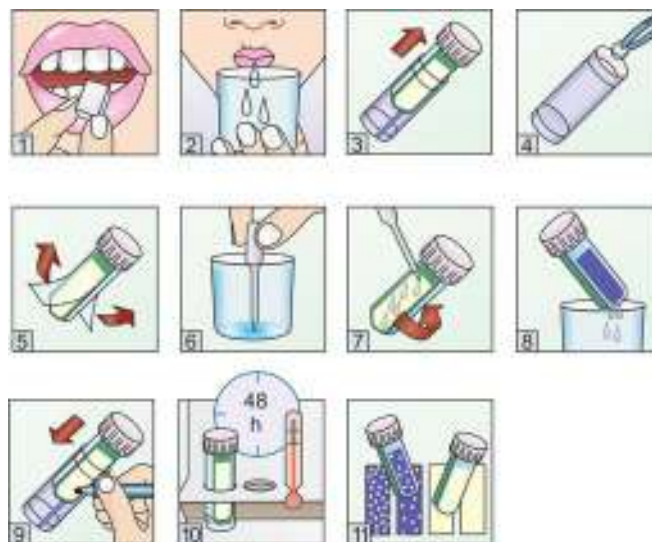


Fig. 21.4: Step by step caries activity test (mutans streptococci and *Lactobacillus* test, cfu/ml of saliva) by CRT bacteria, ivoclar vivadent co.



Fig. 21.5: Strip mutans test; patient's mutans strips compared with ideal photographic chart of mutans colony and predict the caries risk (chair side method)

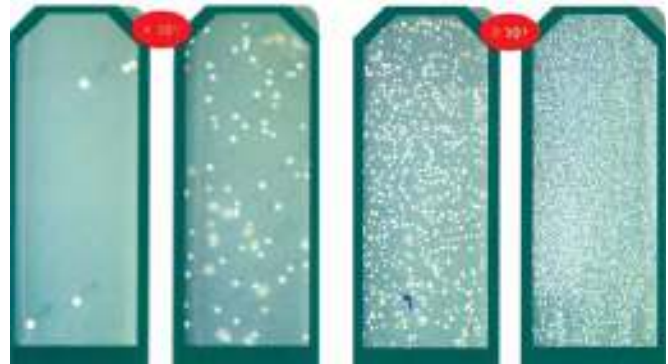


Fig. 21.6: *Lactobacillus* counts test; patient's mutans strip compared with ideal photographic chart of *Lactobacillus* colony and predict the caries risk (chair side method)

sample obtained by chewing paraffin and is shaken with glass beads within test tube to break up bacterial aggregation. The saliva is then mixed with a buffer solution and 1 ml of dilution 10^{-2} and 10^{-3} is mixed with 10 ml melted SL agar. Another 10 ml is then poured into the Petridish, and the plates are incubated at 37°C for 4 days. The plates are then ready to be counted for the number of colonies. If the counts are less than 10^4 - low caries risk, if it is greater than 10^5 - high caries risk.

2. **Dentocult LB method (chair side method):** 1ml paraffin stimulated saliva is poured over both sides of selective agar Dentocult plate. The dentocult LB system contains 'dip slide', paraffin for chewing and a standard chart to evaluate the levels of lactobacilli after aerobic incubation for 4 days at 35 to 37°C . The results of chair side test can be shown directly to the patient (Fig. 21.6).

Saliva

1. **Salivary flow rate:** The absence of saliva (xerostomia), or low salivary secretion rate can result in an extreme in caries risk. The normal range of salivary secretion rates are 1.5 to 1.8 ml/minute. Very low stimulated secretions rate (less than 0.7 ml/minute) or in case of xerostomia may result in a high caries risk. It is therefore of clinical interest to determine the salivary flow-rate. Salivary secretion may vary according to the age, sex, and body weight. The secretion rate for both resting and stimulated saliva was significantly lower for females than for males.

Measurement of Salivary Flow Rate

1. **Collection of resting saliva:** Ask the patient to sits in an upright position with the head bent forward. The patient lets saliva drip into a measuring cup or test tube for 5 to 15 minutes. The result is expressed as ml/minute. A resting secretion rate of less than 0.1 ml/minute is considered as high caries risk individual.
2. **Collection of stimulated saliva:** The patient sits in same position as above. Ask the patient to chew the paraffin for 5 minute. The foam is excluded by using a measuring cup, since it usually does not contain significant amount of saliva. The results is expressed as ml/minute. The risk limit value is 0.7 ml/minute. 1 to 3 ml/minute can be considered as normal value.

Salivary buffer capacity: Buffering ability of saliva is important to maintain the pH level in saliva and plaque, which is responsible for dissolution of the tooth mineral. The buffering ability of whole stimulated saliva is weakly correlated to caries increment in several investigations. When pH value is less than 4 the caries process seems to be facilitated.

Measurement of Buffering Capacity of Saliva

1. **Laboratory method:** The buffering ability of saliva is obtained by mixing 1 ml of saliva sample with 3 ml of HCL (.0033 M for resting and .0055M for stimulated saliva). Air stream is then passed through the mixture for 20 minutes and initial and final pH is measured.

2. Dentobuff strip system (chair side method): This system contains test strip, disposable pipette, chewing paraffin and standard color chart. One drop of stimulated saliva is placed on to the dentobuff test strip containing an acid and pH indicator. After exactly 5 minute, the color of the test strip is compared with standard chart and final pH is obtained. The strip shows low, medium and high buffering capacity.

Snyder Test

In this test, saliva sample is poured into a glucose agar medium. Acid formation is measured by means of color indicator. Snyder test is considered as alternative method of estimating the number of lactobacilli in the saliva.

Swab Test (Fosdick Calcium Dissolution Test)

This test is used to measure the capacity of oral flora to dissolve powdered enamel to determine the caries activity but the test needs expensive equipment and is time consuming.

Note: Caries activity test should not be used as an alternative to the clinical examination or sound judgment. Available data of caries activity test and other investigation should be combined with clinical examination and history to facilitate decisions regarding prevention and treatment.

CARIOGRAM

This method of interaction of carious factor contributing to the development of caries has been introduced by Bratthall and associates in 1999. A Pie circle diagram is divided into 5 sector in the different colors.

- Green:** Green color represents an estimation of the chance to avoid or prevent caries.
- Red:** Shows bacterial counts are based on amount of plaque and Mutans Streptococcus.
- Dark blue:** Diet is based on diet content and diet intake frequency.
- Light blue:** This part of cariogram showed susceptibility of a tooth, is based on combination of fluoride regimen, saliva content and buffering capacity of saliva.
- Yellow:** Represents circumstances that is based on a combination of previous caries experience and related disease.

AIDS AND DENTAL CARIES

- In HIV infected children, the chance of primary dentition caries is considerably high.
- Primary dentition caries in HIV infected children increases with decreasing CD4 percentage and moderate to severe immune suppression (CDC) categories.

PART IV: DIAGNOSIS OF DENTAL CARIES

The modern diagnostic methods of dental caries should allow for detection of the disease in its earliest stages of demineralization.

The following methods are used for caries detection:

- Visual examination.
- Tactile examination.
- By radiograph.
- Electrical conductance measurement.
- Fiberoptic transillumination.
- Quantitative light induced fluorescence (QLF).

Visual Examination (Table 21.4)

This is the most common type of methods for caries detection using color, softness of lesion and resistance to removal of soft part. A magnification glass may be used as an aid in the process of visual examination.

Table 21.4: Ekstrand, et al (1998); Model for visual examination

Scores	Criteria
0	No or slight change in enamel translucency after drying (> 5 sec)
1	Opacity or discoloration hardly visible on wet surface, but distinctly visible after drying
2	Opacity or discoloration distinctly visible without air drying
3	Localized enamel breakdown in opaque or discolored enamel and or grayish discoloration from the underlying dentine
4	Cavitations in opaque or discolored enamel exposing enamel.

Ekstrand et al (1998) provide a score model for visual examination of tooth surface.



Fig. 21.7: Mouth mirror, probe and twizzer are used to detect carious lesion by tactile and visual examination on tooth surface

Tactile Examination (Fig. 21.7)

A fine explorer has been used for tactile examination of the tooth.

By Radiographs (Fig. 21.8) (Conventional Method)

The most frequently used radiograph for caries detection are bitewing radiograph for proximal caries and IOPA (Intraoral periapical X-ray).

Xeroradiography

This method is different from conventional method because it does not need developing solutions for X-ray development, required less radiation and gives more edge enhancement.

By Radiovisiography (RVG)

It has following advantages over conventional radiography.

- i. Less image resolution.
- ii. Less radiation exposure.
- iii. The image is immediately available.

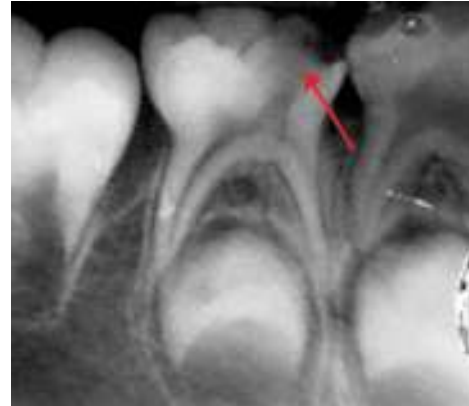


Fig. 21.8: IOPA Xray is most commonly used to detect carious lesion (arrow)

- iv. Can be electronically transferred.
- v. May be enhanced and stored.

Electrical Conductance Measurements

The 1st idea about electrical method of caries detection is given by Magitot in 1878. It is observed that sound tooth surface have a limited or no conductivity whereas carious or demineralized enamel surface have a measurable electrical conductivity. The electrical conductivity increases with increasing demineralization.

Method

Electrical conductance instrument measured the electrical conductance between tip of probe (electrode) placed in the fissure and a connector attached to the gingival or oral mucosa (High conductivity area). The sensitivity and specificity of the ECM was 0.78 and 0.80 for the diagnosis of occlusal dentinal caries and 0.65 and 0.73 for enamel caries.

Fiberoptic Transillumination (FOTI)

The basic idea of fiberoptic transillumination test for caries detection is based on different index of light transmission from demineralized and sound tooth. When fiber optic light passes through a caries or demineralized part, it has shown a lower index of light transmission than unmineralized or sound portion of tooth. The resultant changes in light distribution as light traverse the tooth is then recorded and analyzed for caries detection and progression.



Figs 21.9: DIFOTI instrument with head light which rotate at 180° degrees (arrow)

Digital Imaging Fiberoptic Transillumination (Fig. 21.9)

DIFOTI is a new method for caries detection using FOTI and digital camera. Images captured by intraoral camera and sent to the computer for further analysis.

Quantitative Light Induced Fluorescence (QLF)

Bjerkhagen et al. have shown that difference in illuminance from normal and demineralized human enamel are readily visible when teeth are illuminated by an Argon laser in the blue green region (488 nm). *Hafstrom-Bjorkman Technique:* This technique uses – for detection of caries with the help of a fluorescent dye (Pyrromethane 556, sodium fluoresce). Pyrromethane 556 is a dye that can absorb light in the range of 488 to 515 nm and emit light in the 540 nm range. This light emits wavelengths acceptable for excitation by an Argon laser.

This technique based on healthy enamel and dentine, when compare with dental tissues impregnated with fluorescent dye have different fluorescence efficiency. Carious dental tissues absorb the dye and fluorescence strongly.

Diagnodent (Figs 21.10 and 21.11)

Diagnodent is portable laser diode based device. This method of caries detection is invented and patented by KaVo Co. in 1999. This device is based on bacterial metabolite of the carious lesion, produces fluorescence in the presence of laser light.

Quantitative laser fluorescence is a method of measuring the induced tooth fluorescence and quantifying tooth demineralization and lesion severity.

This system has measurement range (-99 to 99) in which -9 value given to the sound enamel of the tooth. This system helps in determining the amount of carious involvement in different area of the same tooth.

It has ability to recognize:

- Initial carious lesion, difficult to detect on enamel surface
- Demineralization
- Fissures, proximal caries and residual caries.

Disadvantage

- It is unable to differentiate between decay, hypoplasia, or unusual anatomic feature.
- It is unable to differentiate between enamel and dentine caries.

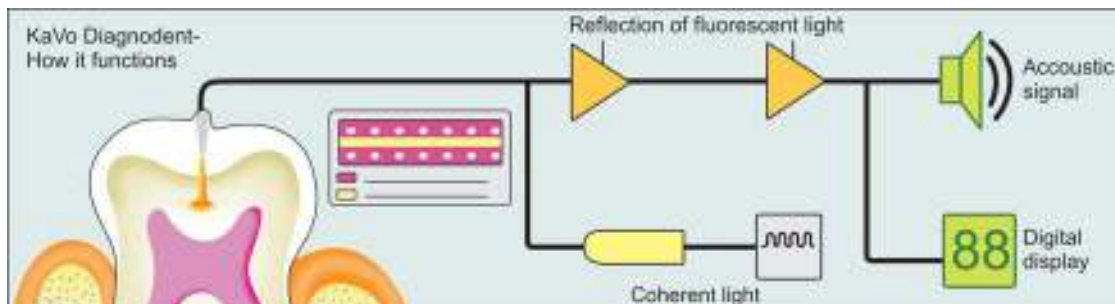


Fig. 21.10: Functional circuit of the Diagnodent (KaVo Co.)



Fig. 21.11: Diagnodent instrument with digital display and diode laser head (black arrow)



Fig. 21.12: Commonly used ultrasound machine

- It is also unable to differentiate between active and inactive lesion.
- It may give false results due to stain, deposits, calculus.

Ultrasonics (Fig. 21.12): Since, enamel and dentin both have different hardness, and percentage of mineralization so, ultrasonic echoes (ultrasound) can be used for comparing of normal tooth surface and demineralized tooth surface.

Dyes: Various dyes have been available in the market for the detection of enamel caries and dentinal caries. Enamel dye is used to stain the enamel caries, e.g. procion dye calcein.

Dentine dye is used to stain the dentin and helps in how much part of carious dentine should be removed. Example:- 9-aminoacrydine and Fuschin.

PART V: RAMPANT CARIES AND NURSING BOTTLE CARIES (TABLE 21.6)

DEFINITION

Massler define rampant caries as suddenly appearing, wide-spread, rapidly burrowing type of caries, resulting in early involvement of the pulp and those teeth surfaces usually considered as immune to ordinary decay (Fig. 21.13).

When a patient has shown excessive amount of tooth decay, it must be determined whether that person actually has a high susceptibility and true rampant caries of sudden onset or poor oral hygiene factor. Rampant caries has been observed in both children and adults of all ages.

Etiology

Emotional disturbances may be considered as causative factor in the development of rampant caries. Depressed emotions, dissatisfaction, fear, inferiority complex, continuous general tension and anxiety have been usually associated with rampant caries patient.

Since adolescence is often considered to be a time of difficult adjustment. An emotional disturbance may initiate with an unusual diet habit for sweets and snacking, which may provoke the development of rampant caries. Development of rampant caries may also be related to the decreased salivary flow resulting impaired remineralization of tooth.



Fig. 21.13: Different developmental stages of rampant carries

As soon as the caries affect the maxillary primary incisors, the name most commonly used as nursing bottle caries, baby-bottle syndrome, rampant caries, and early childhood caries.

There is a definite relation with the nursing bottle caries and use of sweetened beverages (a bottle containing sweet beverages of any kind or breast feeding on demand at night after 6 months of age).

Clinical Features

Tooth decay pattern of nursing caries is characteristic and pathognomic of the conditions it affect the deciduous teeth in the following order.

- i. Primary maxillary central incisor: Facial, lingual, mesial and distal.
- ii. Primary maxillary: Lateral incisor, facial, lingual, mesial and distal surfaces.
- iii. Primary maxillary 1st molar: Facial, lingual, occlusal proximal surface.
- iv. Maxillary canine and second molar: Facial, lingual and proximal surfaces.
- v. Primary mandibular molar at later stage.
- vi. Primary mandibular anterior teeth are usually spared because of protection by tongue movement and cleaning action of saliva due to presence of the orifice of the duct of the sublingual glands close to the lingual surface of the lower incisors.

The pattern of nursing bottle caries starts at a very young age; but in toddlers and preschoolers other factors can play an important role if a 4 years old child with 8 dental cavities, 2 in the maxillary incisors and other 6 evenly distributed among the primary molars, the

pattern should not be labeled as nursing bottle caries. It is unsatisfactory to call dental caries in the maxillary anterior teeth in a preschooler, nursing bottle caries. Only when other lesions in the dentition point in this direction, can the diagnosis be considered correct, allowing the use of an appropriate therapy.

DEVELOPMENTAL STAGES OF NURSING CARIES (TABLE 21.5)

The pattern of nursing bottle caries is recognizable in every stage of the disease. The early recognition of nursing caries is important, because at this stage, a preventive approach has its maximum effect, when a behavioral changes succeeds, resulting in an effective alteration of the child's feeding pattern, the initial caries lesion can be restored to intact enamel surfaces.

Usually, the best treatment of nursing caries is a preventive one, regardless of nursing caries stage. A restorative part is considered to be unsuccessful without the support of adequate preventive measures.

Table 21.5: Developmental stages of nursing caries

Sl. No.	Stage	Age in month	Clinical appearance
1.	Initial	10-20	Maxillary anterior teeth: Opaque white chalky demineralization, cervically and interproximally.
2.	Carious stage or damaged	16-24	Maxillary anterior teeth: Yellow brown, discolorations, cervical/interproximal, superficial defect #54, #64, in 1st stage.
3.	Deep lesion	20-36	Maxillary anterior teeth: Marked enamel defect, pulpal irritations. # 54, # 64 ; 2nd stage and # 74, # 84; in first stage.
4.	Traumatic Stage	30-48	Maxillary anterior teeth: Loss of large enamel and dentine parts, crown inclined fracture #54, #64 in third stage, and # 74, # 84; second stage.
5.	Arrested caries stage	At any stage	Lesion might get a typical dark-brown to black appearance

The problem in early diagnosis of nursing caries is the relative lack of discoloration of an early lesion. The caries begins with demineralization, white chalky superficial lesion on the lingual and cervical surface of the incisors (Due to change in the superficial brilliance of the enamel).

Demineralization is sometimes found on interproximal area, but mostly occurs cervically in a circular pattern, these are the retention place for dental plaque. Discoloration is occurring in later stage of caries, when adequate damage of the enamel and dentine has occurred. The following development stages of nursing caries are given below:

1. Initial or reversible stages: Cervically and interproximal an opaque, chalky white demineralization can be observed in the maxillary anterior teeth, it can be seen only when affected tooth is dried with air syringe. This stage is missed often. Pain and toothache does not occur in this stage.
2. Carious stage: The nursing caries in the maxillary anterior teeth extended in to the dentine and show marked discoloration. Since the caries process is quite rapid and involving the dentine and discoloration seen to take place simultaneously incidentally, child start complaining about toothache when extremely cold food are ingested, such as cold drink or ice-cream. The Rt. upper 1st primary molar and Lt. upper 1st primary molar are affected as in the first stage of nursing bottle caries.
3. Deep lesion: Depending on the time of eruption, cariogenicity of sweetened beverages or milk and frequency of its use, this stage can be observable in 10-14 months. The 1st primary molars are all affected. The upper Rt. and Lt. first primary molars are in the second stage and Lt. lower 1st primary molar, and Rt. lower 1st primary molar have initial lesion. Complain of pain during tooth brushing or eating specially when biting, are frequent. Incidentally, pulpal problems in the maxillary incisors can provoke spontaneous pain during night and pain after hot or cold sensation, and may persist for several minutes. If the parent complains that child faces problem in brushing their maxillary and child uses the canine to incise, a diagnosis of nursing caries is highly predictable.
4. Traumatic stage: If parents neglecting all above stages of caries and its symptom, the maxillary incisors became so weak by caries that relatively small forces

are sufficient to fracture them if toddler or preschooler child visit to the dentist after having caries fractured one or several teeth, cervically or inclined fracture, a diagnosis of nursing bottle caries is almost a certainty. In case of fracture of primary tooth (Accidental), thorough investigation of remaining teeth is mandatory. A discussion of child's eating pattern should also consider. The 1st maxillary molars are in the 3rd stage of nursing caries. Pulpal problem in this situation are caused by caries in the 1st molar. The maxillary incisors already have become nonvital in most of the cases. The 1st mandibular molars are in the second stage of the process. The upper Rt. and Lt. primary canine and upper Rt. and Lt. primary second molar might have lesion in the second stage.

5. Arrested caries: In all the previous stages given above, arrested caries might occurs, when the cause of dental caries is eliminated. During full or partial remineralization, the lesion might get a typical dark brown-to black appearance.

Table 21.6: Rampant caries vs nursing caries

<i>Rampant Caries</i>	<i>Nursing Caries</i>
Acute, burrowing type of caries and showed early involvement of pulp. Involving those surfaces which are usually immune to decay.	It is a specific form of rampant caries
It occurs in all age group including adolescence It occurs in both primary and permanent dentition.	It occurs in infant's toddler or preschoolers Affect the primary dentition only
Mandibular incisors are affected.	Usually, mandibular incisors are not affected.
Multifactorial etiology like frequent snacking, excessive sticky refined carbohydrate intake, decrease, salivary flow and genetic background.	Primarily associated to improper feeding practice such as bottle feeding or breast feeding or pacifier feeding during sleep.
If pulp is exposed, it requires pulp therapy or RCT.	If diagnosed in early stage it can be managed by topical fluoride application and dental education.
Dental health education at mass level given.	Since child is in constant contact with the mother, the preventive dental health education is essential to the mother.

Management of Nursing Caries

Objective of Treatment

- i. Management of existing dental emergency.
- ii. Prevention of carious process.
- iii. Restoration and oral rehabilitation.

First Dental Visit

This phase of therapy involving treatment of the carious lesion, identification of cause and diet counseling.

- All rampant or nursing carious lesions should be excavated and restored with Zinc oxide eugenol or $\text{Ca}(\text{OH})_2$ to prevent further development of the lesion.
- If the abscess is present it can be treated by drainage and antibiotic coverage.
- Dental X-ray like OPG are advised to assess the conditions of the predecessor teeth (succedaneous teeth).
- Collection of saliva for determining the salivary flow and viscosity.
- Topical application of fluoride.

Parent Counseling

Dental surgeon should ask to the parents about child's feeding habit regarding the use of nocturnal bottles, demand the breast feeding, etc.

- In case of considerable emotional dependence on the bottle, advice the use of plain water after every feed.
- The parent should be advised to clean the child's teeth after every feed.
- Parents are advised to maintain a diet record of the child for at least 5 days in a week which includes

the time of diet, frequency and amount of diet content and type of food.

Second Visit

It should be planned one week after the 1st dental visit.

- Analyze the diet chart, provided by parent and explain the disease process and its prevention by controlling sugar content of the diet.
- Caries activity test can be done at monthly interval to monitor the success of treatment and it also helps in educating the patient about dental health.

Third Visit

- Restoring all carious teeth with fluoride releasing restorative material.
- If required, endodontic treatment can be done.
- If the tooth is unrestorable, extraction can be advised followed by space maintainer.
- Crown can be given for grossly carious and decayed or endodontically treated teeth.
- Recall visit after every 3 months.

Prevention

By educating parents about development of nursing caries and its etiological risk factors.

- Breast milk should be encourage, as human milk is highly adapted to the human infant and is almost a complete source of all required nutrients.
- By sealing of all caries free deep pits and fissure by pits and fissure sealant.
- Professional fluoride programs at community level.
- Systemic fluoride programs, if there is suboptimal fluoride concentration in drinking water at specific area (i.e. based on ground water fluoride level).

PART VI: PREVENTION, CARIES CONTROL AND CARIES MANAGEMENT

The prevention of disease can be divided into following stages (Table 21.7):

- i. Primary prevention
- ii. Secondary prevention
- iii. Tertiary prevention.

PRINCIPLES OF PREVENTIVE DENTISTRY

Role of Pediatric Dentist

The pediatric dentist can implement primary prevention before the initiation or onset of new disease and enables

Table 21.7: Modified from Leavell, HR and Clark EG preventive medicine for the doctor and his community, ed 2, New York, 1958, Blakiston Division, Mc Graw-Hill Book Co. Inc.

	Primary prevention		Secondary prevention		Tertiary prevention
	<i>First Level Health Promotion</i>	<i>Second Level Specific Protection</i>	<i>Third Level Early Diagnosis and Treatment</i>	<i>Fourth level Disability Limitation</i>	<i>Fifth Level Rehabilitation</i>
Hard Tissues (caries, bony pathology)	Prenatal and Postnatal counseling on genetics, nutrition and diet, public health education.	Water F, topical F, F tablets or drops, F rinses, F dentifrices, diet counseling occlusal sealants	Early first dental visit periodic bitewing and panoramic radiographs, diagnosis and treatment planning, restorative dentistry	Endodontic treatment, extraction of nonvital teeth and replacement, radiation therapy Cancer	Removable or fixed prosthesis, occlusal rehabilitation
Soft tissue (gingival, periodontal, mucosal)	As above	Plaque control: brushing, flossing, reinforcement of dental health (OHI, PI)	Prophylaxis, scaling, gingival curettage, biopsy	Scaling deep curettage, gingivectomy, mucoperiodontal surgery, excision, and biopsy	Periodontal surgery, oral surgery (benign and malignant lesions), radiation therapy
Occlusion (malocclusions)	As above	Clinical and radiographic evolution of growth and development	Space management: Space maintainers, correct cross bites, cross ectopic, manage supernumerary or congenitally absent teeth, comprehensive orthodontics	Retains, correction of relapsed cases, surgical orthodontics	Occlusal equilibration in conjunction with oral surgery and fixed or removable prosthodontics

life long positive oral health habits and attitude towards their oral health. So that dental and oral structures will be maintained in optimal condition as long as possible.

The most important part of the office preventive concept is not the availability of equipment or the variety of armamentarium that helps the patient, but it entirely depends upon the attitude and philosophy of the office, beginning with Pedodontist own philosophy and enthusiasm.

The dentist and dental staff must show firm commitment to preventive dentistry in their own life style. A dentist who emphasizes the prevention of dental caries (Table 21.8) or gingivitis but is a chain smoker or frequently imbibes alcoholic beverages in excessive amounts obviously does not understand the true meaning of prevention.

Role of Hygienist

Hygienist play important role in the success or failure of any preventive dental program. Dental hygienist is usually responsible for supervising and implementing the preventive program. Such preventive program required several visit. On each preventive phase, patient should be appropriately executed and reinforced for subsequent visit.

It is suggested that only 20 to 25 percent patient receives the preventive dentistry program. Dentist or Dental hygienist must listen carefully to the special needs and concern of the children and parents so a more personalized preventive dentistry program can be developed.

PEDIATRIC DENTAL CLINIC— A PREVENTIVE PROGRAM

A successful preventive dentistry program should include the following:

- i. Prenatal and postnatal counseling.
- ii. Early screening, diagnosis and treatment.
- iii. Disclosing of dental plaque with the help of disclosing agent.
- iv. Proper tooth brushing instruction given to the child and parent so the disclosed plaque will be adequately removed.
- v. Use of dental floss and other oral hygiene control procedure should be advised when it is required.
- vi. Analyze the water fluoride content of specific area so that fluoride supplement or water defluoridation method can be used according to the low or high fluoride content respectively.

Table 21.8: Methods of controlling dental caries and their mechanism of action

Sl. no.	Methods	Mechanism
1.	Tooth brushing	Mechanical removal of plaque, disruption of biofilm structure, vehicle for delivery of antiplaque and antimicrobial agents.
2.	Fissure sealants	Physical protection of caries prone occlusal surfaces.
3.	Fluoride use	Enhances enamel resistances and promotes remineralization, inhibit bacterial acid and polysaccharide production; inhibit bacterial metabolism and growth by inhibiting key enzymes and acidifying cytoplasm.
4.	Antiplaque agent	Antiplaque agent can reduce biofilm formation without necessarily killing
5.	Antimicrobial agent	Antimicrobial agents can kill or prevent the growth of plaque bacteria at sublethal levels they can inhibit traits associated with cariogenic (e.g. sugar transport and glycolysis).
6.	Sugar Substitutes	Bulk and intense sweeteners are used in confectionery. They are metabolized to acid at very slow rates while stimulating saliva how removed advantage from acidogenic and aciduric species.
7.	Vaccination	Subunit streptococcal vaccine could be used to prevent colonization by MS, exploits the facts that mouth is provided with all the components for an immune response.
8.	Passive Immunization	Antibodies that prevent colonization by MS can be applied directly to the teeth.

- vii. Motivation of children and parents in adopting non cariogenic or less cariogenic diet habits.
- viii. Topical fluoride treatment (Knutson's technique, APF gels, stannous fluoride) can be used in conjunction with tooth brushing/professional prophylaxis using a fluoride paste.
- ix. Advice fluoride rinses for patient who have orthodontic or prosthodontics appliances
- x. Pits and fissure sealant is used for the prevention of enamel caries in primary and permanent dentition.
- xi. Diet counseling on the selection of nutritious, non cariogenic and fibrous or detergent food and avoidance of cariogenic and harmful snacks.
- xii. High quality fluoride releasing restorations are advised.
- xiii. Do space analysis and provide space maintainer or regainer, if it is required.
- xiv. Consultation and referrals should be advised when required.
- xv. Recall visit and its importance should be discussed with patient and parent.

Prenatal Counseling: See chapter "Prenatal Oral Health and Oral Health in Pregnancy".

CHILD'S FIRST DENTAL VISIT

Although prenatal orodental counseling starts at 1st trimester of pregnancy. The 1st dental visit started at an early age. The parents are usually aware at this time of

the importance of immunization programs and are receptive to advice for their infants or kids. The parent should be encouraged for orodental examination and consultation shortly after the child's anterior teeth emerges into the oral cavity. Those infant who have developmental disability or whose parents are considered to have poor oral health, the 1st visit should be no later than 6 months after eruption of the 1st tooth. The 1st dental visit is usually recommended between 18-24 months for a normal child.

Postnatal Counseling

Pedodontist should encouraged mother breast feeding if infant is bottle feeded. The Pedodontist should emphasize the effects of formula, frequency and duration of feeding, night feeding and sugar in milk and its formula.

- Placing the infant in bed with bottle containing sweetened beverage (milk, juice) should be discouraged once the teeth begin to erupt.
- Recommended non cariogenic diet, manual massage over erupting tooth gum, and emotional support should be provided to the child.
- The use of pacifier over thumb sucking is still in controversy but certain characteristic feature should be present in pacifier.
 - i. Sturdy one piece construction and made up of non toxic, flexible and firm but not brittle materials.
 - ii. Easily grasped handle.

- iii. Non separable nipple and mouth guard.
- iv. Mouth guard with two ventilating hole and sufficient in size to prevent accidental aspiration.
- v. Non detachable ribbon.
- vi. Tag a warning label against tying the pacifier around the infant's neck.
- vii. Parent should clean the pacifier before placing into infant's oral cavity.
- viii. Parents are advised not to dip the pacifier into sugar or honey to encourage sucking.

As the teeth emerges into the oral cavity parent should clean them with gauze at 1st and then progress to tooth brush (see chapter, Age specific plaque control).

Diet Counseling

Pedodontist should ask the parent questions pertaining to their child's early and present diet habit and ask to make a diet chart of child at least 5 days in a week and find out which food is cariogenic and which one is non cariogenic, frequency of intake of food etc. The following questions are asked pertaining to diet habit:

- i. Child is bottle feeding or breast feeding and how long breast feeding or bottle feeding.
- ii. Frequency of bottle or breast feeding.
- iii. Time of bottle feeding (nap time or at night).
- iv. Baby foods are commercially available or home made food used.
- v. What type of food given to the child as night snacks (if child awakes in the night and ask for food)?

For older child with advanced orodental disease who is also exposed to food outside the home (nursery school, friend's home etc.) an additional question will be necessary.

- i. Breakfast served or not, nature of breakfast.
- ii. If your child free to raid the refrigerator or in kitchen between meals.
- iii. Like or dislike of food items.

In diet counseling, cooperation from the family is of outmost important. To ask a child to refrain from a food or a snack while the rest of the family continues the usual pattern will lead to frustration and poor compliance. Follow-up histories are important to measure the success of the original recommendation. This can be accomplished normally by a recall history reviewing the last week's dietary pattern. No single approach to the diet counseling will be successful. Pediatric dentist

must modify the diet consumed by the patient according to the information received from the parents, or patient responses to the suggested questions (diet chart). The therapist must not recommend modifications that are unrealistic to the teenager's style of life and eating preferences. In these cases optimal use of fluoride and mechanical removal of plaque must be emphasized.

A Showroom of Preventive Dentistry

A separate cell is made for the preventive dentistry adjacent to the operator cell. Instruments and methods of oral disease prevention, wall mounted mirror are used for demonstrating purpose.

The preventive dentistry cell should be attractively decorated and furnished with a sinks at different height for varying age groups and having adequate storage space for dental care kits, floss, educational pamphlets and other behavior modification devices (like Audio, visual display, preventive dentistry poster and illustrative materials).

Community Activities of Pediatric Dental Surgeon

- i. Water Fluoridation
- ii. Fluoride Rinse Program
- iii. School Level Program
- iv. Caries Vaccine Program

1. Water fluoridation: It is obvious that the practicing preventive dentistry must be an active participant in promoting water fluoridation. The Pedodontist must work with appropriate government agencies (like city council, Nagar Nigam, Govt. Health department and other influential health community leaders. So that public will be benefited from preventive education and water fluoridation. A compact water fluoridation unit is available for non fluoridated area or low level of fluoride content in water (venturi fluoridation unit system).

2. Fluoride rinse program: Pedodontist must perform a supervised mouth rinse program in collaboration with health department. It has been observed that supervised fluoride mouth rinse program is always beneficial to the dental health of the community. The news media should be used to inform the public about good nutrition and sound

dietary practices and benefits of fluoride rinse program.

- 3. School level program:** Pedodontist should have an input into the selection of food (less cariogenic,

alter nature of sugar and detergent food preferred) in the school caries preventive program with collaboration of chairperson of school board in the community.

PART VII: USE OF PIT AND FISSURE SEALANT— A PREVENTIVE APPROACH

INTRODUCTION

Pit and fissure enables tooth surface more susceptible or vulnerable for caries development, because these pits and fissure helps in the retention of the food particle, plaque and can not be easily cleaned. The plaque bacteria (Cariogenic) produced acid further results demineralization of the tooth surface.

TYPE OF FISSURES

According to Nango (1960); there are four type of fissure based on alphabetical description of shape.

- i. V-Type and U-Type: Shallow, wide, usually self cleansing and some what caries resistant.
- ii. I-Type: Deep narrow, bottle neck shaped and highly caries susceptible.
- iii. K-Type: It is also highly caries susceptible.

Note: Usually, nonsurgical or noninvasive technique is recommended for V and U shape fissure and surgical or invasive technique for I and K type fissures.

Criteria of Ideal Pits and Fissure Sealant

According to Brauer (1978), the ideal characteristics of pits and fissure sealants are:

- i. It should penetrate deep and narrow fissure.
- ii. It should have adequate wettability and flowability.
- iii. It should have adequate working time.
- iv. Rapidly curable.
- v. Resistance to wear.
- vi. Low solubility in saliva.
- vii. Prolong adhesion to the enamel surface.
- viii. It should be cariostatic in action and showed minimum irritation to the tissues (Biocompatible).

Materials Used as Sealant

1. Cyanoacrylates
2. Polyurethanes: Epoxylite (contain 10 percent sodium monofluorophosphate with liquid polyurethane and utilizes citric acid as etchant). It has poor mechanical property and more toxic than other sealants.
3. Dimethacrylates: A new sealant system initiated by butyl boron initiator. It binds better and is less affected by immersion in water.
4. Glass ionomer: Fluoride releasing and used for fissure whose orifice are more than 100 micron.

Classification of Resin Fissure Sealant

1. Based on Curing Method
 - **First generation:** Polymerized with ultraviolet light of 350 nm wavelength of ultraviolet range.
 - **Second generation:** It is self cured or chemically cured. Most of them are unfilled. It may be transparent, opaque or tinted.
 - **Third generation:** Visible light cured of 430 - 490 nm wavelengths. May be unfilled (usually white) or filled (usually clear).
 - **Fourth generation:** With addition of fluoride for added benefit and colorful and become tooth colored after curing.
2. **Based on Filler particle:**
 - Unfilled sealant shows better flow property.
 - Semi filled – more hard and resistant to wear.
3. **Based on color**
 - Tinted: for easy identification
 - Clear: difficult to detect
 - Opaque: for easy identification
 - Pink (Fuji VII, G.C Company): fluoride releasing sealant.

Selection of Teeth for Sealant Application

- i. **At 3-4 years of age:** All primary molars are preferred for sealant application.
- ii. **At 6-7 years of age:** Ist permanent molar are preferred for sealant application.
- iii. **At 11-13 years of age:** All second and Ist permanent molars and all premolar are preferred for sealant application.

Clinical judgment of the pediatric dentist is to select the teeth for sealant applications are based on:

- i. Age of child
- ii. Oral hygiene, morphology and alignment of teeth in the dental arch.
- iii. Dietary habits.
- iv. Fluoride environment and history.
- v. Familial and individual history of dental caries.

Indications

Clinical judgment of the pediatric dental surgeon is the deciding factor in the application for fissure sealant.

- i. Newly erupted primary molars and permanent molars and premolars with deep grooves and fissures.
- ii. When fissures showed minimal demineralization and no softness present at the base of the fissure.
- iii. A tooth which is selected for the sealant application should have erupted less than 4 years ago.

Contraindications

- i. Wide and self cleansable fissure.
- ii. If there is a radiographic or clinical evidence of caries on proximal, occlusal of posterior teeth and lingual surface of anterior teeth.
- iii. Partially emerged teeth which can't be isolated by any suitable isolating technique.

Technique of Fissure Sealant Application

- i. Select the tooth for sealant application.

- ii. Isolate the tooth with the help of rubber dam.
- iii. Clean the surface of selected tooth with slurry of pumice and water through rubber cup or through prophylaxis instrument having $\text{CaCO}_3 + \text{H}_2\text{O} + \text{Air Jet}$.
- iv. After cleaning of tooth surface, tooth is washed with distilled water and air dried.
- v. Etching Technique: 37-50% phosphoric acid commonly used for etching.

In primary teeth: 37-50% Phosphoric acid is used to etch the enamel surface of deciduous teeth for the period of 120 seconds. Primary teeth etching time higher than the permanent teeth etching time, because erupted primary teeth have lower mineral content, high organic content and higher internal pore volume than does permanent surface-enamel.

In permanent teeth: 37-50% Phosphoric acid is used for 60 second as etchant in permanent teeth.

- vi. After Etching: The etchant should be washed –out with the help of distilled water for 30 seconds and then air dried.
- vii. Etched tooth surface showed frosted appearances (it should not be contaminated with moisture or saliva) until the sealant is applied and cured. If the surface becomes contaminated with saliva after etching, it must be re-etched for an additional 10 second.

Precaution

1. Sealant should be properly flowed into the deepest part of fissure.
2. Air bubbles should not be incorporated.
3. After polymerization of the sealant, all excess sealant should be removed and check for occlusion.

Recall Visit: Depends upon the clinician judgment to ensure that adherence of sealant, or need of further sealant application to the subsequent recall visit.

PART VIII: CARIES MANAGEMENT

The caries management broadly divided into:-

- i. Preventive Treatment.
- ii. Operative Treatment.

The management of active caries always requires preventive treatment including plaque control, oral hygiene aids, fissure sealant, anti plaque agent, sugar

substitutes, vaccination and fluoride application dietary habit as describe previously.

Operative Treatment

The main aim of surgical or operative treatment for caries control is to remove plaque traps and it's irritating by-product from the carious tooth surface. If plaque remains in the carious cavity, the caries continue to progress. The second aim of operative treatment is carious cavities that are inaccessible to a tooth brush tips, provide a nidus for plaque accumulation, leading further caries progression.

Free Smooth Surfaces

Active carious lesion on free smooth surfaces can be treated by plaque control only (Ex:- Root surfaces). In these cases, active carious lesion can be arrested by twice daily plaque removal with fluoride containing tooth paste and chlorhexidine mouthwash 0.2 percent twice/day. After few days, the active lesion becomes harder partly by patient brushing off softened dental tissues and partly by deposition of mineral from saliva.

- A white or brown spot lesion on smooth surface caries can also be arrested by plaque control and fluoride application. This lesion (initial caries) should never be attacked with probe or bur (The lesion may progress to the dentine and mineralized outer layer of caries may be break).
- A disclosing agent should be used and patient asked to brush. Use of disclosing agent helps the patient to check the presence or absence of plaque and its relationship to the active carious lesion.
- Use of disclosing agent also helps the pediatric dental surgeon to check whether the patient can remove the plaque or not.
- If plaque removal is not possible from, inaccessible area, fluoride releasing restoration may be essential to re-establish plaque control and prevention of caries progression.

In root caries, it is only necessary to remove the soft infected dentine with an excavator and restored with glass ionomer cement (or resin modified glass ionomer).

Occlusal Surface (Fig. 21.14)

If occlusal surface (deep fissure) shows no evidence of caries, this fissure should be filled with sealant and ask the patient for plaque control.



Fig. 21.14: Class I cavity on maxillary 1st molar involving only occlusal surface of tooth (Typo model)

Once a carious lesion is seen on IOPA or bitewing radiograph, the dentine is soft and heavily infected. There is formation of a micro cavity in enamel involving dentine and this cavity will help in further trapping of the plaque leading further progression of carious lesion or demineralization. Most of the clinician will access the carious dentine, clear the DEJ of all soft material and remove the soft, infected dentine. The cavity can then be restored with a resin modified glass ionomer cement to replace the removed part of the tooth structure. Finally the remaining fissure system should be protected with a fluoridated fissure sealant.

Proximal Surface (Fig. 21.15); if caries involve the proximal surface and the contact point is present it is difficult to remove the carious part. Most of the clinician makes approach from the marginal ridge of a proximal surface. After removing the marginal ridge, the lesion can now be seen clearly and access for bur and excavators is optimal. All soft, demineralized tissues should be removed and cavity may now be designed for choice of restorative material. Finally the occlusal aspect is restored with composite restoration but now a days many clinician prefer separation of adjacent teeth with the help



Figs 21.15: Class II cavity on maxillary 1st and 2nd molar involving (caries) proximal surface (Typo model)

of orthodontic separators to get the proximal surface access for excavation and restoration.

Note: The dentist should first remove the all carious part conserving as much enamel and sound tooth tissue as possible. At this stage dentist should put the operative instrument on the carious lesion, look, think and designed according to the choice of material available.

CARIES VACCINE

Introduction

“Wagner” was the 1st person to successfully vaccinate rats against caries. Interestingly *S. fecalis* was used as the immunogen. This report was quickly followed by the successful vaccinations of monkeys through the administration of *Streptococcus mutans* intravenously. These observations were confirmed and extended by several investigators using a variety of immunogen derived from *Streptococcus mutans*.

Why a Vaccine is Needed

In recent years, fluoridation of drinking water and fluoride in toothpaste has contributed to a reduced incidence of caries in the developed world (possibly by making teeth more resistant to acid produced by the

mutant organism). Nevertheless especially nearly half of the children aged 5-17 in the United States, especially the under privileged and native Americans have caries in their permanent teeth. Wherever fluoridation or preventive technique are absent or limited, dental disease have reached nearly “Epidemic” proportion. According Taubman “A caries vaccine would be a major Public health measure in alleviating such devastating disease.

Strategy

The Forsyth Institute is an independent Research and Educational Organization focused on oral and cranio-facial Science.

Forsyth’s strategy is aimed at stimulating the production of antibodies that inhibited the enzyme that allows bacteria to accumulate on teeth. The researchers believe that the best way to protect against caries over the long term is to introduce antigen to children at about an age of 1 year. After teeth have began to emerge, but before mutans streptococci bacteria have begun to colonize. At this stage, Taubman explains “Children immune systems are developed enough to produced antibodies to prevent accumulation of mutans bacteria and tooth decaying acid that bacteria manufacture.

Vaccine

It can be defined as ‘A suspension of Infectious agents or some part of them given for the purpose of establishing resistance to an infectious disease’.

Function

To stimulate an immune response in the body by creating antibodies or activated T-lymphocyte capable for controlling the organism. The result is more or less permanent protection against diseases.

Characteristics of *Streptococcus mutans*

1. *Streptococcus mutans* is the principle organism which colonizes the tooth after it erupts into the oral cavity.
2. It is rarely found outside the mouth and appears to require a solid surface on which to colonize, it is regarded as an “Obligate Periphyte”.
3. It synthesizes an extracellular polysaccharide from sucrose using the enzyme glucosyl transferase.
4. Their material is composed of (α -1-3 linked) glucose and undoubtedly facilitates the adherence of *S. mutans*

to tooth enamel and contributes to bulk of dental plaque.

5. Mutans produces a large amount of acid during growth with terminal pH = 4. The lipoteichoic acid (LTA) play important role in pathogenesis of dental caries, e.g. It will bind directly to enamel surface of teeth. It forms a complex with mutans conferring a charge on Glucans charged ions, i.e. Bicarbonate would be enable to diffuse rapidly out of plaque. Uncharged substance (e.g. Sugar) could penetrate into plaque easily.
6. In normal circumstances IgA and IgG are found in saliva in concentration of 19.4 ± 5.37 and 1.44 ± 0.9 mg/100ml.
IgA in saliva is usually a dimmer. It has a unique component linked to it, termed as secretory piece. It is resistant to proteolytic enzymes and extreme of pH and hence can function under influences.
IgG class antibodies to oral microorganism may present in plaque fluid.
7. Type II pneumococcal polysaccharide induce antibodies that cross react with (1-6) Glucans and type IX pneumococcal induce antibodies reactive with (1-3) linked Glucans.
Several other pneumococcal undoubtedly can induce antibodies that cross react with *S. mutans*. This approach is attractive because pneumococcal vaccines have been licensed for use in human being.
8. M.S count in saliva and plaque can be correlated with prevalence and incidence of caries in human being.

Mechanism of *Streptococcus mutans* Adherence to the Tooth Surface

On fermentation of sucrose, glucans is formed by *Strep. mutans*. Glucans can help to attach the bacteria to solid surface of tooth by acting as carrier for other bacteria and forming the matrix.

In addition certain bacteria are involved in initial attachment of *Streptococcus mutans* to tooth surface. Once attachment takes place, a continuous and large acid is produced which commences the demineralization.

Systemic Active Immunization

Gregory and Filler observed that ingestion of a vaccine containing killed *Streptococcus mutans* daily for ten consecutive days induced an increased level of specific secretory IgA antibodies to *Streptococcus mutans* cells. This resulted in reduction in number of viable *Streptococcus mutans* organism in dental plaque and whole saliva.

Systemic Passive Immunization

Michalek, et al. used a multivalent vaccine consisting of whole cell antigen of *Streptococcus mutans* (serotype a, b, c, d, g), to hyperimmunize a group of pregnant cows. They observed low plaque scores decreased number of streptococci in plaque and decreased caries actually as compared to the control. Development of vaccine against tooth decay is still very far away but presence of salivary and serum immunoglobulin in the saliva and then reaction against cariogenic microorganism has proved that the immunization of teeth against decay is possible.

Fluorides and Dental Health

What is fluorine? Fluorine is the most electronegative element having an atomic wt. of 19 and atomic no. 9. Since fluorine element is highly electronegative, it is never found in free state in nature but it combines with other element and forms a fluoride compound. Fluoride enters the atmosphere by volcanic action and entrapment of soil (Lithosphere). Fluorides enter the hydrosphere by leaching from fluoride containing soil and minerals into the ground water and surface water. Fluoride enters into the plant by uptake from soil and water and absorption in the gaseous form in the atmosphere. This plant fluoride may return into the soil through plant waste or it may enter into the food chain and returned to the soil as animal (Biosphere) waste.

Ore of fluoride: The chief fluoride containing minerals in the nature are as follows:

1. Fluorspar (CaF_2)
2. Fluorapatite [$\text{Ca}_{10}\text{F}_2(\text{PO}_4)_3$]
3. Cryolite (Na_3AlF_6).

Source of Fluoride Intake (Tables 22.1 to 22.3)

Water is the main source of fluoride intake. There are some commercial products which are manufactured by communities living in fluoride rich area and consumed by non fluoridated communities. Thus, a variety of foods and beverages can be source of substantial amount of fluoride intake.

Anticaries effects of fluoride have resulted in a variety of fluoride products developed for both home care and professional use. This product includes, fluoridated

mouthwashes, self-applicable gels, and professionally applied topical fluoride including prophylaxis paste, gels, foam and dental varnishes. Since these products are not designed for ingestion but their use in young children may result in accidental ingestion of fluoride.

Absorption of Fluoride

1. The main route of absorption of ingested fluoride is via gastrointestinal tract.
2. Fluoride absorption can also occur from lungs by inhalation of fluoride dust, and fluoridated general anesthesia like halothane, methoxyflurane and isoflurane.

Regarding the vital effect of fluoride, only the fluoride ions are important in dentistry, medicine and community health.

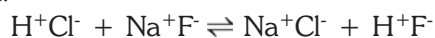
Factors Affecting Fluoride Absorption

1. In fasting stomach, fluoride absorption increases.
2. Any food product like milk or any food item containing fluoride binding ability may decrease absorption from gastrointestinal tract.

Mechanism of Fluoride Absorption

The mechanism and rate of gastric absorption of fluoride pertaining to the gastric acidity (HCl)

Ex.



The uncharged HF molecules easily pass through biologic membranes including gastric mucosa.

Table 22.1: Average fluoride intake from commonly used food items for infants (F-concentration .01 to 8.38 ppm)

<i>Infant food</i>	<i>Fluoride concentration</i>
1. Human milk	5-10 µg/L (Esala 1998)
2. Infant milk powder	
a. Milk based	400-1000 µg/L
b. Soya protein based	1000-1600 µg/L
3. Cow milk	30-60 µg/L (Ekstrand 1984)
4. Wet pack cereal fruit product	2000-3000 µg/L
5. Fruit juices	0.01-6.70 ppm (pangetal 1992)
6. White grape juice	0.15-6.80 ppm (stannerd 1990)
7. Infant chicken product	4.4 ppm

Table 22.2: Average fluoride intake from commonly used food items for school age child, adolescent and adult

<i>Food items</i>	<i>Fluoride concentration</i>
1. Bottled water	<0.4 ppm (usually)
2. A cup of tea	1.33-2.56 ppm
• Decaffeinated tea	3.19 ppm (mean)
• Caffeinated tea	1.50 ppm (mean)
• Herbal tea	0.05 ppm (mean)
3. Chicken	10 ppm
4. Dried sea food	40 ppm

Table 22.3: Fluoride intake from dentifrice and other fluoridated dental products

<i>Dentifrices and dental product</i>	<i>Fluoride concentration</i>
Fluoridated dentifrices	1000-1100 ppm (Note: 2-3 year old child have a greatest risk for toothpaste ingestion because they are not mastered to expectorate properly)
Fluoride mouth rinse	0.05 percent or 230 ppm
Fluoride gel (home care)	1000-5000 ppm
Professionally applied fluoride gel	10000-12300 ppm
Fluoride tablets, drops, lozenges	0.25-1 mg

Fluoride in Blood Plasma

Fluoride present in plasma is of two types:

- Ionic or free fluoride
- Nonionic or bound fluoride.

Since, plasma fluoride levels are not homeostatically regulated, so there is no normal physiologic concentration. Fluoride is readily distributed from blood plasma to all the tissues and organs.

Note:

1. Kidney tubules have a higher concentration of fluoride than blood plasma.
2. Blood brain barrier restricts the fluoride entry into the central nervous system.

Storage of Fluoride in Bone

Ninety nine percent of fluoride found in human body is associated with hard tissues (i.e. bone and teeth).

- Fluoride enters into the hard tissues by the process of isoionic and hetroionic exchange and bound to the mineralized tissue crystal lattice in form of fluorapatite or fluorohydroxyapatite.
- Fluoride is reversibly bound to the bone. The distribution of fluoride within bone is not uniform and it is highest in the area of bone growth and remodeling area of bone.
- Fluoride decreases the physiologic or pathologic bone resorption by osteoclastic activity as well as high levels

of fluoride is liberated from fluoride containing bone during the resorptive process. Fluoride also inhibits osteoclastic activity.

- Long toxic doses of fluoride causes osteofluorosis, which is characterized by osteosclerosis of skeleton with irregular thickening of bone because periosteal membrane forms abnormally structured osseous tissues, osteophytosis, mineralization of tendons and muscle attachments and mineralization of intervertebral disc.
- Fluoride compound like sodium fluoride and sodium monofluorophate may be used in the treatment of postmenopausal osteoporosis.

Fluoride in Plaque

Plaque fluoride comes from two sources, endogenous and exogenous. Endogenous source include saliva, crevicular fluid and exogenous source include diet, fluoridated toothpaste and mouthwash.

- Fluoride exists in plaque in the form of ionic and bound form.
- Dental plaque contains 5-10 ppm fluoride, which is 10-20 percent more than plasma fluoride.

Fluoride in Saliva

Salivary secretions have fluoride concentration ranging from 0.02-0.03 ppm. Thus, individual having higher oral fluid fluoride concentration shows more caries resistant than lower fluoride concentration.

Fluoride in Calculus

Concentration of fluoride in calculus varies from 100 ppm in the inner surface to 1000 ppm on the outer surface.

Fluoride in Dental Tissues

1. *Fluoride in enamel (Table 22.4):* Fluoride is not evenly distributed across the thickness of enamel. Fluoride concentration is highest at the tooth surface and minimal at the interior surface of enamel.

Fluoride concentration also varies according to the anatomy of the outer and inner surface of enamel of permanent and primary dentition.

2. *Fluoride concentration in dentine:* Since the dentinal apatite crystals are smaller than enamel crystals and dentine is much less crystallized than enamel. So, the fluoride uptake capacity of dentine is much higher than enamel. Fluoride concentration is high at the pulpal surface of dentine than the enamel surface of dentine.

The fluoride uptake and distribution in the primary tooth dentine depends upon the total fluoride exposure and process of physiologic resorption, which occurs at the pulpal surface prior to exfoliation. So fluoride concentration in the pulpal surface of primary dentine therefore increases during the period of root formation but it falls during the period of physiologic resorption.

3. *Fluoride in cementum:* Fluoride uptake capacity of cementum is more than enamel and dentine because of less crystal size, less mineral contents and more porous surface.

Placental fluoride transfer: There is no doubt that fluoride crosses the placenta because it is found in foetal blood and calcified tissues. But placenta may have a regulatory function in preventing excessive fluoride in the maternal blood from reaching the foetal circulation. Thus, placenta is a partial barrier to the fluoride transfer (Gedalia 1967 and Zepkin, Babeaux 1965).

Excretion of Fluoride

The main route of fluoride excretion from the body is the kidney. The clearance rate of fluoride from the kidney is 30 - 50 μ l/minute. While clearance rate of chloride, bromide is usually less than 1 μ l/minute.

Other routes of fluoride excretion are as follows:

1. Excretion via breast milk (human milk): The fluoride concentration in mature human milk is about 0.4 μ l.
2. Excretion via feces and sweat.
3. Excretion via saliva and tears (0.01-0.1 ppm).

Table 22.4: Fluoride in dental tissues

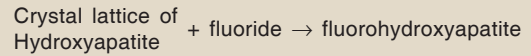
	Fluoridated areas	Non fluoridated areas
Permanent teeth	Total -200 to 300 ppm Outer surface 3000-4000 ppm	Total 150 ppm Outer surface 2000 ppm
Primary teeth	Outer surface 900 ppm	Outer surface 650 ppm
Pure fluorapatite crystal having 38000 ppm		

Mechanism of Action of Fluoride

The role of fluoride in decreasing the prevalence of caries has been well known for many years. The following mechanism of action has been proposed for anticaries action of fluoride:

1. By reducing the enamel solubility.
2. Improved crystallinity of dental tissues (Fig. 22.1).
3. Increased remineralization process of dental tissues.
4. Lower the free surface energy of tooth surface and prevent desorption of protein and cariogenic bacteria.
5. Act as an antibacterial agent by inhibiting bacterial enzymes (Enolase, protein extruding ATPase and sugar transport).
 - Since OH^- of hydroxyapatite crystals and F^- have similar ionic radii and hydration no. 5, So, F^- replaces the OH^- from the crystal lattice and convert hydroxyapatite crystals ($\text{Ca}_{10}(\text{OH})_2(\text{PO}_4)_6$) into more stable fluorapatite crystal lattice ($\text{Ca}_{10}\text{F}_2(\text{PO}_4)_6$) which is more resistant to the acid attack than hydroxyapatite.
 - Fluoride has a capability to convert amorphous calcium phosphate of dental tissues into the crystalline hydroxyapatite crystals. Thus, improved crystallinity.

- Fluoride enhances the remineralization process of enamel by the following mechanism:



Fluorohydroxyapatite has a lower solubility than hydroxyapatite. Thus for a given calcium and phosphate level in saliva, the degree of super saturation to the fluorohydroxyapatite is larger than hydroxyapatite. Thus, thermodynamic force for precipitation determines the rate at which mineral contents precipitates. Nucleus for precipitation is already present in demineralized surface and allows epitaxial growth.

- The action of fluoride at the enamel surface may be as follows:
 1. Desorption of bacteria
 2. Lowering the free surface energy.

Since hydroxyapatite crystals have both positive and negative receptor site. The acidic protein group may be bound at calcium site (positive) and basic protein side group will be bound to the phosphate site of hydroxyapatite crystals. Thus, fluorides (F^-) have a high efficiency towards calcium site and compete with acidic protein group. Thus, higher concentration of fluoride may be effective in desorbing protein by a competitive inhibition for calcium site. Fluoride also affects the wettability of dental enamel. A lowered free surface energy or less wettable surface provides a cleaner surface with less plaque adherence.

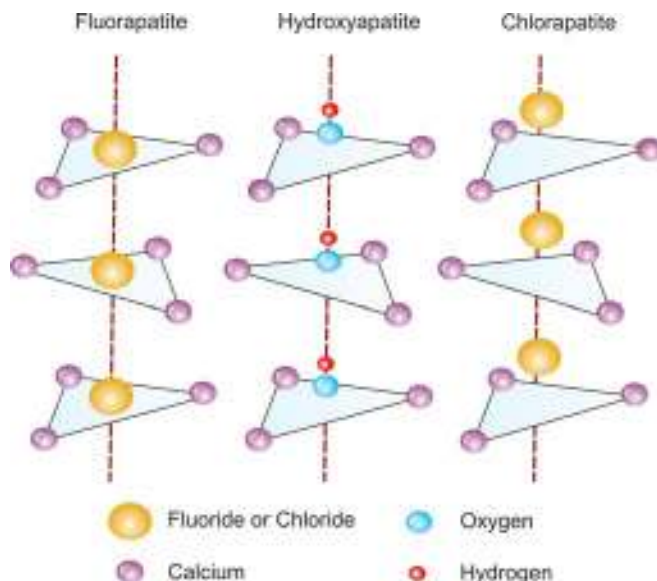


Fig. 22.1: Sketch diagram of structure of fluorapatite, hydroxyapatite, and chlorapatite crystal lattice respectively. See the difference in F, OH and chloride location in the enamel

Antimicrobial Action of Fluoride

Enzyme enolase is important for glycolytic pathway of anaerobic respiration and this enzyme is very sensitive to fluoride and acidification of the cytoplasm. Scientist Marquis (1995) proposed another concept of enolase inhibition. He concluded that fluoride ions enter into the cytoplasm of bacteria in the form H^+F^- acid which lowers the cytoplasmic pH. The enzyme enolase and other enzymes of glycolytic pathway and sugar transport system are sensitive to cytoplasmic acidification.

- The cariogenic bacteria (aciduric) maintain a high internal pH above the external pH by
 1. The efflux of the acidic end products depending on the internal and external ratio of the product.
 2. Active transport of protons through bacterial cytoplasmic membrane associated proton extruding ATPase.

Table 22.5: Different fluoride delivering systems and recommended concentration of fluoride

Fluoride delivering system	Fluoride concentration	Application
1. Water fluoridation	Optimal 1ppm	Continuously
2. Fluoride tablets	0.25-1mg	Daily
3. Fluoride drops	1000-2000ppm	Daily
4. Rinsing solution (dental)	250-1000ppm	Daily
5. Fluoridated toothpaste	500-1500ppm	Twice daily
6. Milk fluoridation	7.5ppm	At school
7. Salt fluoridation	250-350ppm	Continuously
8. Concentrated solutions	10,000ppm	Biannually
9. Concentrated gels	4000-12,300ppm	Biannually
10. Lacquers	1000-22,600ppm	Biannually

Note: The proton extruding ATPase of oral microbiota can be inhibited by F^- .

Classification of Fluoride Administration (Table 22.5)

A. Systemic Administration of Fluoride

- By dietary fluoride and supplements
 - Fluoridated sugars.
 - Fluoridated salt.
 - Fluoridated drops with vitamins.
 - Fluoride tablets.
 - Fluoride sustained release device.
 - Unintentional ingestion of fluoride dentifrices/mouth rinses.

2. By community

- Water fluoridation
- School water fluoridation
- Milk fluoridation.

B. Topical Fluoride Administration (Fig. 22.2)

- Professional fluoride application
 - Topical fluoride solutions
 - Fluoride varnishes
 - Fluoridated foam
 - Fluoridated gels
 - Fluoridated dental materials
 - Fluoridated dental cement.
 - Fluoridated amalgam
 - Fluoridated alginates.

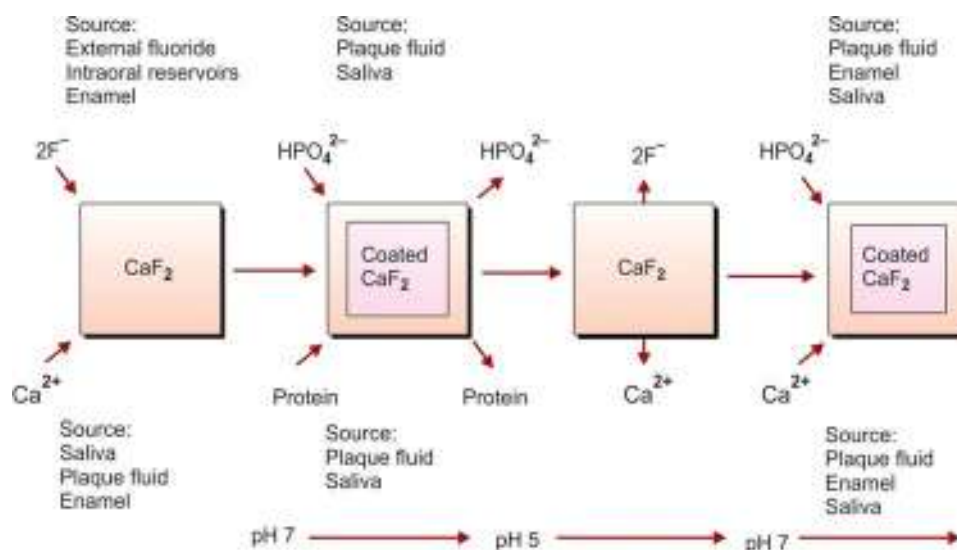


Fig. 22.2: Formation of calcium fluoride during topical application of fluoride. It acts as reservoir which increases the release of fluoride when pH falls below critical pH (5.4). This reservoir greatly influences both remineralization and demineralization process

- Fluoridated impregnated prophylaxis paste.
 - Ionotophoresis.
2. Self application
- Fluoridated dentifrices
 - Fluoride impregnated floss
 - Fluoridated chewing gum.

Community Water Fluoridation

Most of the research publications indicate that community water fluoridation is the most effective method of reducing the dental caries problem in the general populations (56-62% caries reduction).

Since water consumption by the community depends upon the climate (temperature) of the specific area, the fluoride ion concentration considered optimal for the particular locality is predicted upon the average of the maximum daily temperature. Optimum level of water fluoride level in specific areas can be calculated by following formula:

$$\text{Water fluoride level} = 0.34/E$$

(In ppm)

$$E = 0.38 + 0.0062 \times \text{temp. in } ^\circ\text{F}$$

(E is estimated water intake)

Advantages of Water Fluoridation

The following advantages of water fluoridation are given below:

- a. Water fluoridation has both pre eruptive and post-eruptive cariostatic effective.
- b. Fluoridated drinking water strengthens the crystal lattice of hydroxyapatite during not only pre eruptive stage but also strengthens the post eruptive enamel through the fluoride release in saliva and makes dental enamel more resistant to acid attack.
- c. Systematically administered fluoride excreted in saliva for extended period; provide protection against demineralization of dental tissue and facilitate remineralization of incipient carious lesion.
- d. Fluoridation of community water is the least expensive and most effective way to provide fluoride to the specific community.
- e. Fluoride incorporation during formative stages of teeth makes pit and fissure more shallow and self cleansing.
- f. Any food items or beverages manufactured in fluoridated area and transferred to fluoride deprived

population have a beneficial effect. This is known as diffusion or halo effect of fluoride (WHO 1994 recommendation of fluoride level in drinking water is 0.5-1.0 ppm).

Thus, community water fluoridation provides most cariostatic effect (50-60%) than fluoride salt, fluoride toothpaste, topical fluoride.

School Water Fluoridation

Fluorides are added to the school water supply tank for caries prevention in children. Since children spend only 6-8 hrs. in school, so concentration of fluoride is 4-6 times more than recommended community water fluoridation. School water fluoridation has some disadvantages also. Most of the children are 5-6 year old to begin their schooling, up to this age their dental development does not receive the fluoride from school water fluoridation and will not provide pre-eruptive contact to the primary developing teeth and it provide only limited post eruptive protective benefits to the primary teeth.

Dietary Fluoride Supplements

Dietary fluoride supplements are administered in the following ways:

- a. Fluoridated salt
- b. Fluoridated milk
- c. Fluoride in sugars
- d. Fluoride in beverages
- e. Fluoride drops with vitamins
- f. Fluoride tablets
- g. Fluoride oral rinse supplements
- h. Fluoride sustained release device.

Salt Fluoridation

Table salts have been proposed as a vehicle for fluoride supplementation specially in those countries that are devoid of wide spread municipal water system. Fluoride has been recommended 200-250 mg/kg salt. The commonly used fluoride in salt are potassium fluoride (250 mg/kg salt) and sodium fluoride (225 mg/kg salt).

Advantage

Salt is easily available and almost used in every houses.

Disadvantage

Since salt is usually ingested with food hence fluoride absorption from GIT is relatively slow.

Milk Fluoridation

Milk fluoridation is developed as an alternative method of water fluoridation for caries prevention, because only 5 percent of fluoridated water used for drinking purposes and 95 percent of fluoridated water is wasted.

Disadvantages

- It provides protection against caries in only infants and children because consumption of milk tends to decrease with increasing age.
- Absorption of fluoridated milk is slow as compared to fluoridated water. (Due to Ca^{++} of milk).
- The whole procedure for milk fluoridation is relatively costly and inapproachable to lower socioeconomic group of children.

Fluoridated Sugar

Several research study showed that addition of fluoride to sugar or sugar based product has ability to reduce the cariogenic effect of sugar or fermentability of sugar product.

Fluoride in Beverages

Now a days soft drink consumption among children has increased. Pang (1995) found that fluoride content of juices and juice drinks, beverages was highly variable and ranged from less than 0.01-6.70 ppm.

Unintentional Ingestion of Fluoride

2-3 years old child have greatest risk for toothpaste and oral rinse ingestion because they are not mastered to expectorate properly. Therefore, mouth rinses are contraindicated before age of 7 years.

Fluoride Sustained Release Device

Several researcher have been found that continuous low levels of fluoride in the oral cavity are more effective in reducing caries by remineralization of initial carious lesion. So, a fluoride sustained release intraoral device is developed. These devices contains fluoride compound

and covered with copolymer membrane or bioadhesive membrane. This device is applied usually on the molar teeth.

A number of fluorides releasing dental material is also developed, e.g. glass ionomer cement, fluoridated amalgam and resins.

Topical Fluoride Application

Topical application of fluoride has been a corner stone of preventive dentistry for many years. Topical fluorides are directly applied to the partially or fully erupted primary and permanent teeth. Fluoride application enables tooth to be more resistant to acid attack.

Indications of Topical Fluoride Application

- Caries susceptible individual:* Those individual who have a past history of caries experience or who develops new carious lesion on smooth surface of tooth.
- Children shortly after periods of primary or permanent tooth eruption particularly those who are not caries free.
- Salivary flow reduction or xerostomia:* Those individuals who are on salivary flow reducing medicaments or are receiving radiotherapy for head and neck carcinoma.
- Topical fluoride should be applied after periodontal surgery specially in those cases where roots of teeth have been exposed.
- Individuals wearing fixed or removable prosthesis.
- Topical fluorides should be applied after placement or replacement of restoration.
- Those individuals who are suffering from eating disorders.
- Mentally and physically handicapped individuals.

The choice of topical fluoride for each individual depends on age, oral health, habits, physical dexterity and education.

Professional Application of Topical Fluoride

To reduce the chances of ingestion of fluoride during professionally topical fluoride application, the following procedure should be under consideration:

- Patient should be seated in the upright position.
- Oral prophylaxis and polishing of teeth should be completed before application of fluoride.

3. Rubber dam should be placed.
4. Use soft tray with absorptive liners.
5. Only 2.5 ml of fluoride gel is placed in each stock tray (not more than that).
6. Always use salivary ejector during and following treatment.
7. Remove excess gel from teeth with gauze following tray removal.
8. Patient is advised to expectorate repeatedly and thoroughly following treatment.

1. Sodium Fluoride Solution (2% NaF, 9040 ppm, pH 7)

Sodium fluoride was the first fluoride agent to be used in the early clinical trials for the prevention of dental caries.

KNUTSON TECHNIQUE (1948)

- I. Clean and polish the teeth during first visit (pumice oral prophylaxis).
- II. Isolate the teeth with cotton gauge or rubber dam.
- III. Dry the teeth with air syringe thoroughly.
- IV. Apply 2 percent sodium fluoride on cleaned isolated and dried teeth with the help of cotton rolls applicator and allow drying for 4 minutes. Second, third and fourth application of fluoride done at weekly interval and application is recommended at 3, 7, 11 and 13 years of age.
- V. Sodium fluoride 2 percent applied once in each visit. Because once a layer of CaF_2 is formed on the surface of tooth, it prevents the further diffusion of F^- ions to react with hydroxyapatite crystals. This is known as choking phenomenon.
- VI. Advice the patient to avoid eating or drinking for 30 minutes after application.

Precaution: Sodium fluoride is always kept in plastic bottle. If stored in glass bottle, the silica of glass reacts with fluoride and forms SiF_2 and reducing free fluoride availability.

Advantages of NaF

- I. Chemically stable solution.
- II. Acceptable taste, non irritating to the gingiva and does not discolor teeth.
- III. Inexpensive.

Disadvantage

Patient had to make four visits to the pediatric dental surgeon within a relatively short time.

2. Stannous Fluoride Solution (8% SnF_2 , 19360 ppm)

Howell conducted first clinical trial in 1955 and showed that SnF_2 has produced significantly greater caries reduction (59%) than sodium fluoride (30%).

MUHLER TECHNIQUE (1957)

- I. A through oral prophylaxis and polishing of teeth should be completed prior to the fluoride application.
- II. Isolate one quadrant with cotton rolls and dry the teeth with air syringe.
- III. Prepare 8 percent SnF_2 solution in distilled water immediately at the time of application.
- IV. Apply this freshly prepared solution with the help of cotton applicator to the isolated tooth every 15-30 second. So that the teeth are kept moist with the solution for 4 minutes.
- V. Advice the patient not to eat or drink for 30 minutes after application.
- VI. Once a year topical application of SnF_2 , 8 percent is recommended.

Advantages

- I. Rapid penetration of fluoride to the deeper layer of enamel.
- II. Highly insoluble tin fluorophosphates complex form on the enamel surface that acts as a protective layer for the enamel decay.

Disadvantages

- I. Unstable in aqueous solution and should be prepared fresh for each patient.
- II. It is highly acidic in nature (pH 2.1-2.3)
- III. It has metallic taste which is unacceptable to most of the children and patient.
- IV. It may cause gingival irritation particularly to dehydrated and diseased gingival tissues.
- V. SnF_2 produces discoloration of hypocalcified area of teeth.

VI. It will produce staining on the margins of the restorations.

3. Acidulated Phosphate Fluoride Solution

This is the acidulated solution of sodium fluoride (1.23%) having pH 3 and 12300 ppm of fluoride.

The success of APF is attributed to its ability to deposit fluoride in enamel as fluorapatite. APF may provide both a short term and long term protection. The short term effect by acting initially as more potent reservoir of fluoride and long term effect by formation of fluorapatite which is more resistant to caries attack. Since enamel acts as a fluoride reservoir which will ensure that fluoride is available at the site of developing carious lesion helps in its remineralization. This is the main reason why enamel or tooth needed multiple topical fluoride application.

BRUDEVOLD TECHNIQUE (1963)

- I. A through oral prophylaxis should be completed prior to APF application.
- II. Isolate the quadrant selected for application and apply APF solution continuously and repeatedly with the help of cotton applicator.
- III. Keep the teeth moist for 4 minutes.
- IV. Pass the APF solution dipped floss through each interproximal embrasure to ensure wetting of these surfaces.
- V. Repeat the same procedure for the remaining quadrant.
- VI. Advise the patient not to eat or drink for half an hour.

Advantages

- I. APF solution is cheap.
- II. It is stable in solution or gel form and have long shelf life.
- III. Fluoride uptake by enamel from APF (1.23%) as compared to 2 percent NaF is much higher.

Disadvantages

- I. Teeth must be kept wet with the solution for 4 minutes.
- II. APF solution is acidic in nature and bitter in taste.
 1. APF gels: (pH 4 - 5) it is not a true gel. The incorporation of water soluble polymer, i.e. sodium carboxymethylcellulose into aqueous solution of APF, produces a viscous solution. The

most widely used topical fluoride is APF gel because of its ease of application. It is also used semiannually.

Other Topical Fluoride Agents

1. *Titanium tetra fluoride*: One investigator showed that topical application of titanium m-tetra fluoride inhibit dental caries more than did APF but further investigation needed.
2. *Amine fluoride*: Muhlemann (1957) find out that hydrofluoride of long aliphatic chain amine reduced enamel solubility to a greater extent that did stannous fluoride. Further research showed that in vitro uptake of fluoride was greater for amine fluoride than for APF and stannous fluoride (further investigation is needed).
3. *Ammonium fluoride*: Manley and Bibby (1949) They reported that ammonium bifluoride (NH_4HF_2) with a pH 3.5, reduced the acid solubility rate of enamel to a greater extent than did neutral 2 percent sodium fluoride. Further clinical trial have been required to prove its efficiency.
4. **Dual fluoride treatment technique** to increase the effectiveness of topical fluoride agent
 1. Acid etching followed by APF solution application.
 2. APF application followed by stannous fluoride application.
 3. Dicalcium phosphate dihydrate followed by fluoride solution.

Further investigation is needed to prove its better anticaries efficiency of dual treatment technique.

Fluoride Varnishes

Fluoride varnishes were first developed in Europe in 1960. The first fluoride varnish tested was Duraphat (Germany).

Duraphat contains 2.26 percent of fluoride. It is viscous, resinous in nature which is applied to clean, dried and isolated teeth. Duraphat hardens into yellowish brown coating on teeth in the presence of saliva.

Fluoroprotector (vivadent co.): It contains 0.7 percent fluoride ion (Silane fluoride) in a polyurethane base. It makes a clear transparent film on teeth.

Fluoritop (INDIA): Also marketed in 0.4 ml container.

Fluoride varnishes are particularly useful in disabled children or application after restorative or replacement

of restoration. Fluoride varnishes are safe because the amount of varnish usually used is 0.3-0.5 ml which delivers only 3-6 mg of fluoride.

Note: Patient is advised not to eat or brush for at least 4 hrs. after varnish application. Biannual applications are widely recommended.

Fluoride Containing Oral Prophylaxis Paste

Fluoride containing prophylaxis paste is not a substitute for topical fluoride solution or gel application for caries susceptible children. A thorough polishing of teeth with rubber cup may remove a thin and highly mineralized outer layer of enamel. A fluoride containing oral prophylaxis paste should be used which may help to replenish the mineral that are abraded during polishing. Commercially available fluoride containing paste are:

1. APF-Silicon dioxide paste.
2. SnF₂-Zirconium silicate paste.

Listerfluor Fluoride Dental Rinse

Composition:

Sodium fluoride	2.21 mg per 10 ml
Ethyl alcohol	6.65 percent v/v

Pharmacological Action

Together with its antienzymatic properties, sodium fluoride enhances the remineralization process of enamel, making it effective as an aid in preventing dental caries.

Indications

As an aid in the prevention of dental caries.

Contraindications

- Hypersensitivity to any of the ingredients.
- Do not give to children under 6 years of age.

Dosage and Direction for Use

Children 6-14 years: Brush teeth and rinse mouth as usual. Rinse the mouth with 10 ml (a quarter cup full) of undiluted listerfluor fluoride dental rinse for 60 seconds once or twice a day. Do not swallow. For maximum benefit, do not eat or drink for a period of 30 minutes after rinsing.

Side Effects and Special Precautions

Do not swallow. If excessive amounts of fluoride are repeatedly swallowed, developing teeth of children under 6 years of age may become permanently discolored.

Iontophoresis

It is based on the theory that small electric current will help to move the fluoride ions further into deeper dental tissues producing the desired effect, e.g. Reduced enamel solubility, increased fluorapatite formation, reduce dentine sensitivity and sterilization of root canals.

Uses of Iontophoresis

1. Management of hypersensitive root surface.
2. To increase fluoride uptake by dental hard tissues.
3. Endodontic purpose (Sterilization of root canal).

Note: Iontophoresis for the purpose of increasing fluoride uptake during topical fluoride application is of questionable value.

Fluoridated Dental Materials

- Glass ionomer cement widely used for cementation of crowns and having fluoride leaching property.
- 1.5 percent stannous fluoride is added to the silver amalgam for anticaries effect (Jerman, et al. 1970).
- Fluoride containing varnishes and sealants and resins.
- Alginate impression materials have been suggested as a vehicle for topical application of fluoride EX. Kerr alginate having 1.5 percent fluoride.

Self Applicable Topical Fluoride

- a. *Fluoridated dentifrices (Table 22.6):* American dental association recommend that all fluoridated dentifrices should contain 1000-1500 ppm fluoride either in the form of sodium fluoride or sodium monofluorophosphates and none contain stannous fluoride.

Advantages

It is an easily available and frequent source of low concentration fluorides that inhibit routine demineralization and enhanced remineralization of incipient lesion.

Table 22.6: Recommended brushing with fluoridated toothpaste in different age group child

Age of child	Recommendation for use of fluoridated toothpaste
Below 4 years	Fluoride tooth paste is contraindicated
4-6 years old child	Recommend brushing once with fluoridated tooth paste and other two times with non fluoridated dentifrices.
6-12 years old child	Brushing twice with fluoridated tooth paste and once with non-fluoridated tooth paste.
Above 12 years	Recommend 3 times brushing with fluoridated tooth paste.

- b. *Fluoride impregnated dental floss*: Dental floss is an important component of the oral hygiene aids. Dental floss helps in removing the plaque from interproximal area of tooth, if the interproximal area receives the benefits of additional fluoride during dental flossing this may increase its value as a caries preventive aid.

Gilling BRD (1973) utilized sodium fluoride and stannous fluoride, successfully developed and patented several formulas of fluoridated dental floss because of unknown sample size and lack of clinical data no definitive conclusion about its cariostatic effectiveness could be made.

Commercial floss containing fluoridated soluble wax was made. Unfortunately there is no clinical or laboratory data available regarding efficacy of fluoridated floss so the product was withdrawn by the manufacturing company.

- c. *Fluoridated chewing gum*: Fluoridated chewing gum has been used for delivering fluoride to the enamel surface but its clinical cariostatic effect needs further investigation.

Fluoride Toxicity

Several research have been shown that prolonged use of recommended levels of fluoride in water does not produce harmful physiological effect in human. Dental fluorosis which has been found true in person consuming drinking water up to 8.0 ppm fluoride. Dental fluorosis occurs in those individuals who are consuming water 2.0 mg/liter or more fluoride in their first 8 years of life.

The skeletal fluorosis can occur if water contains more than 4 ppm fluoride and consumed regularly.

Acute toxicity: Horowitz (1984) reported that toxic effect could result from acute ingestion in excess of 8 mg/kg body weight. Therefore, the lethal dose of fluoride was in the range of 32-64 mg/kg body weight. He estimated that acute lethal fluoride poisoning would occur after ingestion of 5-10 gram for 70 Kg adult and 320 mg for two year old weighing about 10 kg.

The acute toxicity of fluoride usually associated with young children ingesting large amount of fluoride relative to their body weight. Acute fluoride poisoning showed following clinical symptoms:

- Nausea vomiting
- Diarrhea
- Muscle tremor
- Thirst and excess salivation
- Cardiac arrhythmias
- Fall in blood pressure
- Coma and death.

Management of Acute Toxicity of Fluoride

- Vomiting should be induced by drug and gastric lavage should be done.
- To prevent fluoride absorption from GI tract by giving calcium hydroxide liquid or antacid containing aluminum or magnesium hydroxide.
- At the sign of muscle tremor calcium gluconate should be administered orally.
- Fluid replacement may be required because of vomiting and diarrhea and to maintain urinary flow rate. The intravenous fluid may contain sodium bicarbonate or Ringer lactate solution to minimize the degree of acidosis and to elevate urinary pH. Clinical monitoring and supportive therapy should be continued under supervision of physician, until the vital sign, serum chemistry and mental alertness are within normal range.

Chronic toxicity: Chronic toxicity of fluoride is due to prolong ingestion of a smaller amount of fluoride. Chronic toxicity usually associated with hard tissue (BONE) and kidney tubules.

- Skeletal fluorosis may occur at ingestion of 10-25 mg F/day for 10-20 years.
- Kidney may occur at ingestion of 5-10 mg F/day for 6-12 months.

DEFLUORIDATION (REMOVAL OF FLUORIDE)

The term defluoridation means to remove the excess fluoride from drinking water and adjusting fluoride level in water up to 1 PPM. The following methods are used for Defluoridation purpose:

Nalgonda Technique

This technique developed by (NEERI) India in 1975. The advantages of this technique are, easiest to operate, simplest and least expensive. National Environment Engineering Research Institute (NEERI), Nagpur has been involved in defluoridation research since 1960. The first defluoridation community plant was constructed in the district Nalgonda in Andhra Pradesh (India) in the town of Kathri.

Procedure

Raw water is mixed with adequate lime (chuna) and alum. The amount of lime depends on the alkalinity of the raw water. If the raw water has adequate alkalinity, the lime addition is not required. Alum is added after the addition of lime and stirred slowly for 10 min. Flocs are formed and allowed it to settle. This process of flocs formation and setting of flocs required an hour.

This method is also useful for defluoridation of domestic drinking water as required. It is advised that lime and alum mixed with water in big container and leave it overnight so that next the clean supernatants is decanted for use and is safe for consumption. Defluoridation by Nalgonda Technique, meets with standard laid down by the Bureau of Indian standard (Fluoride Content < 1 mg/liter of water).

NALGONDA CALCINED MAGNESITE TECHNIQUE OR DUAL DEFLUORIDATION TECHNIQUE

In Tanzania, the calcined magnesite technique and nalgonda technique both were introduced as flow system of plant for experiment in 1985.

In this dual fluoridation technique, Nalgonda technique was passed through a filter bed consisting of calcined magnesite granules. The fluoride of raw water was absorbed first by calcined magnesite granules and then by Nalgonda technique. But after defluoridation the pH of raw water rises up to 10, then further treatment of water pH is needed before being drunk.

Prasanti Technology for Defluoridation

This technology of defluoridation is developed by bio-science department of Satya Sai University for Higher Learning in Prasantu Nilayam, Ananthapur district of Andhra Pradesh (India). This technology uses activated alumina in raw water for defluoridation. In Andhra Pradesh, 25 community defluoridation plant were constructed, each serving 200-400 people in location and have been functioning since 1998. Besides, the community plants, approximately 450 domestic defluoridation filters are being used by people living in fluoride endemic area.

Defluoridation by Reverse Osmosis

The reverse osmosis is well known procedure in industry. All elements in water get diminished after membrane filtration. This method is claimed to be the best water defluoridation and water purification process available. This process seems to be expensive for developing countries as 30 percent of raw water is lost in the reverse osmosis process.

Adsorption and Ion Exchange Method

Some chemical substance adsorbs fluoride ions by the surface and exchanges its negative ions (OH^-) for the fluoride ions, because a radius of OH^- is similar to radii of F^- . Thus, the concentration of fluoride in water decreases. This process is affected by following condition:

- I. pH
- II. Surrounding temperature
- III. Flow rate of raw water
- IV. Grain size of the adsorption substance used.

Some commonly used adsorbing materials as follows:

- a. Activated alumina (Al_2O_3)
- b. Fluidized activated alumina
- c. Activated bauxite
- d. Zeolite ($\text{NaO}_2.\text{Al}_2\text{O}_3$)
- e. Tricalcium phosphate
- f. Activated bone charcoal, activated carbon.

Precipitation Method

In high pH, the water elements co-precipitate with fluoride ions and form fluoride salt. Sometimes, it may cause flocculation, if the substance used is aluminum ion. Thus, fluoride concentration in water decreases. The

following substances are used for precipitation method—Alum, alum plus lime and calcium chloride.

BIBLIOGRAPHY

1. Bibby BG, Van Kesteren M. The effect of fluoride for mouth bacteria. *J Dent Res* 1940;19:391.
2. Knutson JW, Armstrong WD. The effect of topically applied sod. fluoride on dental caries experience. *Public Health Rep* 1943;58:1701-15.
3. Knutson JW. Sodium fluoride solution: Technique for a application to the teeth. *J American Dental Association* 1948;36:37-9.
4. Marquis RE. Antimicrobial action of fluoride for oral bacteria. *Can J Microbial* 1995;41:955.
5. Mirth DB, shern RJ, Emilson CG, et al. Clinical evaluation of an intra-oral device for controlled release of fluoride. *J of American Dental Association* 1982;105:791-7.
6. Peterson JK, Jordan WA, Snyder JR. Effectiveness of stannous fluoride-silex silicon prophylaxis paste. Two year report-Moorhead, Minnesota, Northwest dental 1963;42: 276-8.
7. Ripa LW. Review of anticaries effectiveness of professionally applied and self applied topical fluoride gels. *J Public Health Dent* 1989;49:297.
8. Skartviet L, Wefel JS, Ekstrand J. Inhibition of artificial recurrent caries by fluoride containing amalgam. *Scand J. Dent* 1991;99:287-94.
9. Sutton SVW, Bender GR, Marquis RE. Fluoride inhibition of proton translocating ATPase of oral bacteria. *Infact. Immunol* 1987;55:2597.
10. Toumba KJ, Curzon MEJ. Prevention of dental caries using fluoride slow releasing glass devices in children caries. *Res* 1996;30:306.

Pediatric Restorative Dentistry

Dental amalgam, despite its clinical imperfection, has been the restorative material of choice for posterior primary teeth. Pedodontist must have a thorough knowledge of anatomic difference between primary and permanent dentition before restoring primary tooth with amalgam or other restorative materials. Following are the anatomic differences between primary and permanent dentition.

1. Primary teeth are smaller in all dimensions than permanent teeth.
2. Primary crowns have different shapes from their succedaneous permanent tooth.
3. The mesiodistal diameter of crown of primary molar is greater than the cervico-occlusal dimension.
4. The buccal and lingual surfaces of primary molars diverge towards the cervix, creating a narrow occlusal table and a pronounced cervical bulge.
5. Enamel cap of primary tooth is thinner and has a more consistent depth than that of a permanent tooth, being approximately 1 mm thick around the whole enamel cap.
6. The cervical enamel rods slope occlusally and end abruptly at the cervix instead of being oriented gingivally and gradually becoming thinner as in the permanent teeth.
7. The pulp chambers of the primary teeth are proportionally larger and the pulp horns are closer to the outer surface of the crown. This is especially true of the mesiobuccal pulp horn of the primary molars (ideal depth for cavity preparation in primary tooth is 1.5 mm from the cusp tip).
8. Primary molars have a broader and flatter contact area than permanent molars. This makes early diagnosis more difficult.

Principles of Cavity Preparation

The objective of cavity design is to remove the carious part of tooth, prevent future caries attack, and restore a proper anatomic form to the tooth with restorative material. The principle of cavity preparation in primary dentition is based on the literature of GV Black. He advocates following principle for cavity preparation:

1. *Outline form*: Include surfaces of tooth that were decayed or susceptible to decay.
2. *Resistance form*: Shaping the preparation to withstand the stresses of mastication. To achieve the resistance form, the pulpal and gingival floor should be horizontal to the long axis of the tooth.
3. *Retention form* is a part of resistance form. Retention form prevents the displacement of restoration. For example, preparing a dovetail in the occlusal table of a Class II cavity and paralleling or slightly converging the walls of the cavity towards the occlusal surface and forming retentive grooves in the proximal box of a Class II.
4. *Convenience form*: To allow the dentist to properly condense the restorative material.
5. Finishing the enamel walls with hatchet and toilet of the cavity.

Note:

1. A sharp angle between the pulpal floor and the axial wall of the cavity should be avoided. Rounded angles throughout the preparation will result in less concentration of stresses and will permit adaptation of the restorative material into the extremities of the preparation.
2. In the conventional Class II cavity preparation for amalgam, the buccal and lingual extension should

be carried to self cleansing area. The proximal extension should be divergent in pattern. Ideally, the width of the preparation at the isthmus should be approximately one third the intercusp dimensions.

3. The axiopulpal line angle should be beveled to reduce the concentration of stresses and to prevent the fracture of the restorative material.

Finn's Modification of Black's Classification for Primary Teeth

Class I: Cavities on the pits and fissures of the molar teeth and the buccal and lingual pits of all teeth.

Class II: Cavities on the proximal surfaces of molar teeth with access established from the occlusal surface.

Class III: Cavities on the proximal surfaces of anterior teeth that may or may not involve the labial or lingual surface.

Class IV: Cavities on the proximal surfaces of anterior teeth that do involve the incisal edge.

Class V: Cavities on the cervical third of all the teeth including the proximal surface where the marginal ridge is not included.

Class VI: Cavities on the incisal edge of anterior teeth or occlusal cusp heights of posterior teeth (Simon's modification).

Class I Preparation for Incipient Caries in a Very Young Child (Fig. 23.1)

During routine examination of a child under 2 years of age, the dentist may occasionally found incipient caries on the central fossa of different primary molars. The operating dentist asks the parents to hold the child in

their lap and a small cavity may be made without applying rubber dam and local anesthesia. Restore the tooth with amalgam or resin or glass ionomer cements.

CONVENTIONAL CLASS I CAVITY PREPARATION IN PRIMARY TEETH

The outline form for Class I cavity involves all caries susceptible area including pits and fissure on the occlusal surfaces. As shown in Figure 23.1, the ridges that traverse the occlusal surfaces of the mandibular 1st molar and maxillary second molar are normally not crossed in cavity for these teeth. The ridges are relatively caries immune. Since, occlusal anatomy of primary second molars is similar to the permanent 1st molar, therefore outline form is likewise similar.

During Class I cavity preparation, the operator uses a round bur in a high speed hand piece with water spray and holds it parallel to long axis of tooth. The depth in the central fossa is 1.5 mm from the enamel surface or 0.5 mm in the dentin, the operator then uses a straight fissure bur and extend the cavity according to the outline form or caries extension for prevention. The walls slightly converge towards the occlusal surfaces. The prepared cavity is washed with saline and dried. An appropriate pulp protecting agent is applied (Dycal) and cavity is restored with amalgam or modified GIC.

Class II Cavity in Primary Tooth (Fig. 23.2)

1. If very small carious lesion is present on proximal surface of primary posterior teeth: Very small incipient proximal lesion may be prevented with topical fluoride therapy, improved oral hygiene and improved diet. Recall the patient every 3 months and take bitewing radiograph to see the growth of carious lesion and treat it accordingly.



Fig. 23.1: Outline forms commonly employed for Class I carious lesion in primary molars



Fig. 23.2: Class II cavity on maxillary right second primary molar

2. If a small lesion on the proximal surface may be excavated by a small bur or by tilting the air abrasion tip laterally and pulpally at the initial opening (i.e. marginal ridge). Fluoride releasing or composite resin restoration is condensed into the cavity.

3. Proximal carious lesion with greater dentine involvement (Class II cavity): The conventional Class II cavity consists basically of an occlusal step, proximal box that is joined with the isthmus. The proximal box should have its margins extended to the self cleansing area. The tip of a probe should be able to just pass between the buccal and lingual margins and the adjoining tooth and gingival floor should be below the contact area.

The extreme care must be taken when breaking through the marginal ridge to prevent damages to the adjacent proximal tooth. The angle formed by the axial wall and the buccal and lingual walls of proximal box should approach a 90° angle. The axiopulpal line angle should be beveled and grooved to reduce the concentration of stresses. The resistance and retention form can be achieved by preparing dovetail on the occlusal table.

The steps of cavity preparation is the same as for Class I cavity. The proximal wall and gingival floor are then refined with hatchets. The cavity is then washed and dried before application of pulp protecting agents. The cavity is ready for amalgam or modified GC condensation.

MINIMAL INTERVENTION FOR PROXIMAL CARIES IN PRIMARY TEETH

Tunnel Shaped Cavity Preparation

It is a type of cavity preparation made when the caries is localized in the proximal surface, more than 2.5 mm from the marginal ridge. The proximal surface is intervened from the triangular fosse of the occlusal surface without cutting the marginal ridge. Thus, a tunnel is formed keeping the marginal ridge intact.

Proximal Slot Preparation

This type of cavity preparation is also done for proximal caries. The cavity outline is like a box with no step such as for gingival seat. It provides more retention to the filled restorative material. It is a conservative approach.

Proximal Approach

Proximal approach for proximal box preparation is done when there is proximal caries and no adjacent teeth are present.

MATRIX BANDS, RETAINERS AND WEDGES

A matrix band replaces the missing proximal surface of the tooth. Retainers are used to secure the bands on affected teeth. Wedges are used to adapt the matrix band closely to the tooth surface especially at the cervical constriction and thereby preventing any extension of material into the gingival crevice during condensation of the amalgam in a Class II cavity preparation.

Classification of Matrix Band

The matrix band can be:

- A. Without retainers - e.g. Spot welded
- B. With retainers - e.g. Tofflemire matrix retainers
- C. Metallic - e.g. Spot welded, Tofflemire matrix bands
- D. Non-metallic - e.g. Mylar strip.

Tofflemire: It is used to restore the missing wall of proximo-occlusal caries on a posterior tooth. It is available in straight and contra-angle types.

Mylar strips: These are non-metallic matrix band made of soft plastic, used for glass ionomer and composite restorations.

Spot-Welded Matrix Band

It can be individually custom-made for each tooth and also available in prefabricated form for each tooth.

The steps involved in fabrication of custom made spot welded matrix bands are:

1. 5 cm length of band material is cut and the ends of the band are welded together in one spot to form a closed loop.
2. The loop is placed around the tooth and held firmly at the lingual surface with pinching pliers lingually, until the band is drawn up snugly around the tooth. The band is removed and welded together.
3. The excess band material is cut off 1 mm beyond the welded joint. The cut edges of the band are rounded and bent and merge to the main band materials. The band and joints are soldered and finished. The cervical and contact areas are contoured.

WEDGING

Holding the band with one finger on the abutment tooth, the wedge is inserted snugly through buccally or lingually at the level of cervical margin; to make sure the band is positioned snugly at the gingival margins and walls of the preparation.

Wedges

Types of Wedges

1. Based on the material used
 - A. Plastic
 - B. Wooden.
2. Based on the cross-sectional shape
 - A. Round
 - B. Triangular (Figs 23.3 to 23.6).

Triangular wedges are preferred as they adapt well to the triangular shape of the embrasure space leading less trauma to gingiva.

Uses of Wedge

1. Adapts the matrix band close to the tooth.
2. Protects the gingival papilla from condensed restorative materials.
3. Helps in minimal tooth separation.

Consequences of Faulty Wedging

1. A concavity at the cervical portion of the proximal box of primary teeth can result if the rubber dam displaces the wedge or if an oversized wedge is used. The purpose of the wedge in the primary dentition is to hold the matrix band at the cervical margins of the proximal box area.
2. Loosely placed wedge may lead to overhanging of the restorative material.

3. Use of oversized wedge may lead to an open contact area. If the child has primate spacing or space between the teeth, it is advisable to restore the natural space.

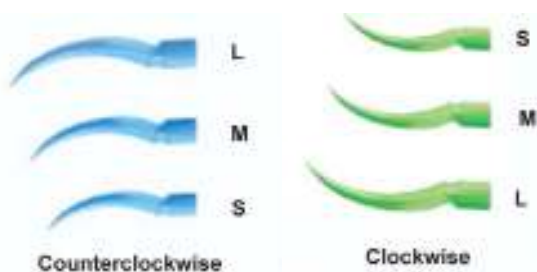
Class III Cavity (Fig. 23.7)

The Class III cavity consists of a proximal box, a labial or lingual step and an isthmus. The Class III cavity is indicated in primary anterior teeth when carious lesion present on the proximal surface. The principle for Class III cavity preparation is same as for Class II. The dovetail lock prepared on the labial or lingual step. The dovetail is usually placed on the palatal surface of maxillary canines and the labial surface of mandibular canines.

Note: The proximal box of Class III cavity preparation for amalgam restoration is typically on the distal surface of canines to improve the esthetics. The carious lesion on the mesial and distal surface of canine is usually restored by nanocomposite for esthetic purpose.

The proximal box of Class III cavity should be sufficiently wide to allow a probe to pass between the margins of the preparation and approximating tooth. Amalgam retention is dependant on the degree of convergence between the labial and lingual walls of the proximal box and the walls of the dovetail step. Amalgam retention can be enhanced by incorporating proximal axial retentive point or groove.

The Pedodontist starts preparing a Class III cavity by utilizing a no. 330 bur in an airtoror handpiece. The cavity depth should be 0.5 mm within the dentin. It is always advice to create the dovetail 1st and then proximal box. The walls are refined with the help of a hatchet. The prepared cavities are then washed and dried and placement of a pulp protecting agent is done. Now cavity is ready for amalgam condensation or other esthetic restorative materials.



Figs 23.3 to 23.6: Most commonly used triangular wedges. Wedges held in proximal surface of MOD cavity



Fig. 23.7: Class III cavity in primary canine



Fig. 23.8: Modified Class III cavity in primary maxillary incisors

Modified Class III (Fig. 23.8): The modified Class III preparation uses a dovetail on the lingual or sometime on the labial surface or both, to improve the retention of restorative material.

Class IV cavity; (Fig. 23.9): Designed for esthetic cavity preparation on primary anterior teeth with carious lesion involving incisal edge are shown in Figure 23.9. The steps of cavity preparation are given below:

1. Isolate the tooth with rubber dam.
2. The cavity preparation includes proximal reduction through the incisal angle, carious lesion and ends at the cervical seat, formed in the sound dental tissue. The labial and lingual locks are then prepared on the cervical 1/3rd of tooth. The enamel margins of the cavity are beveled to increase the retentive surface area. The beveled surface is etched and bonding agent is applied and cured. The cavity is ready for composite filling. The cavity is then filled with resin in increments to minimize the polymerization shrinkage.
3. The initial shaping of the restoration may be accomplished with a finishing bur. The gingival margin may be finished with a scalpel blade. The final polishing may be accomplished with rubber cup and a fine moist abrasive material or composite finishing system.

Class V Cavity

The outline form of the Class V cavity for primary or permanent teeth depends upon the location and size of the caries. It can be kidney or circular shaped. Overhanging enamel should not be present in the cavity. The pulpal floor should be in sound dentin. Enamel



Fig. 23.9: Design of Class IV cavity (esthetic resin restoration for primary anterior teeth)

margin should be beveled for composite restoration. For GIC or amalgam restoration, enamel margin bevel is not needed in Class V cavity.

Esthetic Composite or GIC Restoration for Posterior Primary Teeth

1. The conventional Class I and II cavity are modified by the beveled enamel margins for the resin restoration. Whenever composite restorative material are employed enamel beveling, etching and bonding agents are recommended. The cavity is filled with resin by increments and cured it with 550 nm blue light. Finally, finished it with composite finishing kit.
2. No modification is required in conventional Class I and II cavity for glass ionomer restoration.

Veneer Restoration in Primary Teeth

1. **Bonded composite veneer restoration:** The restorative resin simply becomes veneer when it is used on etched labial or lingual surface of a primary tooth. The bonded composite veneer is useful for restoring small hypoplastic or discolored area of a tooth. It is also useful for masking the intrinsic discoloration of a tooth by veneering the entire labial surface.

2. Bonded laminates veneer restoration: Laminate veneer restoration has been used for both primary and permanent anterior teeth. The laminate veneer technique offers esthetic improvement because the restored teeth simulate the natural hue and appearance of normal healthy tooth structure with minimal loss of tooth structure.

Tooth preparation: Reduce the facial enamel about 0.5 to 1 mm at the incisal and middle 1/3rd with tapering towards cervical margins. The enamel reduction is 0.25

to 0.5 mm at the cervical margins. The cervical margins are finished in a well defined chamfer.

Bonding technique: A thin prefitted porcelain facing or veneer is bonded to the reduced abutment with the help of tooth colored resin system. Before bonding, the inner surface of the porcelain veneer is etched with the HF acid and self curing bonding agents are applied over it. The tooth is etched with 37 percent phosphoric acid, dried and bonding agents are applied over it. The self curing composite are interposed in between these two layers of bonding agents.

Various Designs of Prefabricated Crown in Pediatric Dentistry

INTRODUCTION

Crown is an artificial replacement that restores missing tooth structure by surrounding most or all of the remaining structure such as cast metal, resin, porcelain or a combination of materials. It is intended to reproduce both the form and the function of the tooth (Figs 24.1 and 24.2) and to restore the esthetics.

FACTORS INFLUENCING THE DESIGN OF CROWN

1. *Crown Length*: Teeth must have adequate cervico-occlusal crown length to achieve sufficient retention form.
2. *Crown Form*: Internal surface of crown form should be exact negative replica of reduced abutment and it should follow the rule of parallelism, necessitating
- full coverage retainers to improve their retentive and esthetic qualities. The outer surface of the crown must follow the form of the same no. of opposite tooth within the intra arch.
3. *Degree of Mutilation*: The size, number and location of carious lesions or restorations in a tooth affect whether full or partial coverage restorations are indicated.
4. *Periodontal Health*: Crown design must be taken into account with those who practice minimally acceptable oral care (cervical finish line).
5. *Occlusion*: The occlusal forces brought to bear on a crown are related to the degree of muscular activity and the patient's habits such as bruxism.
6. *Age of the Patient*: Cast metal or porcelain fused metal crowns are usually contraindicated in the mouth of



Fig. 24.1: Grossly carious tooth indicated for stainless steel crowning



Fig. 24.2: Grossly carious tooth restored with stainless steel crown

young and adolescent patients, when the teeth are not fully erupted or the pulp is excessively large and prohibit retentive crown reduction. In this situation tooth reduction should be kept to a minimal and the prosthesis should be considered temporary, to be remade when pulp size permits.

PREFABRICATED METAL CROWNS (GOLD IONIZED, METAL AND STAINLESS STEEL CROWN RESPECTIVELY) (FIGS 24.3A TO C)

Prefabricated metal crown can be divided into two types for deciduous teeth:

- Permanent crowns
- Temporary crowns.

The permanent prefabricated crowns are made from stainless steel or nickel base alloy and temporary crowns are made of aluminium or tin base alloy.

- The stainless steel crowns are made from alloys such as 305 or 321 stainless steel. These alloys (18 or 8 Ni) are austenitic steel with a composite of 17-19 percent Cr, 9-13 percent Ni and 0.8 - 0.12 percent carbon, e.g. Rocky Mountain and Unitek stainless steel crown.
- The nickel base crowns are an Inconel type of alloy with the following composition 76 percent Ni, 15.5 percent Cr, 8 percent iron, 0.4 percent C, 0.35 percent Mg, 0.2 percent Silicon, e.g. Ion crown.
- The tin base alloy has a composition of 96 percent tin, and 4 percent silver.
- Temporary prefabricated crowns are made of aluminium alloys containing 1.2 percent Mg, 1.0

percent Manganese, 0.7 percent Iron, 0.3 percent Silicon and 0.2 percent Cu.

STAINLESS STEEL CROWN (FIG. 24.4)

Stainless steel crown were introduced early in the 1950s by Humphrey. Preformed stainless steel crowns form are strong and durable and can serve a child for 5 to 10 years.

Indications

1. *Extensive decay in primary teeth:* Steel crown is indicated wherever one or more cusps are destroyed or weakened by caries. This commonly occurs in the first primary molars when the distal interproximal carious lesion is untreated.
2. *After pulp therapy:* In both primary and permanent teeth, after pulp therapy tooth become more brittle. So, it is recommended that post operative tooth fracture be prevented by placing a stainless steel crown.
3. *As an alternative restoration of amalgam:* Stainless steel crown is a preventive restoration because it helps to avoid amalgam failure or tooth fracture. It can be used to prevent caries from developing in other areas of the tooth. This application can be used in handicapped child whose lack of oral hygiene may encourage further decay. Most of the practitioners no longer place MOD restorations in the first primary molars of preschool children rather they prefer to place a stainless steel crown.



Figs 24.3A to C: Gold ionized, metal crown and stainless steel crown respectively



Fig. 24.4: Stainless steel crown seated on right lower primary second molar (Stainless steel crown 3M co.) see the adaptation of crown with no blanching of marginal gingiva

4. *To mask the developmental defects of tooth:* Linear hypoplastic defects can undermine the occlusal surface of first primary molars if the systemic disturbances occur at natal and prenatal stage. Similarly, amelogenesis and dentinogenesis imperfects can alter tooth morphology and predispose the dentition to excessive wear and loss of cervico occlusal length.
 - Since, hypoplastic and hypocalcified defects on teeth may be more susceptible to caries because the anatomy encourages plaque accumulation. In these entire instances stainless steel crown can be indicated.
5. The stainless steel crown on the first permanent molar is frequently used as a semi permanent restoration for certain period in adolescent patient. When adequate secondary dentine has formed then it is replaced by more permanent restoration like, porcelain.
6. Stainless steel crown can be used for space maintainer. For example, crown and loop space maintainer.
7. Multiple rampant caries cases.
8. *Fracture of permanent and primary incisors:* It is useful restoration in cases where the fracture is close to the gingival margin and isolation likely to be subjected to occlusal stresses the strength of the stainless steel crown is a great advantage.



Fig. 24.5: The different styles of stainless steel crowns – (Unitek crown)

9. Severe bruxism cases.
10. As esthetic restoration; in conjugation with composite resin.

SELECTION OF CROWNS

Manufactures of stainless steel crown

- Unitek stainless steel crown.
- 3 M company stainless steel crown.
- Rocky mountain stainless steel crown.
- Denovo crowns.

These crowns differ in size, shape, occlusal anatomy and composition.

Rocky mountain crowns are 18:8 stainless steel crowns, the Fe-Ni-Cr crowns from 3M company are made of a Ni-Cr alloy. These crowns are already work hardened while the stainless steel crown are soft and malleable initially and gradually hardens as they are adapted with the pliers.

Unitek crowns are also 18:8 stainless steel crowns, available as untrimmed and pretrimmed, the main difference is in the length of the crown. The Fe-Ni-Cr crowns are precontoured and pretrimmed so Fe-Ni-Cr crowns are the easiest to fit and usually require the least amount of additional crimping, trimming and contouring (Fig. 24.5).

A correctly selected crown prior to trimming and contouring should cover all the tooth preparation and provide resistance to removal.

- The preoperative mesiodistal width of the tooth to be crowned can be measured with calipers and this width matched with an appropriate steel crown.
- During preoperative assessment we should also consider the presence or absence of primate spaces by an oversized crown may prevent early mesial migration of the mandibular first permanent molar from cusp to cusp occlusion into angle class

one relationship. Similarly, over contoured and oversized steel crowns on second primary molars can prevent the normal eruption of the first permanent molars.

PRIMARY TOOTH PREPARATION

Primary Anterior Tooth Preparation

- The aim of the primary tooth reduction is to clear the interproximal contacts and properly crown adaptation. The gingival margin should have no ledge or shoulder preparation; rather the chamfer should merge with uncut apical placed tooth structure at the free gingival margin.
- Incisal reduction is required to prevent unnecessary elongation of the tooth and proper occlusion.
- Lingual reduction is necessary, when the lingual surfaces of the maxillary incisors are not properly fitted with the labial surface of mandibular incisors or when there is incomplete overbite or open bite exists, the lingual surface need not be reduced.
- The undercut towards the gingival margin is used for retention; for this same reason the only tooth reduction that should occur on the labial surface is that which will remove caries.

Primary Posterior Tooth Preparation (Figs 24.6 to 24.11)

Proximal Slices (Fig. 24.6B)

- Proximal reductions take the form of a ledge or shoulder free vertical slice which clears the contact area buccally, lingual and gingivally about 1mm.
- Distal reduction is required even when there is no erupted tooth distally. If not, follow this recommen-

dation, it will result an oversized crown, which may interferes the eruption of the first permanent molar.

Occlusal Reduction

- This should follow the anatomy of the tooth to a depth of 0.5 to 1 mm which allows sufficient space for the stainless steel crown (Fig. 24.6A).

Buccal and Lingual Surfaces

- Reduce first the buccal and then the lingual surface to the level of the gingival margin by about 1 mm and bevel the angles between these surfaces and the occlusal and proximal surfaces.
- Retention of the crown is obtained by the normal gingival contour of primary molars and leaving the crown margin apical to this in the gingival sulcus.
- The preparation is completed by rounding off all sharp line angles (Fig. 24.6C).

STAINLESS CROWN TRIMMING, CONTOURING, CRIMPING AND SEATING (FIGS 24.7 AND 24.8)

The purposes of crown trimming and contouring are respectively to leave the crown margins in the gingival sulcus and to reproduce the tooth's morphology.

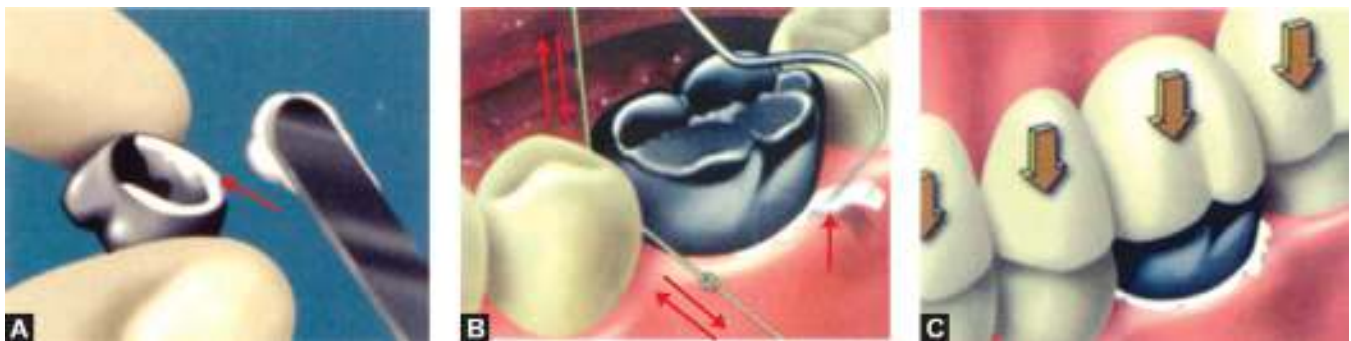
- Initial crown contouring is preferred with adjacent teeth, if necessary, use an Abble 112 plier to expand the crown and produce better contacts.
- Polish the margin of the crown with a stone or rubber wheel.
- Pulp protecting bases should be placed over the deep areas of the preparation, followed by a cavity varnish prior to cementation. Seat the crown on the tooth from lingual to buccal side (allows excess cement to flow out buccally) and the crown should be left



Figs 24.6A to C: (A) Occlusal reduction, (B) Proximal slicing, (C) Beveling of line angle respectively



Figs 24.7A to C: (A) Trimming of crown with scissors, (B) Crown contouring, (C) Crimping of cervical margin



Figs 24.8A to C: (A) Crown loaded with luting cement, (B) Seating of crown, (C) Checking of appropriate occlusion, respectively

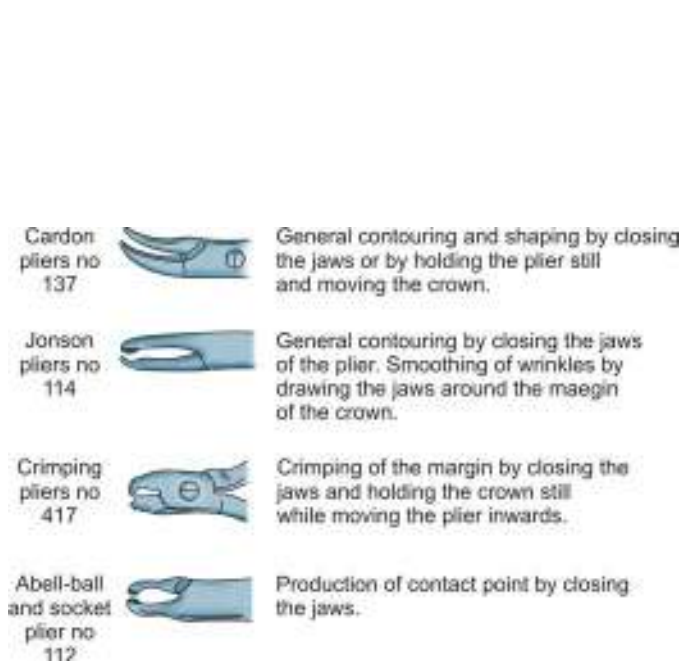


Fig. 24.9: The types and functions of the pliers for adapting stainless steel crowns (see the design of beak)

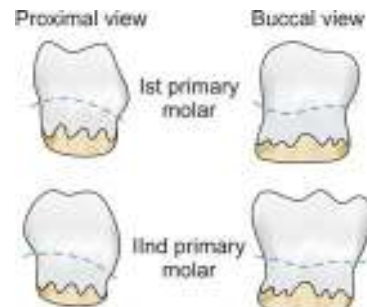


Fig. 24.10: The curvature of the gingival margin of the stainless steel crown should simulate that of the natural tooth, if the gingival tissues are not to be traumatized by the crown. This marginal adaptation prevents plaque accumulation

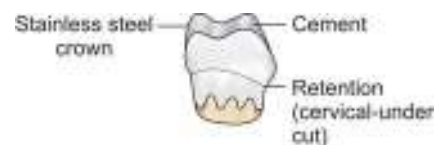


Fig. 24.11: A mesiodistal cross section of seated stainless steel crown on prepared abutment. See the marginal fit into the cervical undercut

undisturbed during setting. After that excess cement should be removed and finally polish the crown with pumice and rubber cup.

STAINLESS STEEL CROWN MODIFICATIONS

- 1. For the Undersized Tooth or the Oversized Stainless Steel Crown:** Make a cut with the help of curved scissor on the buccal surface of the oversized crown from cervical margin to the occlusal table. The one free crown margins insert under the other free margins to achieve correct size then spot welded, soldered and polished and cemented to the reduced abutment.
- 2. For the Oversized Tooth or the Undersized Crown:** A vertical cut is made on the buccal surface of the crown. The margins are pulled apart and an additional piece of stainless steel band material is spot welded to the buccal surface to increase the dimensions of the crown. After contouring the crown, the cut surface is spot welded, soldered to fill any microscopic deficiency in seal. The crown is polished and cemented.
- 3. For Deep Subgingival Caries:** Use untrimmed rocky mountain crown to encompass the preparation along with deep carious part.
- 4. For the Open Contact Problem:** Select a larger crown or exaggerated interproximal contour can be obtained with 112 (ball and socket) pliers to establish a closed contact. Localized addition of solder can also build out the interproximal contour.

Complications

1. Steel crown should not be considered to be long term restoration for permanent teeth because they tend to cause periodontal problem. Cast crown are preferred for children over the age of 19 years.
2. The marginal integrity of the crown is reduced when it is imperfectly adapted. Recurrent caries seldom occurs around open margins but precautionary fluoride application can be done.
3. Chances of ingestion of crown are more as compared to cast crown.
4. Children with tooth grinding habit may exhibit wear through existing stainless steel crowns.
5. Lack of accessible tooth surface for future pulp testing.
6. Crown fitting is time consuming and difficult.

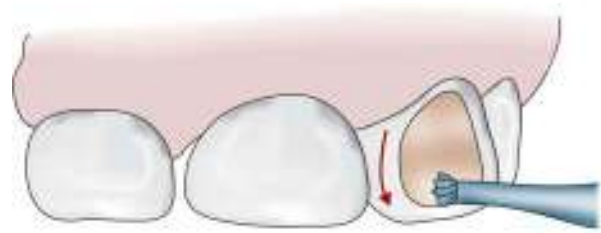


Fig. 24.12: Sketch diagram of open face steel crown for anterior maxillary primary teeth

ESTHETIC RESTORATION OF PRIMARY ANTERIOR TEETH BY

Open Face Steel Crown or Chair Side Veneered (Fig. 24.12)

- This technique is developed by Helpin in 1983. Stainless steel crown provides the strongest and most durable restoration for primary anterior teeth.
- Esthetically they are poor, but it is possible to achieve considerable improvement by cutting a window on labial side of the stainless steel crown, create mechanical undercuts laterally and Incisal and placing a composite resin facing. The window extends just short of the Incisal edge–gingivally, to the height of the gingival crest and mesiodistal to proximo buccal line angles.

Advantages

1. Tooth structure is accessible for pulp testing.
2. Esthetics is improved.

Disadvantages

It takes long time to place a crown because of two step procedure.

- Crown placement
- Composite placement.

Pre-veneered Stainless Steel Crowns

New preveneered stainless steel crowns for primary incisors and canine are now available.

- Kinder crowns
- Whiter Bite crowns
- Nu smile primary crown.

Preparations for these crowns are identical to the preparation for the non veneered and open face crown.

Advantages

1. Esthetically pleasing
2. When moisture control is difficult and a resin crown can not be placed, these crowns being less moisture sensitive may offer a good alternative.

Disadvantage

1. Limited Crimping primarily to the lingual surfaces.

INDICATIONS FOR FULL CORONAL COVERAGE OF INCISORS (FIG. 24.13)

1. Incisors with multiple hypoplastic defects or developmental disturbances, e.g. ectodermal dysplasia.
2. Discolored incisors that are essentially unpleasing ex. tetracycline staining.
3. Incisors with small interproximal lesions that also demonstrate large area of cervical decalcification.
4. Incisors with large interproximal lesions.
5. After pulpal therapy of incisors.
6. Incisors that have been fractured and have lost an appreciable amount of crown part.

There are several methods of providing coronal coverage to primary incisors:

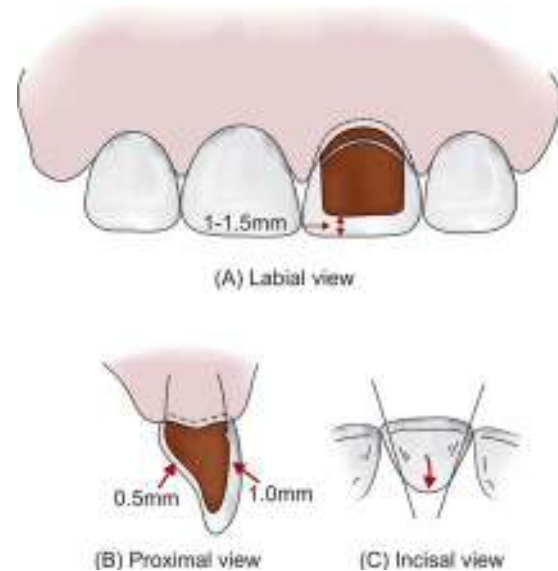
- a. Polycarbonate crown.
- b. Preformed plastic crown.
- c. Stainless orthodontic bands.
- d. Stainless steel crown.
- e. Veneered or open face stainless steel crown.
- f. Resin crown (strip crown).

ACID ETCHED (STRIP) COMPOSITE CROWN

Acid etched composite crown was introduced by Webber. These transparent crown forms simplify composite work for Pedodontist, trimmed and filled with either chemical or light curing restorative material, make a vent on the mesioincisal angle to avoid air bubble entrapment and placed over the etched abutment and they contour the material and support it while it sets and then transparent crown strip is cut by B.P. blade from lingual surface and remove the strip crown.

Example:

- Unitek pedoderm crown forms.
- 3M health care crown.



Figs 24.13A to C: Full coronal coverage of incisors

Selection Criteria

1. When esthetics are a great concern.
2. Adequate tooth structure should be available for etching and bonding of composite material.
3. Child is not highly trauma prone.
4. Gingival hemorrhage is controllable.

Tooth Preparation

1. Clean the tooth with prophylaxis paste to remove smear layer.
2. Select the shade of the composite restoration required.
3. Reduce tooth surfaces and incisal length to allow crown form to fit over tooth. Consider preparing a circumferential retention groove in the cervical third.
4. Remove all caries.
5. Maintain a dry field.
6. Protect pulp with appropriate material.

Strip Crown Preparation

1. Select appropriate crown and trim margins with curved scissors.
2. Try in the crown over the tooth to check contour and margins.
3. Make a small hole in the palatal side or mesioincisal angle to escape airbubble and extra material during seating of the crown with cement.

Etching

Etch the enamel for the appropriate time with the etching solution or gel (37% phosphoric acid – 15 to 30 sec.) after that wash the tooth for 30 sec with the water then dry it with the air syringe and check that enamel has become chalky white frosty appearance indicating a proper etch.

Positioning

1. Apply an appropriate bonding agent to the etched tooth surface.
2. Fill the strip crown form with composite restorative material, avoiding or venting any air bubbles.
3. Place the filled crown on the prepared tooth.
4. Quickly remove any excess material with a probe and checking the interproximal areas and occlusion particularly. Wait for few minute to set the materials.
5. When the material has completely set, cut through the strip crown form with surgical blade with light pressure, starting at the cervical margin and strip it off leaving a smooth surface.
6. Check the cervical margins and the occlusion carefully and make any necessary adjusted before dismissing the patient.
7. Finish and polish the composite crown.

Advantage

- Very good esthetic.

Disadvantages

Strip crown are difficult to place because of the complexities of

- Tooth preparation,
- Pulp protection, moisture control
- The need for a perfect bonding technique.

Polycarbonate Crown

It is aromatic linear polyesters of carbonic acid. Polycarbonate crowns are made in a range of sizes and make esthetic restorations for primary incisors and also temporary permanent incisors.

Contraindications

1. In case of bruxism (since it is poor abrasion resistance).
2. Evidence of excessive abrasion of anterior teeth.
3. Deep impinging overbite.

MANIPULATION OF POLYCARBONATE CROWN (FIGS 24.14A TO C)

Crown Selection

The proper mesiodistal dimension for the crown should be determined before the tooth is prepared.

Preparation of Tooth

- Proximal surface should be reduced until the contacts are open and the surface becomes parallel.
- The labial and lingual surfaces are also reduced 0.5 mm to allow space for the crown form.
- The Incisal edge is reduced 1 to 2 mm and finally adds an undercut to increase the retentive properties of the preparation.

All remaining caries should be removed and pulp protective and fluoride solution applied.

Crown Adaptation

The selected crown form is adapted to the preparation by selective grinding of the gingival margin and the internal portion of the crown.



Figs 24.14A to C: Crimping of crown margin, loading luting cements, seating of polycarbonate crown respectively

Cementation

Drill a hole through the palatal surface of the crown this will allow excess resin to escape. After the resin has set smooth and polish the margin of the crown.

Disadvantages

- Excessive amount of natural tooth must be reduced in order to adapt the crown adequately.
- Rapid deterioration at the gingival margin.

Preformed Plastic Crowns

- Pre formed plastic crowns serve as the best esthetic replacement of gross carious primary anteriors.
- The enamel of the incisors is cut away with a tapered fissure bur.
- Selected preformed plastic crown is fitted then cemented to abutment with zinc phosphate cement.

Stainless Orthodontic Bands

- Used to restore badly decayed anterior teeth. Remove all caries from the teeth and apply a Ca(OH)_2 sub base where necessary.
- Select the appropriate commercially available orthodontic band.
- Fit the stainless orthodontic bands to badly decayed tooth.
- Trim away most of the labial portion of the band so only a narrow portion (1.5 to 2 mm) of the band remains gingivally.
- Cement the band on abutment tooth.
- Use the brush technique to apply restorative acrylic, the result is esthetically pleasing for the patient and child and economically feasible in the dental clinic.

Castable Glass Ceramic Veneer (Porcelain)

A more recent development is a castable glass ceramic material that has physical and mechanical properties similar to those of enamel. It has best esthetic result.

Acrylic Jacket Crown

Technique

1. Reduce the incisal edge by 2-3 mm slice across the proximal surfaces so that walls of the preparation converge from the cervical margin to the Incisal edge.
2. Do not produce shoulder at the cervical margin.
3. Reduce labial and palatal surfaces.
4. Remove only enough labial enamel to eliminate the natural contouring of the labial surface.
5. The amount of palatal reduction depends on the occlusion.
6. Smooth the preparation.
7. Take an impression with a silicon type impression material and pour the cast in die stone.
8. Make a crown with inlay wax on die and carve it appropriately with wax carver, and set into the flask with plaster of paris.
9. Dewaxing done.
10. Make a temporary crown with acrylic:
 - Before cementing the laboratory made acrylic crown, select the proper shade of cement by mixing cement powder with water and placing it in the crown.
 - For a child a minimal shoulder less tooth preparation is recommended to avoid possibility of damaging the pulp.

Atraumatic Restorative Technique (ART)

INTRODUCTION TO ART

Dental caries and decay among the Indian population is on the rise. There are several factors responsible for it; one of them is food habit. This is one of the factors that led to the spread of dental diseases. Other reasons include poverty, lack of facilities especially to underprivileged section of the society, etc.

ART was 1st discovered in Tanzania in mid 1980s to suit the needs of the developing countries by JE Frencken. Later, in Zimbabwe, the experiment was repeated by his team in larger school population group. WHO endorsed the ART procedure for the underprivileged population on world health day in April 7, 1994 an occasion that also marked the beginning of the year of Oral Health 1994/95. The idea of ART is strongly supported by the modern scientific approach in controlling caries—maximal prevention, minimal invasiveness and minimal cavity preparation with minimal cost.

The need to develop a new approach to oral care for use in economically less developed countries was most strikingly reinforced by SA Thorpe, WHO's Regional Advisor for Oral Health for the African region. In most economically underdeveloped countries and regions, extraction is the predominant oral care procedure performed by the dentists. This situation has remained largely unchanged for decades, despite efforts by many to adopt western types of oral care technology for use in local situations in these countries. These efforts include the manufacture of mobile drilling and suction equipment, the development of portable dental chairs and the use of portable generators. Unfortunately, in

most cases, the imported technology has proven to be too complicated for sustained use. Attempts to further simplify the equipment has resulted in introduction of air-driven drills and suction equipment and simplified operating beds such as those made of bamboo and/or wood.

Despite these developments mobile oral equipment is rarely used to its full capacity in underdeveloped countries for a number of reasons as:

- Vehicles are required to transport the equipment to the outreach situations.
- Technical skills are required to maintain the equipments.
- It requires electricity for its functioning.

Therefore, a new approach was needed to make oral care more available for the majority of people in economically less developed countries. Thus, the ART is the procedure that fulfills almost all the requirement including dental health and cost to the economically less developed communities.

ART is an approach of removing infected and demineralized dental tissue wherein only hand instruments are used for opening and subsequent cleaning of carious cavity with an adhesive restorative material to produce a sealant restoration. It is based on stabilization on carious process through placement of fast setting auto curing glass ionomer dressing that causes healing or remineralization of affected dentine.

Barnes DE (1996) mentioned that ART is a high quality approach suitable for all populations at all levels of economic development. The impressive beginning of ART is encouraging for the WHO's mission in oral health and the WHO will follow developments in its

implementation, modification and testing. Frencken JE, Pilot T, Songpaisan Y, Odont Dr, Phantumvanit P (1996) discussed the technique, rationale, advantages and limitations of the Atraumatic restorative treatment. Despite long term efforts to use appropriate dental equipment for treating dental caries in economically less developed countries, the predominant treatment remains extraction. Supported by results of research undertaken in economically developed countries, a 15 step treatment module (ART) for dental caries is presented. They also mentioned about its use in a school oral health programme in Zimbabwe and concluded that ART can make restorative oral care more available or feasible to a larger part of the world population. Pilot T (1999) in his article: 'ART from a global perspective', stated that ART is an innovative approach and is supported by the modern scientific approach to control caries: maximal prevention, minimal invasiveness and minimal cavity preparation.

Concept of ART

"The basic concepts of ART technique is the removal of decalcified dental tissues using readily available hand instruments, following the modern concepts of cavity preparation and the use of high technology adhesive restorative material. Minimal intervention with minimal cost has opened up new horizon of a treatment modalities for patients that preserve far more tooth structure than was ever previously possible with greater patient comfort and oral health care".

Aims and Objectives of ART

There are three objective of ART to guarantee against a continuous caries process or deactivation of residual caries by:

1. Restriction of nutrient supply to the active carious process from the oral cavity.
2. Operative treatment, that is excavating the carious dentine.
3. Use of a cariostatic filling materials.
 - In most cases, the excavation of the carious dentine will lead to a reduction in the number of micro-organisms. Initial removal of the cariogenic microbial biomass is considered an important step in arresting caries. The cariostatic material used which is mostly GIC containing fluoride which has a positive influence on the remineralization of the enamel as well as the dentine.

Advantages of ART

1. The use of easily available and relatively inexpensive hand instruments rather than expensive electrically operated dental equipment.
2. This technique enable us to reach to those patient who otherwise never would have received any oral care.
3. A biologically friendly approach involving the removal of only decalcified tooth tissues, which results in relatively small cavities and conserves sound, tooth tissue.
4. None or minimal pain during ATR, thereby minimizing the need for local anesthesia.
5. A straight forward and simple infection control practice without the need to use sequentially autoclaved handpiece.
6. The chemical adhesion of GIC that reduces the need to cut sound tooth tissue for retention of the restorative material.
7. The leaching of fluoride from GIC prevents secondary caries development and remineralizes carious dentin.
8. It is a combination of a preventive and curative treatment in one procedure.
9. ART technique is a non threatening oral procedure and is therefore patient-friendly and popular in children.
10. Low cost.
11. The technique allows to visit people in their own living environment, e.g. in senior citizen homes or the institutions of handicapped.
12. Effective in fearful, anxious and young patients.

Limitations of ART

1. Long-term glass ionomer ART restorations and sealants are not yet available; the life of GIC restorations is about 3 years.
2. The techniques acceptance by oral health care personnel is not yet assured.
3. The possibility of frequent hand fatigue exists from the hand instruments over a long periods of usage.
4. Hand mixing of GIC might produce a relatively unstandardized mix of glass ionomer, varying among operators and different geographical or climatic situations.
5. The misapprehension that ART can be performed easily is not the case, and each step must be carried out perfectly.

Prerequisites for the ART Procedure

The prerequisite for ART procedure include knowledge and the ability to:

- Provide a good working environment in and outside the mouth.
- Select and use the correct instruments.
- Control cross infection.
- Use the correct material.

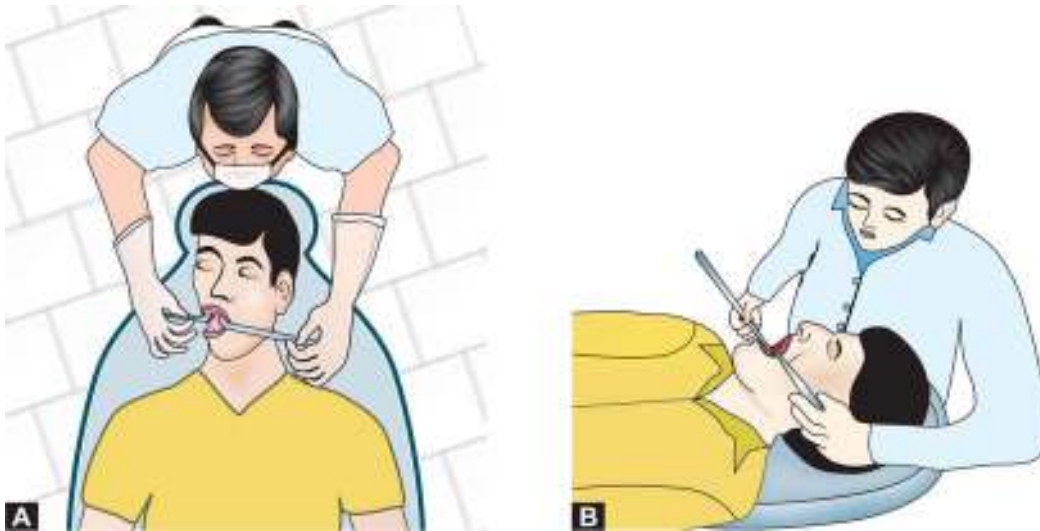
Dentist's Posture and Positions during ART

The work posture and position of the operator should provide the best view of the inside of the patient's mouth (Figs 25.1A and B). At the same time both patient and operator should be comfortable. The operator sits firmly on the stool, with straight back, thighs parallel to the floor and both feet flat on the floor. The head and neck should be still with the head bent slightly forward to look at the patient's mouth.

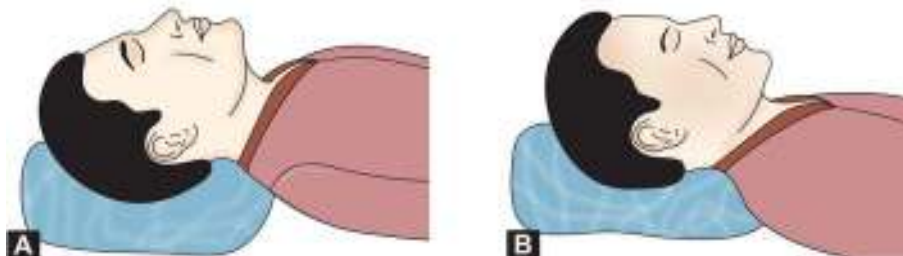
The distance from the operator's eye to the patient's tooth is usually between 30 and 35 cm. The exact position of the operator will depend on the area of the patient's mouth to be treated. If the patient's mouth is considered to be at the centre of a clock face the range of positions from which the operator can perform all tasks lies on an arc from 10 to 1 on the clock. The direct rear position, i.e. at 12'o clock and the right rear position, i.e. at 10'o clock are the most commonly and frequently used positions.

Patient Position

Along with correct operator position correct patient position (Figs 25.2A and B) is also necessary. A patient lying on the back on a flat surface will provide safe and secure body support and a comfortable and stable position for long periods of time. A headrest made up of 'U' shaped firm foam or a rubber ring with a cover,



Figs 25.1A and B: Dentist's work posture and positions during ART procedure



Figs 25.2A and B: Positions of the head and neck during ART

both stabilizes the patient's head in the desired position and improves the patient's comfort. So the patient should be placed on a flat surface, for example a bamboo, or wooden portable dental bed or a table or chair. Assuming that a table is present in most communities a very acceptable patient position is created by attaching a head support to the end of the table. A layer of foam plastic will provide more comfort.

Use of Natural or Head Lamp Operating Light

Good vision is essential for working in the oral cavity. The light source can be natural or artificial (head lamp, Fig. 25.3). Artificial light is more reliable and constant than natural light because it can be focused in a particular desired spot. Therefore, in the field setting, a portable light source is recommended example a headlamp or light attached to the mouth mirror. For the artificial light source a rechargeable portable battery is the source of energy.

Essential Instruments and Materials for ART Procedure

The success of ART depends on the operator knowing the functions of the various instruments and using them properly and correctly. They must also be maintained in a good condition. The following instruments can be used in ART (Fig. 25.4).



Fig. 25.3: Sketch diagram of dental surgeon with head lamp along with a rechargeable battery

- 1. Mouth mirror:** This instrument is used to reflect light onto the specified area of operation to view the cavity indirectly and to retract the cheek and tongue, if required. Illuminated mouth mirror can be used which will provide illumination in the area of work. The magnifying mouth mirror will provide magnification in the area of work.
- 2. Tweezer:** This instrument is used for carrying cotton wool rolls, cotton wool pellets, wedges and articulation paper from the tray to the mouth and back
- 3. Explorer:** This instrument is used to identify where soft carious dentine is present. One should not poke the carious lesions because this may destroy the tooth surface and the caries arrestment process. Also do not probe into deep cavities which may cause pulp exposure.
- 4. Spoon excavator:** This instrument is used for removing soft carious dentine. There are three sizes of spoon excavator;

Small: The diameter of the spoon is about 1mm. The instrument is used for in small cavities and for cleaning the enamel/dentine junction.

Medium: The diameter of the spoon is about 1.5mm. The instrument is mainly used for removal of soft dentine from larger cavities.

Large: The diameter is about 2 mm. This instrument can be used in large cavities and for removing of excess glass ionomer material from the restoration.



Fig. 25.4: Different instruments used in ART procedure (arrow indicates reflecting mouth mirror)

5. **Dental hatchet:** This instrument is used for widening the entrance of the carious lesions and for slicing away thin unsupported enamel.
6. **Carver:** This double ended instrument has two functions. The blunt end is used for inserting the mixed GIC into the excavated and cleaned cavity as well as into pits and fissures. The sharp end is designed to remove excess restorative material and to shape the GIC restorations.
7. **Mixing pad and spatula:** These are necessary for mixing GIC. The most commonly used mixing pad for GIC is disposable paper pad and the plastic spatula used is called agate spatula.

Other Materials used in ART (Fig. 25.5)

1. **Cotton rolls and pellets:** These are used for isolation and cleaning and drying cavities respectively so that the tooth to be treated is kept dry.
2. **Petroleum jelly:** This material is used to keep moisture away from the glass ionomer restoration during setting.
3. **Plastic strip:** This is used for contouring the proximal surface of multiple surface restorations.
4. **Wedges:** These are used to hold the plastic strip close to the shape of the proximal surface of the tooth so that restorative material is not forced between the gingival crevices.



Fig. 25.5: Materials in ART (arrow indicates dental strip, cotton rolls, wedge etc.)

5. **Restorative material:** GIC is the choice of filling material in ART procedure. The types of GIC that can be used are:

Type II, Type VII, Type IX, and Resin modified GIC in the clinical settings.

- **Type VII GIC** is a high fluoride releasing non-resin containing autocure glass ionomer cement that can be light cured to hasten the final setting reaction.
- **Type IX GIC** is self hardening cement which set by conventional neutralization reaction but has properties that rival or exceed those of resin modified systems. Setting is rapid, early moisture sensitivity is considerably reduced and solubility in oral fluids is very low. These properties are of prime importance in case of ART in under-developed or developing countries, because supply of electricity is sparse due to which sophisticated dental facilities such as power hand pieces and dental curing lamps cannot be relied on.

ART for Posterior Teeth

To restore one surface cavity using ART, the important steps and their rationale for use are as follows:

1. Isolate the tooth to be treated with cotton rolls placed buccally and lingually. This will absorb saliva and keep the tooth dry. It is easier to work in dry environment rather than in a wet one and cotton rolls are easily available.
2. Clean the tooth surface to be treated with a wet cotton pellet to remove plaque from the tooth surface and then dry the surface with a dry pellet. The wet cotton pellet removes the material Alba and plaque from the surface, thus improving visibility. The extent of the lesion and any unsupported enamel then can be identified.
3. If the cavity opening in the enamel is small then the entrance should be widened. This can be done by inserting the blade of the dental hatchet into the cavity and then turning the instrument forward and backward like turning a key in a lock (Figs 25.6 and 25.7). For opening very small cavities the corner of the working tip is placed in the cavity first and then rotated.

By rotating the instrument tip, unsupported enamel will break off, creating an opening large enough for the small excavator to enter.



Fig. 25.6: Fracturing of unsupported enamel with a hatchet



Fig. 25.8: Circular scooping movements of the excavator during removal of soft carious part



Fig. 25.7: Completed cavity after removing unsupported enamel with hatchet

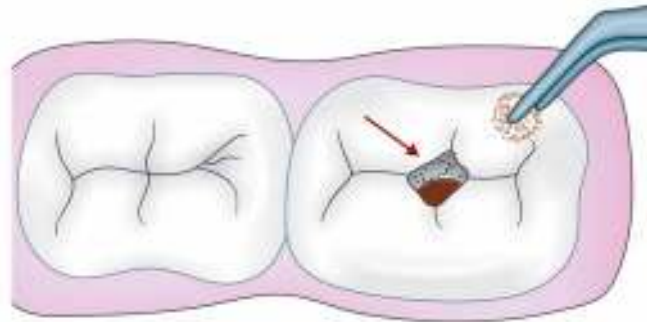


Fig. 25.9: Cleaning and conditioning of the tooth with cotton palette soaked in conditioner

4. Depending on the size of the cavity use either the small or medium sized excavator to remove caries. Soft caries is removed by making circular scooping movements along the long axes of the instrument (Fig. 25.8). Remove caries at the dentin-enamel junction before removing caries from the floor of the cavity. Enamel that is unsupported by dentin can be broken away carefully by placing the hatchet on the enamel and pressing gently downward.

Thin, often decalcified, unsupported enamel is relatively easy to break off. The enamel and the dentin-enamel junction need to be thoroughly cleaned to prevent caries progression and to obtain a good seal of the coronal part of the restoration. All soft caries should be removed.

5. Pulpal protection is required only for very deep cavities and is achieved by applying a setting calcium hydroxide paste to the deeper parts of the floor of the cavity. The cavity floor does not need to be covered completely because it will reduce the area available for adhesion of the filling material. Calcium hydroxide stimulates repair of dentin.
6. Clean the occlusal surface using a wet cotton pellet (Fig. 25.9). All the pits and fissures should be clear of plaque and debris as much as possible. The remaining pits and fissures will be sealed with the same material used for filling the cavity.
7. Conditioning of the cavity and occlusal surface should be done to improve the chemical bonding of GIC and the cavity walls. A dentin conditioner

or the liquid supplied with glass ionomer can be used for this purpose. Conditioning increases the bond strength of glass ionomer.

- Dentin conditioner is usually 10 percent solution of polyacrylic acid. Take a drop of conditioner on a cotton wool pellet and then clean the entire prepared cavity and the adjacent fissures for 10-15 seconds to remove smear layer.
 - 10 percent GIC liquid can also be used for conditioning of the cavity. This is done by placing one drop of liquid on a pad or slab and dipping a pellet moistened in water into it and use this as a conditioner. The conditioned surface should then be washed several times with distilled water. The surfaces are then dried with dry pellets.
8. Mix glass ionomer cement according to manufacturer's instructions. Make sure that the tooth surface is kept dry during the restorative phase. Use the spatula to divide one scoop powder into two equal portions, and then dispense a drop of liquid next to the powder. First spread the liquid with the spatula over a surface of about 1.5 cm^2 . Start mixing by adding one half of the powder into the liquid using the spatula. Roll the powder into the liquid, gently wetting the particles without spreading them around the slab. As soon as all powder particles are wetted the second portion is folded into the mix. Now mix firmly while keeping the mass together. The mixing should be completed within 20-30 seconds depending on the brand of glass ionomer used.
 9. Insert mixed glass ionomer into cavity using the flat end of the applier and overfill slightly. Then plug into corners of the cavity with the smooth end of an excavator or with a ball burnisher. Avoid the inclusion of air bubbles. The material also is placed in pits and fissures in small amounts.
 10. Gloved finger is coated with petroleum jelly (Vaseline) and gently pressed on the entire occlusal surface for a few seconds and then moved. This is called 'Finger press technique'. Remove the finger sideways after a few seconds.

The finger pressure pushes the glass ionomer into the deeper parts of pits and fissures. Any excess material will overflow the occlusal surface and can be removed easily by carver. This will result in a smooth restoration surface and reduce the need for carving.



Fig. 25.10: After filling of the tooth, occlusal height should be adjusted

11. Check the occlusion by placing articulation paper over the restoration or sealant and asking the patient to take a bite on it. The petroleum jelly left on the surface prevents saliva contact with the restoration or sealant while the occlusion is checked.
12. Remove excess material with the help of carver.
13. Recheck the occlusion and adjust the height of the restoration until comfortable to the patient (Fig. 25.10).
14. Cover the restoration or sealant with petroleum jelly once again for proper setting of restorative material.
15. Instruct the patient not to eat for at least one hour after restoration.

Restoring Multiple Surface Cavities using ART

In principle, the same stages described for one surface cavity preparation and restoration have to be followed for multiple surface cavities. Ensure that the cavity outline is smooth and free of caries, particularly the outline in the proximal surface (Figs 25.11A and B).

Multiple surface cavities of posterior permanent teeth can be restored using a Mylar strip. Place the strip between the teeth; insert a wedge (Fig. 25.12) to support the strip under the contact point at the gum margin.

The cavity is conditioned with 10 percent dentine conditioner or 10 percent of GIC liquid to remove smear layer as described above in one surface cavity. Insert material into unsupported enamel of the prepared cavity



Fig. 25.11A: Traumatic stages of rampant caries right lateral incisors



Fig. 25.11B: Restoring lateral incisors and central incisors with ART. Dental hatchet was used for smoothing the proximal outline

(Fig. 25.12). The cavity should be slightly overfilled with filling materials. After filling, use gloved finger pressure technique to smooth the restorative material and over flushed material is removed with carver and then remove the wedge and strip.

Check occlusion with articulation paper and if necessary remove excess restorative material with the carver. Insure that that the cusps of the opposite tooth will not destroy the restoration.

Trim the proximal margins with the carver and apply new petroleum jelly. Check the height of the restoration again with articulation paper (Fig. 25.13). Remove cotton wool rolls and instruct the patient not to eat for at least 1 hour.

ART for Anterior Teeth

Procedure for restoring multiple surface cavities in anterior teeth:

1. Isolate the tooth with cotton rolls, remove all carious part and clean the cavity.
2. Place a plastic strip between the teeth and use this to make the correct tooth contour of the proximal surface.
3. Insert a soft tooth wedge between the teeth just at the gum margin to keep the plastic strip firmly in position.
4. Same method applied for conditioning the cavity as for posterior tooth conditioning.



Fig. 25.12: Wedge is inserted into the proximal surface of the prepared cavity to provide support to the restorative material position and restorative material inserted into the prepared cavity



Fig. 25.13: Completed restoration by ART

5. Mix the glass ionomer and insert it into the cavity until it is slightly overfilled.
6. Hold the strip slightly with the index finger on the palatal side of the tooth. Wrap the strip firmly around to the buccal side to adapt the restorative material well into the cavity. Hold the strip with the thumb on the buccal side for 1-2 minutes until the material has set firmly. For shaping up the restoration, a straight instrument can be held against the strip.
7. Remove the strip and wedge and cover the restoration with petroleum jelly. Excess materials should be removed with carver, check the occlusion with articulation paper and apply another coat of petroleum jelly. Remove cotton rolls and ask the patient not to eat for 1 hour.

Evaluation of ART

The evaluation criteria for the glass ionomer sealants are as follows:

Score	Criteria
0	Present, good seal
1	Present partly, visible pits and/or fissures are free of active caries. No sealant is needed.
2	Present partly, visible pits and/or fissures show signs of (active) caries. Treatment is needed.
3	Not present, pits and/or fissures show signs of (active) caries. No treatment is needed.
4	Not present, pits and/or fissures show signs of active caries. Treatment is needed.
9	Unable to diagnose

While the retention rate has routinely been used as a criterion for success, the ultimate success of a sealant

should be expressed in terms of caries prevention, the reason that sealants are placed in the first place. Thus, biological outcomes should take precedence over mechanical outcomes.

ART in Primary Dentition (Figs 25.14 and 25.15)

Performance of ART restorations in the primary dentition: ART approach in primary dentitions is in their initial stage, hence fewer studies and of shorter duration is available for analysis.

- Honkala et al. in 2003 assessed the feasibility of ART approach in primary teeth and compared the ART approach with traditional amalgam restorations in primary molars. The ART and amalgam restorations were placed randomly on comparable pairs of primary molars. In a 2 year follow up, 89.6 percent of all ART restorations were considered successful which indicated the appropriateness of the ART approach in primary teeth.
- A comparison between the survival rates for single surface ART restorations in the deciduous dentition compared to those in the permanent dentition suggests that those in the former are lower. The 3 years results from Syria, where ART restorations were placed in a clinical setting by 8 dentists seem very promising.

Other Applications of ART

1. **ART procedure helps in reducing dental anxiety:** In patient especially popular in children and young dental patient.



Fig. 25.14: Different stages of rampant caries in 4 year child



Fig. 25.15: A blunted straight instrument is used to press against the strip to shape the GIC filled materials

2. **Use of ART in outreach situations:** The development of ART, however, means that effective restorative treatment can be delivered virtually anywhere to almost any individuals.
3. **Use of ART in other specific situations:** Because of its flexibility, the ART approach has been proposed as a means of extending the provision of preventive, interceptive and restorative care to situations where conventional dental care is impossible. Many of these areas are outside of what could be considered the normal sphere of general practice. Some specific examples of this are:
 - Early childhood caries in toddlers.
 - Patient with contraindications for local anesthesia.
 - Those Patients who are with mentally or physical handicapped.
 - Children who present with behavior management problems, e.g. those who under normal situations cannot be treated except under sedation or general anesthetic agent. They have been found manageable with the use of ART.

Conclusion

ART appears to be a very “patient friendly” approach with a scope to increase implementation. This technique has the potential to make oral health care more available to a larger area of the world’s population than earlier.

- A very large portion of carious dentine lesions in permanent teeth can be treated using the ART approach.
- ART should be considered a caries treatment modality that benefits larger population of the world with minimal equipments.
- ART should be taken seriously by the dental profession and educational courses should be organized before the approach is used in the clinic.

BIBLIOGRAPHY

1. Amerongen WE. Dental Caries under Glass Ionomer Restorations.
2. B monse-schneider, Assessment of manual restorative treatment(MTR) with amalgam in high-caries Filipino children: results after 2 years, Community dentistry and oral epidemiology 2003;31:129-35.
3. Barmes DE. Foreword. Journal of Public Health Dentistry 1996;56(3):131.
4. Berge M ten, et al. Childhood dental fear in the Netherlands: prevalence and normative data. Journal of Community Dentistry and Oral Epidemiology 2002;30:101-7.
5. Bresciani Eduardo. Clinical trials with atraumatic restorative treatment in deciduous and permanent teeth. Journal of Applied Oral Science 2006;14;1.
6. Burke FJT, S McHugh, et al. UK dentists attitude and behavior towards atraumatic restorative treatment for primary teeth, British Dental journal 2005;199:365-9.
7. Chalmer’s M Jane. Minimum intervention dentistry: Part II strategies addressing restorative challenges in older patients, JADA 2006;72,(5):435-40.
8. CKS Carvalho, ACB Bezerra. Microbiological assessment of saliva from children subsequent to atraumatic restorative treatment. International Journal of Pediatric Dentistry 2003;13(3):186-92.
9. ECM Lo,Y LUO, et al. Clinical investigation of two glass ionomer restoration used with the atraumatic restorative treatment approach in china, two year results caries research 2001;35:458-63.
10. Ersin Nazan Kocates, Candan ımit, et al. A clinical evaluation of resin based composite and glass ionomer cement restoration placed in primary teeth using ART approach, result after two months. JADA 2006; 137:1529-36.
11. Frenken JE, et al. Atraumatic restorative treatment: Rationale, Technique, and development. Journal of Public Health Dentistry 1996;56(3):135-40.
12. Frenken JE, et al. Effectiveness of single-surface ART Restorations in the permanent dentition: A meta-analysis, J Dent Res 2004;83(2):120-3.
13. Going RE, Losche WJ, et al. The viability of microorganisms in carious lesion five years after covering with a fissure sealant JADA 1978;97:455-62.
14. H Hausen. Caries prediction – State of ART. Community dent oral epidemiology 1997;25:87-96.
15. Holmgren Christopher, Introduction, Journal of Public Health Dentistry: 132.
16. Holmgren Christopher. Discussion from the symposium minimal intervention techniques for caries, Journal of Public Health Dentistry 1996;56(3) (special issue):161-3.
17. Holmgren CJ. ART restorations and sealants placed in chinese school children- results after three years, Community dentistry and oral epidemiology 2000; 28:314-20.
18. Horowitz Alice M. Introduction to the symposium on minimal intervention techniques for caries, Journal of public health dentistry 1996;56(3) (special issue): 133-4.
19. J. Anusvice Kenneth. Does ART have a place in preservative dentistry? Community Dent Oral Epedemiol 1999;27:442-8.
20. Jokstad A, Mjor IA. Analysis of long-term clinical behavior of class-II amalgam restorations, Acta odontol scand 1991; 49:47-63.

21. Journal of Public Health Dentistry 1996;56(3):150-4.
22. Lopez Naty. Atraumatic restorative treatment for prevention and treatment of caries in an undeserved community, American Journal of Public Health 2005;95(8):1338-9.
23. Mallow PK, et al. Restoration of permanent teeth in young rural children in Cambodia using the atraumatic restorative treatment(ART) technique and fuji II glass ionomer cement, International of Paediatric Dentistry 1998;8:35-40.
24. Massler Maury. Pulpal reaction to dental caries, International Dental Journal 1997;17(2):441-60.
25. MCM Schriks. Atraumatic perspectives of ART: psychological and physiological aspects of treatment with and without rotary instruments, Community dentistry and oral epidemiology 2003;31:15-20.
26. MCM Schriks. Atraumatic restorative techniques could reduce discomfort in children receiving dental treatment, Evidence-based dentistry 2005;6:9.
27. Mickenautsch Steffen, Atraumatic restorative treatment (ART)- Factors affecting success, J Appl Oral Sci 2006;14 (special issue): 34-6.
28. Mickenautsch Steffen. Atraumatic restorative treatment (ART)- Factors Affecting Success, J Appl Oral Sci 2006;14 (special issue):1-4.
29. Mjor Ivar A, et al. A review of atraumatic restorative treatment(ART), International Dental Journal 1999;49:127-31.
30. ND Shashikiran, et al. A review of new concept in caries management minimum intervention part II, Journal of international college of dentists, 2004.

Endodontic Therapy in Primary and Young Permanent Teeth

The maximum attempts must be made to preserve primary teeth in a healthy state until physiological exfoliation occurs. Since primary teeth have important roles in mastication, appearance, speech development and space maintenance for the permanent successors. The endodontic treatment of primary teeth differs from that of permanent teeth for the following reasons:

1. Tooth morphology
2. Pulp pathology.

Endodontic technique and medicament differs due to above factors and the process of physiological root resorption and natural loss of primary teeth. There are twelve basic differences between primary and permanent dentition.

1. Primary teeth are smaller in all dimensions than corresponding permanent dentition.
2. Primary crowns are wider in mesial to distal dimension compared with their crown length than permanent crowns.
3. Primary teeth have narrower, cylindrical and longer roots in comparison with crown length and width in permanent teeth.
4. Primary teeth have more constriction at DEJ than permanent dentition.
5. The facial and lingual cervical 1/3rd of crowns of anterior primary teeth are much more prominent than those of permanent teeth.
6. The facial and lingual surfaces of primary molars converge occlusally so that occlusal surface is much narrower in the faciolingual than the cervical width.
7. The roots of primary molars are comparatively more slender and longer than the roots of permanent molars.

8. The roots of primary molars flare out near the cervix and more at the apex than do the roots of permanent molars.
9. The pulp chambers in primary teeth are comparatively larger than those in permanent teeth.
10. The pulp horns are higher in primary molars than they are in permanent molars.
11. The enamel is thinner in primary teeth than permanent teeth.
12. The thickness of dentine between pulp chambers and the enamel in primary teeth is less than permanent teeth.

Note: The roots of primary teeth are in close relationship to the developing permanent successor and will undergo physiological resorption during the process of exfoliation. Obturating material used within the primary root canal system must be resorbable in nature. The close relationship means that trauma to, or infection of primary teeth may affect the developing successor resulting enamel defect or cyst formation.

Primary Root Canal Anatomy (Fig. 26.1)

Pedodontist must have a thorough knowledge of primary root canal system and its variations before starting root canal treatment of primary teeth. The primary tooth is unique insofar as resorption of the roots begins soon after formation of the root length has been completed. At this time, the form and the shape of the root canals roughly correspond to the form and shape of external anatomy of the teeth. Root resorption and deposition of additional dentine within the root canal system, however, significantly change the number, size, and shape of the root canals within the primary tooth.



Fig. 26.1: OPG shows the maxillary and mandibular teeth anatomy and pulp anatomy of mixed dentition period. See the tooth sac with different stages of teeth developments

Root canals of primary maxillary incisors: Root canals of primary central and lateral incisors are almost rounded but slightly compressed. Usually these teeth have one canal without bifurcations. Accessory canals and lateral canals are rare but sometimes it may occur.

Root canals of primary mandibular incisors: The root canals of primary mandibular central and lateral incisors are flattened on mesial and distal surfaces and grooved pointing to an eventual division into two canals. 10 percent of mandibular incisors showed two canals in its root. Some time lateral and accessory canals are also observed.

Root canals of maxillary and mandibular canines: The root canals of maxillary and mandibular canines resembles to the external root shape, a rounded triangular shape with the base towards the facial surfaces. The primary canines have the simplest root canals system of all the primary teeth and offers least problems when being treated endodontically.

Root Canals of Primary Molars

Usually primary molars have the same number and positions of roots as the corresponding permanent successors. The roots of the primary molars are long and slender compared with crown length and width, and they diverge to allow permanent tooth bud formation.

The deposition of secondary dentine in primary teeth has been reported. After completion of the primary roots, the basic morphologic pattern of root canals may change,

producing variations and alterations in the number and size of the root canals caused by the deposition of secondary dentine. Secondary dentine deposition begins in primary root canal system as soon as resorption begins. Accessory canals and apical canals are common in primary molars (10 to 20%).

Root Canals of Maxillary 1st Primary Molars

Two to four canals are usually seen in maxillary 1st primary molars. It resembles to the external root form with much variations. The palatal root is often rounded; it is often longer than the facial roots. A bifurcation of the mesiofacial roots into two canals occurs in approximately 75 percent of maxillary 1st primary molars.

Root Canals of Maxillary Second Molars

Two to five canals are usually seen in maxillary 2nd primary molars. It usually resembles the external root shape. Mesiofacial root normally contains two distinct canals (85 to 90%). Fusion of palatal and distofacial roots may occur and producing variations in the root canal systems.

Root Canals of Mandibular 1st Primary Molars

Three canals are usually seen in mandibular 1st primary molars. It resembles to the external root anatomy, but it may have 2 to 4 canals. Mesial root contains 2 canals in 75 percent of the cases, where as only 25 percent of the distal root contains more than one canal.

Root Canals of Mandibular 2nd Primary Molars

The mandibular 2nd primary molar may have 2 to 5 canals. Mesial root has two canals in 85 percent of mandibular 2nd primary molars while distal root contains more than one canal only in 25 percent cases.

Pulp Diseases in Primary Teeth

Pulps of primary teeth are more sensitive to inflammatory changes of carious attack than permanent teeth. Inflammatory changes are soon irreversible and extend through out the coronal pulp of primary teeth. Symptom arising from pathological changes in primary teeth may not be severe until the later stages of necrosis and abscess formation.

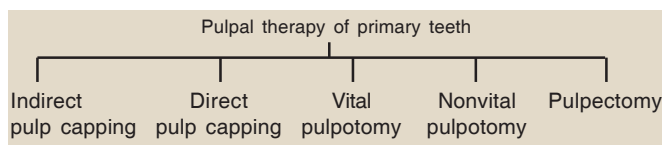


Fig. 26.2: Electric digital pulp tester with cathode and anode lid

Diagnosis of pulpal status: No reliable clinical diagnosis tools exist for accurately evaluating the status of the pulp that has become inflamed. An accurate determination of the extent of inflammation can not be made clinically within the pulp (only made by histological examination). A suggested out line for determining the pulpal status of cariously involved teeth in children are as follows:

1. Visual and tactile examination of carious part of tooth and associated periodontium.
2. History of spontaneous unprovoked pain
3. Pain from percussion and mastication
4. Degree of mobility
5. Palpation of surrounding soft tissue
6. Radiographic examination
 - a. Furcation area
 - b. Periradicular area (Trabecular pattern, bone density)
 - c. Periodontal space (Normal, large, obliterated)
 - d. Pulp canals (Normal, obliterated, shape)
 - e. Stages of developing succedaneus teeth.
7. Size, appearance, and amount of hemorrhage associated with pulp exposures.
8. Pulp test (Fig. 26.2): Electrical pulp tester is of little value in the primary dentition or in young permanent teeth with open apex. Although the pulp tester may indicate vitality, it will not give reliable data as to the extent of inflammation within the pulp.

Another pulp tester, doppler flowmetry provides the data for the viability of pulp, but it is also not reliable up to the extent of inflammation within the pulp.



Indirect pulp capping: Indirect pulp capping is indicated in tooth with deep carious lesion and without clinical and radiographic evidence of pulp disease. The above tooth should be asymptomatic too. This situation may be in a child whose cooperation or attention span would not allow the treatment to progress to pulpotomy. Success of indirect pulp capping relies on the basis that the advancing front of the carious lesion contains very few cariogenic bacteria.

Procedure

1. Apply rubber dam to the affected tooth.
2. Overlaying infected dentine is removed and a small amount of softened dentine may be left in the deepest part of the cavity, if there is a chance of pulp exposure.
3. Apply a thin layer of Ca(OH)_2 or ZOE.
4. If ZOE is applied for several weeks (4 to 6 week) then further excavation of the dentine would have been performed. This has now been replaced by covering the Ca(OH)_2 with a layer of hard setting cement, restoring the tooth definitively and reviewing clinically and radiographically for pulp disease.

Direct pulp capping: Direct pulp capping is generally contraindicated for cariously exposed primary dentition. Guideline developed by American academy of pediatric dentistry (AAPD), recommended that direct pulp capping should be reserved for small mechanical or traumatic pinpoint exposure in primary teeth. In this condition it is presumed that pulp responses are favorable and optimal. The material of choice for direct pulp capping is Ca(OH)_2 . Ca(OH)_2 is placed over the exposure site when pulpal bleeding is minimal and easily controlled.

Pulpotomy in primary teeth: Pulpotomy is the removal of the inflamed coronal pulp tissues and the fixation of the vital radicular pulp tissues. Material of choice for the pulpotomy in primary teeth is formacresol. The effect of formacresol on pulp tissues is controlled by quantity and quality (concentration) that diffuses into the tissues and depends on length of time of application, concentration used, the method of application, or a combination of all these factors. One fifth concentration of formacresol is recommended for pulpotomy procedures because it is as effective as and less damaging than traditional preparation.

Buckley's Formacresol (original)

- Tricresol 35 percent
- Formaldehyde 19 percent
- Glycerol 15 percent
- Water 31 percent.

Note: 1/5 concentration of Buckley's formacresol solution is recommended for pulpotomy in primary teeth for high success rate.

1/5 Concentration of Buckley's Formacresol

- Buckley's formacresol 1 part
- Glycerol 3 part
- Water 1 part.

Indication for Pulpotomy in Primary Teeth

- Restorable tooth
- No history of spontaneous pain
- No abscess or sinus present in relation to tooth
- No internal resorption
- No radiographic evidence of inter radicular bone loss.

Contraindication for Pulpotomy in Primary Tooth

- Unrestorable tooth
- Spontaneous pain
- Presence of abscess or sinus
- Radiographic evidence of inter radicular bone loss, internal resorption
- Succedaneous tooth close to eruption
- Pulpal bleeding does not stop.

Technique

1. Anesthetize the affected tooth with local anesthesia.
2. Isolate the affected tooth with rubber dam.
3. All peripheral caries should be removed before entering into the pulp chamber.
4. Roof of the pulp chamber is removed with high speed bur and copious water spray.
5. All the coronal pulp is removed with a spoon excavator.
6. The pulp chamber is thoroughly washed with normal saline to remove all debris.
7. The rest of the saline of the pulp chamber is removed by suction or cotton pellets.
8. Control the pulpal bleeding and identify the pulp stump.

9. A small cotton pellet is dipped in the 1/5 dilution of formacresol and squeezed in gauze to remove excess. This is then applied to the radicular pulp for 4 minutes.
10. On removal of cotton pellet, the radicular pulp stump should appear dark brown and there should be no bleeding(If bleeding continue after 2 to 3 minute of cotton pressure it means radicular pulp is inflamed- pulpectomy is indicated).
11. When pulpal bleeding has been stopped, the pulp chamber is filled with ZOE and restored with stainless steel crown.

Note: Failure of formacresol pulpotomy is usually detected from radiograph by the following sign:

- Pulpotomized tooth showed internal resorption of the root adjacent to the area where the formacresol was applied.
- Some time internal resorption may be accompanied by external resorption, especially as the failure progresses.

Drawback of Formacresol

- Cytotoxic
- Mutagenic
- Carcinogenic.

Other medicaments for pulp therapy in primary teeth are as follows:

Gluteraldehyde

- a. It is used as an alternative medicament for formacresol.
- b. Two percent to 4 percent aqueous Gluteraldehyde produces rapid surface fixation of the underlying pulpal tissues.
- c. Its fixative property is better than those of formaldehyde.
- d. It is less penetrative than formacresol, thus less able to diffuse into periapical tissues.
- e. It has relatively low antigenicity compared with formacresol.
- f. Clinical studies have shown high success rate (82-98%) by using 2 percent solution.

Calcium Hydroxide

- Calcium hydroxide is contraindicated in pulpotomy of primary teeth because it causes internal resorption.

Ferric Sulfate

It is a hemostatic agent used for pulpotomy in primary dentition especially primary molars. Ferric sulfate causes agglutination of blood proteins results from the reaction of blood with ferric and sulfate ions with the acidic pH of the solutions. The agglutinated proteins block the capillaries orifices.

Technique

1. Affected tooth was treated under local anesthesia and isolated with rubber dam.
2. After pulpal roof removal, a 15.5 percent solution of ferric sulfate is applied over the pulp stumps for 10 to 15 seconds then the tooth is restored with stainless steel crown.

Advantage

The ferric solution only need to be applied for a few second, compared to 4 minutes of formacresol.

Cell Inductive Agents

- a. Mineral trioxide aggregate (MTA): MTA is identified as potential effective pulpotomy agents(Abedi and ingle)
- b. Bone morphogenic protein (BMP): BMP 2 and 4 has been implicated in odontoblastic differentiation. Both the protein induces dentinal bridge formation and bone induction. It is a true biological pulp capping agent and pulpotomy agents.
- c. Freeze dried bone: few studies showed that freeze dried bone were superior to calcium hydroxide within the parameter of their study and might have potential as pulpotomy agent if substantiated by studies in human.

Pulpectomy in Primary Teeth (RCT)

Pulpectomy is the removal of necrotic and infected pulp from the root canal system. Since root canal system is complex with many fine accessory canals, it is not possible to completely clean and fill the system. The root undergo physiological root resorption (Fig. 26.3) and for these reasons, the technique employed differ from those used for the permanent dentition.



Fig. 26.3: Arrow indicates physiological root resorption of 2nd primary molar and apical root of the primary canine

Contraindication for Primary Root Canals (Pulpectomy)

- a. A non restorable tooth
- b. Internal resorption
- c. Mechanical/pathological perforations of the floor of the pulp chamber
- d. The presence of follicular or dentigerous cyst
- e. Pathological loss of bone support with loss of normal periodontal attachment
- f. Interradicular or periapical lesion involving the crypt of the developing permanent successor.

Access Opening for RCT in Primary Teeth

- a. **Anterior primary teeth:** Lingual surfaces of the anterior primary and permanent teeth are preferred site for access opening, except for discolored maxillary primary incisors, where use a facial approach followed by an acid etched composite restoration to improve aesthetics. The only difference between lingual and facial access opening is that access edge is more extended towards Incisal edge than with the normal lingual access to give as straight approach as possible into the root canals.
- b. **Posterior primary teeth:** The shapes of the access of posterior primary teeth are the same as those for the permanent teeth. The only difference between the primary and permanent teeth are the length of crown, the bulbous shape of crown and very thin

dentinal walls of the pulpal floor and roots. When the roof of the pulp chamber is removed identify the orifices of root canals.

Determination of Working Length (Fig. 26.4)

A preliminary working length is determined by a radiograph. The working length is then determined by a radiograph with a Ni-Ti file in the canals (Apex locator is unreliable in working length determination in primary teeth). It is advisable that working length would be shortened to 2 to 3 mm short of radiographic root apex.

Root Canals Cleaning and Shaping

The canals cleaning and shaping is the most important steps of primary root canal treatment. The main objective of biomechanical preparation is debridement of canals. Only NiTi files are recommended for primary root canals preparations. The canals are enlarged several sizes past the 1st file that fit snugly in the canal with a minimum sizes of 30 to 35 no. file

Canal Irrigating Agent

After canals debridement, the canals are flushed with NaOCl and are then dried with sterile paperpoint.



Fig. 26.4: Determination of working length with the help of file or master cone

Obturation

If the prepared root canals are dried and there is no exudates exist; obturation is performed in the same sitting. If exudates is present, a slurry of $\text{Ca}(\text{OH})_2$ is sealed into the root canals and pulp chamber with temporary cement. At a next appointment, the canal is reentered under rubber dam. Clean and flush the canals with NaOCl, if the tooth is free of all sign and symptoms of inflammation, Obturation will be done by ZOE, Iodoform or $\text{Ca}(\text{OH})_2$ paste metapex.

Obturation Technique (Fig. 26.5)

A spiral lentulo or a pressure syringe is used to obturate the primary root canals. When canals have been filled, the pulp chamber is filled with ZOE or metapex cement and the tooth is restored with a stainless steel crown for posterior teeth and composite resin strip crown for anterior teeth.

Obturing Materials for Primary Root Canals

The prerequisite of obturating materials for primary root canals must be absorbable, so that it absorbs as the roots resorbe and does not interfere with the eruption of permanent successor. The ideal root canal obturating material for primary teeth should resorbe at a similar rate as the primary root, be biocompatible with periapical tissues, and to the permanent tooth germ, be antiseptic, shows less shrinkage, adhere evenly to the wall and be easily removed if required.

- a. **ZOE Paste:** The filling material of choice in primary root canal is ZOE without a catalyst.
- b. **Iodoform Paste (KRI Paste):** It contains Iodoform, camphor, parachlorophenol and menthol. It absorbed rapidly and has no undesirable effect on succedaneus teeth when used in abscessed primary teeth.



Fig. 26.5: Obturated mandibular left, second primary molar with metapex

c. **Ca(OH)₂ paste:** Calcium hydroxide and Iodoform mixture has been frequently used for obturating materials for the primary teeth (Vitapex and Metapex paste).

d. **Gutta-percha Obturation:** When succedaneous permanent tooth bud is missing and the retained primary tooth pulp becomes infected, the canals are filled with gutta-percha after pulpectomy.

Recall visit: Endodontically treated primary teeth must be regularly reviewed clinically and radiographically every 3 month.

Pulp Treatment for Young Permanent Teeth

The rationale and procedures for pulp treatment, for the primary and young permanent teeth are similar in most occasions.

Permanent Tooth Pulpotomy

Ca(OH)₂ is the material of choice for carious, iatrogenic or traumatic pulp exposure in young permanent teeth particularly with open apex. After apex closure, it is generally recommended that conventional root canal obturation be accomplished to avoid the potential long term outcome of root canal calcification.

Procedure

1. Anesthetize and isolate the tooth to be treated.
2. Excavates all caries.
3. Irrigate the cavity with water and dry it with cotton pellets.
4. Remove the roof of the pulp chamber with high speed fissure bur.
5. Remove the coronal pulp with spoon excavator.
6. Control pulpal bleeding with cotton pellet applied with pressure.
7. Place Ca(OH)₂ powder over the radicular pulp stump at the canal orifice.
8. Seal the rest of the pulp chamber with ZOE and restored with stainless steel crown (Fig. 26.6).

Ca (OH)₂ vs MTA as Pulp Therapy Agent

Mineral trioxide aggregate (MTA) produces less inflammation than Ca(OH)₂ when applied on the pulpotomised radicular pulp. It showed more biocompatible with pulp and less cytotoxic than calcium



Fig. 26.6: If the crown is weakened by decay or carious fracture, a stainless steel crown rather than an amalgam restoration should be used to prevent cusp fracture

hydroxide. It also showed earlier dentine formation with more dentinal bridging in a shorter period of times.

Note: Every attempt should be made to maintain the vitality of the pulp with immature root apex of a tooth. The indirect pulp therapy technique should be used whenever possible with deep carious lesions to avoid exposure of the pulp. Since, loss of pulp vitality before root completion leaves

1. A weak root more prone to fracture
2. A poor crown: root ratio
3. A tooth becomes more susceptible to periodontal breakdown because of excessive mobility.

If required, the remaining pulp can be extirpated and conventional root canal treatment may be performed, when root formation has been accomplished. When indirect, direct pulp capping and pulpotomy procedure are not successful in the young permanent tooth, the apexification procedure or surgical endodontics may still be performed.

Apexification

Apexification technique is indicated in pulpless permanent teeth with an immature apex. The pulpless tooth with an incompletely formed apex shows thin, fragile dental walls and made it difficult to achieve an apical seal. Recently, the most widely accepted technique is cleaning and filling the canal with a temporary paste to stimulate

the formation of calcific barrier at the apex. The temporary paste is later removed after radiographic evidence of apical closure has been obtained, and a permanent filling of gutta-percha is placed in the canal. The term apexification is used to describe above procedure. Now a days apical barrier technique using MTA has become the accepted treatment of choice for pulpless immature root apex of a tooth.

The Use of Ca(OH)_2 for Apexification Pulpless in Immature Apex

Apex was 1st reported by Kaiser in 1964. The Ca(OH)_2 powder has been mixed with physiologic saline, Ringers solution, distilled water or anesthetic solution. Sometime barium sulphate may be mixed with Ca(OH)_2 to enhance the radio opacity. The recommended ratio of barium sulphate is one part added to eight part of Ca(OH)_2 powders.

Note: Apexification does not occurs when the root apex penetrate the cortical plate. For a successful apexification, the immature apex must be completely within the confines of the cortical plate.

The calcific apical barrier has been histologically identified as an osteoid or cementoid material by researchers who have done apexification, after periapical involvement of treated teeth. The normal root formation usually does not occur after apexification due to absence of Hertwig's sheath.

Apical Barrier Technique

Although apexification with Ca(OH)_2 paste has been successful but alternative treatments using artificial barriers that allows immediate obturation of the canal have replaced this procedure. The use of mineral trioxide aggregate as the apical barrier has become the standard. The advantages of apical barrier technique over conventional apexification technique are:

1. Low cost
2. Lesser appointments
3. Lesser chances of root fracture.

The use of MTA as an apical barrier was reported in 1996. Research showed that MTA induces apical hard tissue formation more often than osteogenic protein-1 or Ca(OH)_2 powder, while producing less inflammation. MTA is a hydrophilic particle that sets in

the presence of moisture. Hydration of the powder produces a colloidal gel with a pH 12.5 that solidify into hard structure. The setting time of MTA is 4 hours. MTA has been shown as osteoconductive and promotes osteogenesis when implanted intraosseously.

MTA Barrier Technique

1. As in apexification, the canal is cleaned with sonic or ultrasonic or hand instrument under rubber dam isolation.
2. The length of the canal is established with radiograph.
3. Irrigate the canal with NaOCl.
4. After thorough debridement, the canal is dried and medicated with slurry of calcium hydroxide paste and sealed.
5. When tooth is free of all sign and symptoms of infection, it is reisolated with rubber dam and canal reentered.
6. The canal is thoroughly flushed and cleaned, all the Ca(OH)_2 medicaments.
7. The cleaned canal is dried and a plug of MTA is compacted into the apical 4 to 5 mm with the help of plugger.
8. The excess MTA is removed from the canals with the help of large paperpoint or cotton tipped plastic applicator.
9. A wet cotton pellet is placed into the canal to provide moisture for MTA setting, and tooth access is sealed with cavit.
10. At a next appointment, the tooth is reisolated and cavit and cotton removed.
11. Verify the setting of MTA with endodontic file.
12. The remainder of the root canal will be obliterated with bonded composite resin to strengthen the root canal wall by Luminex post system.
13. After strengthening of the canal, it is obturated with conventional endodontic obturation technique and a permanent restoration is placed.

BIBLIOGRAPHY

1. Abedi HR, Ingle JI, et al. Mineral Trioxide aggregate: a review of new cement. Calif Dent Assoc J 1995;23:36.
2. Adrian JC. Pulp effect of neodymium laser. Oral surgoral medioral pathologyoral radiol Endod 1977;44:301.
3. Arnold DS. The use of formacresol as a pulp capping agent in human primary teeth. University of Nebraska, School of Dentistry, 1970.

4. Davis M, et al. An alternative to formacresol for vital pulpotomy. *Dent Child* 1982;49:176.
5. DiMaggio JJ, et al. Histological evaluation of direct and indirect pulp capping. *J Dent Res* 1963.
6. Fin SB. Morphology of the primary teeth: clinical Pedodontics. 4th ed. Philadelphia: WB Saunders 1973.
7. Frankle SH. Pulp therapy in Pedodontics. *Oral surg* 1972;34:192.
8. Greely CB. Pulp therapy for the primary and young permanent dentition. In: Forrester DJ, et al. *Pediatric dental medicine*. Philadelphia: Lea and Febiger 1981;456-60.
9. Haskell EW, et al. Direct pulp capping treatment: a long term follow up. *J Am Dent Assoc* 1978;97:607.
10. Held-Wyderler E. Natural (indirect) pulp capping. *J Dent child* 1964;31:107.
11. Law, et al. The effect of calcium hydroxide on deep carious lesions. *Colorado Dent J* 1964;42:27.
12. Mc Donald RE. Diagnostic aids and vital pulp therapy for deciduous teeth. *Am Assoc* 1956;53:14.
13. Mejarel, Cevak M. Partial pulpotomy in young permanent teeth with deep carious lesions. *Endo Dent Traumatol* 1993; 9:238.
14. Nirschl: Evaluation of a new pulp capping agent in indirect pulp therapy. *J Dent Child* 1983;50:25.
15. Rengelstein D, Slow WK. The prevalence of Furcation foramina in primary molars. *Pedi Dent* 1989;11:198.

Unconventional Local Anesthesia Techniques for Child and Adolescent

LOCAL ANESTHETICS

They may be defined as drugs that block the generation and propagation of impulses in nervous tissue. When applied locally to the nerve tissue in appropriate concentrations, local anesthetics reversibly block the action potentials responsible for nerve conduction and impulse conduction along nerve axons and other excitable membranes that utilise sodium channels as the primary means of action potential generation.

- They act on any part of the nervous system and on every type of nerve fibre. Thus, a local anesthetic in contact with a nerve trunk can cause both sensory and motor paralysis in the associated area. This action can be used clinically to block pain sensation.
- The clinical advantage of the local anesthesia is its reversible action at appropriate concentration. Its use is followed by complete recovery in nerve function with no evidence of damage to nerve fibres or cells.
- Local anesthetics are prepared as hydrochloride salts dissolved in sterile water or normal saline because their free base forms are poorly soluble in aqueous solutions. The solution is acidified to a pH of 4.40-6.40 to favor existence of the water soluble, cationic, and quaternary amine form of the local anesthetic molecule. But this decreases the potency of the anesthetic, shortens the onset of action, and increases the duration of blockade.
- The potency of action of local anesthetic solution is increased by carbonation. The mechanism of action being a direct depressant effect of carbon dioxide on the axon, an increased conversion of the local anesthetic to the active cation form, at the site of action.

- In the axon, diffusion traps the anesthetic solution inside the axon, and/or direct modification of local anesthetic binding sites in the Na⁺ channels. Local anesthetics containing epinephrine are acidified to inhibit oxidation of epinephrine. pH of drug without epinephrine is 5.5 to 7.0 while with epinephrine is 5. When this is injected buffering capacity of the tissue fluids raise the pH back to 7.4.
- Retardation of oxidation to increase the shelf life, is achieved by addition of anti-oxidants like sodium bisulphite in 0.05 to 0.1 percent concentrations.
- Paraben derivatives of parahydroxybenzoate, such as methylparaben, ethylparaben, and propylparaben are added for anti-fungal and anti-microbial activity but paraben derivatives are potent allergens and have been implicated in allergic reactions initially attributed to local anesthetic. Because of this, preservative containing local anesthetic are not used for intravenous use. Local anesthetic solution containing epinephrine and 2-chlorprocaine or procaine, may discolour by prolonged exposure to light.

Difference between general and local anesthesia

Features	General anesthesia	Local anesthesia
1. Site of action	CNS	Peripheral nerve
2. Body area involved	Whole body	Limited area
3. Consciousness	Lost	Unaltered
4. Care of vital functions	Essential	Not needed
5. Physiological trespass	High	Low
6. Poor health patient	Risky	Safer
7. Use in non-cooperative patient	Possible	Not possible
8. Major surgery	Preferred	Not preferred
9. Minor surgery	Not preferred	Preferred

Composition of Local Anesthetic

Composition of a standard Lidocaine solution with 1:80,000 adrenalin contains following component.

<i>Lidocaine Hydrochloride</i>	<i>As anesthetic agent</i>
1. Sodium Chloride	To adjust the tonicity of the solution
2. Adrenaline Hydrochloride	As Vasoconstrictor
3. Methyl Paraben	As bacteriostatic
4. Sodium Metabisulphite	Antioxidant to prevent decomposition of vasoconstrictor
5. Sodium hydroxide	To adjust the pH

They are supplied in amber colour 30 ml vials to protect from sunlight for multiple uses and in 1.8 ml cartridges for single use.

Mechanism of Action

Nerve impulse blockade is done by the following order:

- Solution of local anesthetic is deposited near the nerve. It then permeates the nerve's axon membranes and equilibrates there and in the axoplasm. The speed and extent of these processes depend on a drug's pKa and on the lipophilicity of its base and cation species.
- Binding of local anesthetic to sites on Na⁺ channels prevents opening of the channels by inhibiting conformational changes that underlie channel activation
- During onset of and recovery from local anesthesia impulse blockade is incomplete, and partially blocked fibers are further inhibited by repetitive stimulation, which produces an additional, use dependent binding to Na⁺ channels.
- One local anesthetic binding site on the Na⁺ channel may be sufficient to account for drug's resting (tonic) and use dependent (phasic) actions. The access to this site may involve multiple pathways, but the primary route is the hydrophobic approach from within the axon membrane.
- The clinically observed rates of onset and recovery from blockade are governed by the relatively slow diffusion of local anesthetic molecules into and out of the whole nerve, not by their much faster binding and dissociation to ion channels.

INSTRUMENTATION

Local anesthetic delivery systems usually consist of three elements:

- Needle
- Cartridge
- Syringe or pump with cartridge holder.

There are International Standards to which needles, cartridges and conventional syringes are manufactured. International Standard for syringes design for intraligamentary injections was developed. Syringes are designed to administer the local anesthetic by hand pressure, which may be increased by the use of levers that are found in some specialized syringes. Devices incorporating pumps, deliver the solution under control of computer. Those that use a pump also contain additional components such as connecting tubing and may connect with a power supply.

Needles (Fig. 27.1)

Needles for use with dental syringes comprise of two parts. The stainless steel needle itself, is coated at the working end with silicon and has a hub that connects to a syringe.

The hub may be threaded or unthreaded and is made of plastic or metal. Plastic hubs should be checked for damage after they are attached to the syringe. The tip of the needle has a bevelled chamfered shape.

The direction of the bevel is shown in some models on the hub. Some needles have more than one bevel at the needle tip and the degree of chamfer varies between designs. The point is classified as either normal, which has an angle of 12° or short with an angle of 18°. The end of the needle opposite to the point is known as the butt-end and this has a chamfer of between 15° and 55°.

Dental and Luer lock needles are supplied in a number of lengths and gauges. The gauge is representing

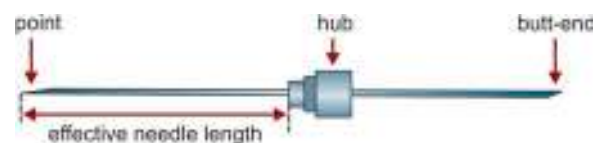


Fig. 27.1: The basic needle design of dental intraligamentary syringe

outside diameter of the needle. The standard gauges used are 27 and 30. The larger the number the narrower is the needle; 27 gauge needles have 0.4 mm in diameter and 30 gauges have a diameter of 0.3 mm. The effective needle length, which is measured from the end of the hub to the point, varies from 6 mm to 35 mm. The distance from hub to the butt-end ranges from 9 mm to 14 mm.

Needles should be disposable and use in one patient only. They may be used for more than one injection in the same patient as in the case of insulin delivering syringes. Since, sharpness of the needles is reduced after each tissue penetration it may be advantageous to change needles after each injection.

Cartridges (Fig. 27.2)

Cartridges consists of three components:

- A cylinder
- A plunger
- A cap.

The cylinder is made of glass or plastic. This must be clear to allow visualization of the contents. The following information should be indicated on the cylinder:

- Contents
- Concentrations of anesthetic and vasoconstrictor
- Expiry date
- Manufacturer's name and address
- Batch number.

Glass cylinders are suitable for all types of cartridges used in dentistry. Plastic cylinders are contraindicated for intraligamentary syringes.



Fig. 27.2: Cartridges are stored in 70 percent ethyl alcohol or undiluted pure isopropyl alcohol

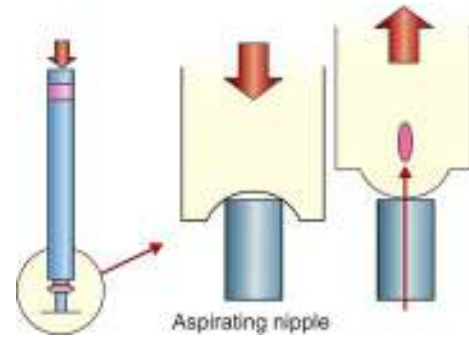


Fig. 27.3: Design of plunger

The standard cartridges is containing 1.8 ml of anesthesia. It is an universal size. The maximum length of a 1.8 ml cartridge is 64.6 mm; the corresponding value for the 2.2 ml type is 77.5 mm. The maximum external diameter for cartridges including any applied label is 9 mm.

The plunger (Fig. 27.3) is made of rubber. When with a patient with a severe latex allergy such plungers should be avoided. Plungers found in cartridges used are of two types:

- Solid
- Hollow.

The hollow plunger is that designed to combine with the special plunger rod found in Astra self-aspirating syringe systems.

- Extrusion of the plunger from the end of the cylinder may occur in association with a large air bubble. This scenario indicates possible contamination and the cartridge should be discarded.

Syringe

Syringes designed to accept dental local anesthetic cartridges can be classified as:

- Conventional
- Intraligamentary
- Computerised
- Powered injectors.

Conventional Cartridge Syringes (Fig. 27.4)

Syringes are made of metal, plastic or a combination of both types of material. Some are designed for single use and are supplied presterilized by the manufacturer. Those intended for re use must be capable of sterilization

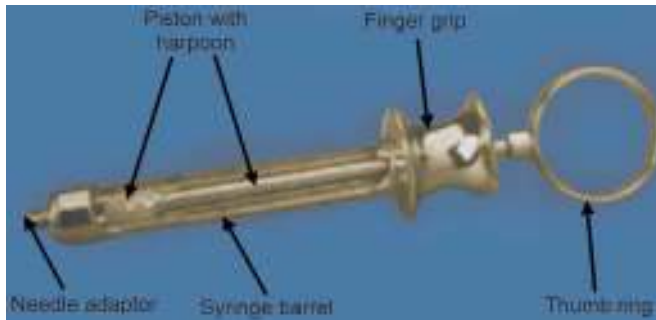


Fig. 27.4: The conventional cartridge syringe

without alteration of function. There are a number of universal components in the reusable designs complying with the International Standard. These are:

- The barrel
- The viewing port
- The threaded needle-mounting hub
- The plunger rod
- The handle or thumb ring or rest
- The finger grip
- The barrel is the part that accepts the cartridge. This may be loaded from the end (breech loading) or from the side of the barrel.
 - The threaded needle-mounting hub is at one end of the barrel. The threaded screw is designed to firmly engage the needle hub.
 - The plunger rod (Fig. 27.5) has a handle or thumb ring at one end. It transmits force from the



Fig. 27.5: Different plunger designs of syringes

operator's thumb to the cartridge plunger to allow injection. The plunger rod end design varies. It may be:

- A. Butt-ended
- B. Have a plunger engaging device
- C. Be of the Astra self-aspirating design.

Single-use Syringes (Fig. 27.6)

Disposable syringes for single use are usually made of plastic. A protective sheath or plastic cap is incorporated into the barrel of the syringe and this is slid over the needle at the end of the injection. This means that the needle does not have to be removed. This has been shown to reduce the number of needle-stick injuries to dental professionals.

Intraligamentary-syringes (Figs 27.7 and 27.8); Designed for Intraligamentary or periodontal ligament injections, employ conventional dental needles and cartridges. Some will only accept 1.8 ml cartridges. These devices have many of the components that were detailed above for conventional cartridge syringes. They differ from the conventional type in that the design provides a mechanical advantage. The force is delivered by a lever. This mechanical advantage may be as much as twelve-fold of conventional design. Two designs are well accepted. These are:

1. Pen grip type
2. Pistol grip

Pistol grip type: The pistol grip provides a greater mechanical advantage but has a more aggressive appearance. The protective sheath protects the patient



Fig. 27.6: Different part of single use syringes, plunger, needle and cartridges



Fig. 27.7: Design of Pen grip type intraligamentary syringe

and the operator from damage produced by sharp pieces of glass. Plastic cartridges are contraindicated with these syringes as they can distort under pressures generated.

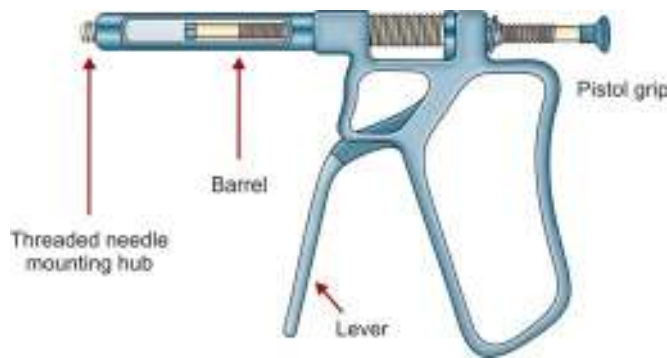


Fig. 27.8: Pistol grip type Intraligamentary syringe

Computerized Delivery Systems

During the last decade the design of dental local anesthetic syringes has been revolutionised with the advent of computerised delivery systems. These devices permit slow delivery of solution. At present there are two designs available. These are:

- The Wands (Figs 27.9 and 27.10)
- Comfort control syringe (Fig. 27.11).



Fig. 27.9: Computerized LA delivery system



Fig. 27.10: The wands computerised dental LA delivering syringes

The Wand operates by the computer component driving a plunger rod into the local anesthetic cartridge at slow speed. This allows a very slow rate of disposition of solution into the tissues.

- The comfort control syringe uses both dental cartridge and dental needles. It has a speed selector with pre-programmed injection rates for infiltration (0.007 ml/sec) and intraosseous (0.02 ml/sec) injections. During the first 10 seconds of the injection the rate is identical for all techniques then the predetermined speed is delivered.



Fig. 27.11: Part of comfort control syringe system

The Comfort Control syringe uses both dental cartridge and dental needles. It has a speed selector with preprogrammed injection rates:

Infiltration	- 0.007 ml/sec
Regional block	- 0.02 ml/sec
Palatal	- 0.008 ml/sec
Intraligamentary	- 0.007 ml/sec
Intraosseous injections	- 0.02 ml/sec



Fig. 27.12: Jet injector syringes

Powered Injectors or Jet Injectors (Fig. 27.12)

There are designs of syringe that force local anesthetic through mucosa without the use of a needle. The power used to force the anesthetic solution from the device through mucosa is generated mechanically by springs or by gas pressure. These designs have not received universal acceptance in dentistry but advances in the field, which could lead to the elimination of needles from the local anesthetic delivery system.

Ideal Properties of Local Anesthetics

The ideal local anesthetic should possess the following properties:

1. Its action must be reversible.
2. It must be nonirritating to the tissue and produce no secondary local reaction.
3. Its reaction should have no or minimal systemic toxicity.
4. It should have sufficient potency, a rapid onset of action and have an adequate shelf life.
5. It should provide complete regional anesthesia.
6. It should have sufficient penetrating properties to be effective as a topical anesthetic.
7. It should be relatively free from producing allergic reactions.
8. It should be stable in solution and undergo biotransformation readily within the body.

Indications for Local Anesthesia

Local anesthetics are used to produce insensibility to the pain of teeth and the supporting structures. Specifically they are indicated for:

1. Extraction of teeth.
2. Odontectomy or surgical removal of teeth.
3. Alveoloplasty and alveolectomy.
4. Incision and drainage of abscesses.

5. Cavity preparation especially in deeper painful cavities.
6. Pulp procedures like pulpotomy and pulpectomy.
7. Periodontal surgery and gingival surgery.
8. Cyst enucleating or marsupialization.
9. It is indicated in removal of residual infection, small neoplasm growths and salivary stones.
10. Pain relief from sore spots of dentures.
11. Diagnostic test of various facial pains, especially trigeminal neuralgia.
12. Symptomatic therapy of trigeminal neuralgia.
13. Relief from gagging reflex due to placement of radiographic film in mouth.
14. It can be used for routine minor surgical procedures of oral cavity and jawbones like treatment of fractures, growths etc.

Advantages of LA vs GA

Local anesthesia is well tolerated in the dental office for minor oral surgical procedures and has multiple advantages.

Advantages

- Patient is awake and cooperative.
- Patient does not have to omit the previous night meals as in case of general anesthesia.
- No additional expenses to the patient are there nor are any additional trained persons required in the dental office for this purpose.
- There is a very negligible incidence of morbidity.
- The patient can leave the dental office unescorted, as practically there is no distortion of normal physiology.

Contraindications

Local anesthetics are not recommended to be used in the following conditions:

1. Patient not to be undertaken under local anesthesia if they are fearful, apprehensive and refuse injection.
2. Allergy to local anesthetic solution patient should be tested for sensitivity to the solution. During this procedure, a syringe of antihistaminic and corticosteroid injection should be kept ready in order to meet any undesirable reaction.
3. Acute infection as there is fear of needle contamination and spread of infection into different planes (abscess). Local anesthetics are ineffective in acidic medium.

4. When the anatomic anomalies make the anesthetic injection difficult or impossible.
5. Hyperthyroidism, since the local anesthetics contain vasoconstrictor and can produce thyroid crisis.
6. Liver disorders, since, LA drug metabolism are disturbed in the liver disorders.
7. Patients with cardiac problems especially ischemia, infarction, coronary artery blockade etc.
8. Renal disorders especially renal failure as the drug is excreted through the kidneys.
9. Patients with diabetes mellitus as the vasoconstrictor present in the solution.
10. Patients with integral hemorrhage as the drug may elevate the blood pressure and induce fresh hemorrhage because of presence of the vasoconstrictor adrenaline.

Complications of Local Anesthesia

1. Systemic complication:
 - Acute circulatory insufficiency
 - Toxic reaction
 - Intoxication by vasoconstrictor
 - Allergic manifestation
 - Complication due to predisposing systemic conditions
 - Hyperventilation Tetany.

Local complications: They can be further divided into two according to time of reaction:

- I. Immediate complications are those which occur at the time of injecting anesthesia they are:
 - Pain at the site of injection
 - Blanching of tissue
 - Needle breakage
 - Burning sensation during injection
 - Hematoma formation
 - Aspiration of foreign bodies
 - Double vision (diplopia)
 - Temporary blindness
 - Transient Bell's palsy
- II. Late complications are delayed complication that occurs after injecting the solution they are:
 - Necrosis of mucosa
 - Infection
 - Trismus
 - Parosmia
 - Lip-chewing

Unconventional Local Anesthetic Techniques

The various unconventional techniques are as follows:

- Topical anesthetics technique
- Intraligamentary technique
- Intraseptal technique
- Intraosseous technique
- Intrapapillary technique
- Intrapulpal technique
- Gow-gates technique
- Vazirani akinosi technique
- Electronic dental anesthesia
- Computerized delivery system
- Jet injection technique.

Topical Anesthesia (Fig. 27.13)

Topical anesthetics achieve beneficial effects prior to needle penetration such effects are psychological or pharmacological. Factors that influence the efficacy of topical anesthetics agent include:

1. The agent used
2. Duration of application
3. Site of application

Topical anesthesia can be delivered in following form:

- Aerosols
- Pastes
- Powder
- Solution
- Impregnated patches
- Tablets
- Ointments
- Gels
- Lozenges.



Fig. 27.13: Different topical LA delivery system

Different formulations of the same anesthetic drug need different concentrations to achieve a similar effect. For example, sprays require a higher concentration than patches. The transfer of the anesthetic through the mucosa is concentration dependent. Topical anesthesia belongs to ester group. The most common anesthetics used are Benzocaine, Amethocaine, and lidocaine.

Duration of Application

Topical anesthetic agent should be applied for at least 2.5 to 5 minute to achieve desirable effect. The effectiveness of topical anesthesia varies in different parts of the mouth. The mandibular buccal fold is more susceptible than the corresponding area in the maxilla.

Uses

- It is used prior to needle penetration of conventional techniques.
- There are reports of soft tissue surgery procedures performed in the mouth under topical anesthesia.

Intraligamentary Injection (Fig. 27.14)

- It came into practice in 1912 to 1923, but from 1980s it gained popularity and maintains till today. It is also known as periodontal injection.

Nerves anesthetized are:

- Terminal nerve ending at site
- At apex of the root
- Areas anesthetized; Bone, soft tissue, apical and pulpal tissue at the site of injection.



Fig. 27.14: Site of Intraligamentary injection

Indications

- Pulpal anesthesia of one or two teeth in a quadrant.
- Treatment of isolated teeth in two mandibular quadrants to avoid bilateral inferior alveolar block.
- Patients for whom residual soft tissue anesthesia is undesirable.
- Where regional block is contraindicated.
- As an aid in diagnosis of particular pulpal pain.

Contraindications

- Infection
- Acute inflammation
- Primary teeth where permanent tooth bud is present.

Advantages

- Anesthesia of the lips, tongue and other soft tissue does not occur.
- Minimal dose of local anesthetic is required approximately 0.2 ml per tooth.
- It can be used as an alternative to partially successful regional anesthesia.
- Rapid onset of action and profound pulpal anesthesia within 30 seconds.
- Less traumatic than conventional block injection.
- Well suited procedure in children's extraction, periodontal, and endodontic procedure, single tooth procedure.

Disadvantages

- Proper needle placement is difficult to achieve in some areas like distal of second or third molar.
- Special syringe is required.
- Leakage of solution in patient mouth gives unpleasant taste.
- Excessive pressure may break glass cartridges or may cause focal tissue damage.
- Post injection discomfort for several days.
- Potential for extrusion of tooth, if excessive pressures or volumes are employed.

Technique

- 27 or 30 gauge needle is recommended.
- Area of insertion; in long axis of tooth on mesial or distal aspect of root interproximal for single as well as multi rooted tooth.
- Target area; needle tip is located at depth of gingival sulcus.

Landmarks

- Root(s) of tooth
- Periodontal tissue.

Procedure

- Patient's position should be supine or semi supine with head turned to maximize access and visibility and it may be sometime necessary to bend needle to achieve proper angle for distal aspect of second or third molars.
- Stabilize syringe and direct it along long axis of root to be anesthetized with bevel faces root of tooth
- Deposit 0.2 ml of local anesthetic in minimum 30 seconds with PDL syringe.
- The success of injection is indicated by feeling resistance as of nasopalatine injection site, sometime ischemia or necrosis adjacent to injection site may occur.

Duration of Anesthesia

Duration of anesthesia is extremely variable, Lidocaine with epinephrine 1:100,000 duration ranges from 5 minutes to 55 minutes. PDL injection may be repeated to obtain expected anesthesia.

Intraseptal Injection (Figs 27.15 and 27.16)

Intraseptal injection technique is almost similar to the intraligamentary injection technique. It is useful in achieving osseous and soft tissue anesthesia and hemostasis for periodontal curettage and minor periodontal surgical procedures. It may be effective



Fig. 27.15: Comparative site of intraseptal and intraligamentary local anesthesia

where the condition of the periodontal tissue in the gingival sulcus precludes the use of the intraligamentary injection.

Some scientist shows the path of diffusion of anesthetic solution is through medullary bone.

Nerve Anesthetized

- Terminal nerve endings at the site of injection and adjacent soft and hard tissues
- Areas anesthetized: Bone, soft tissue, root structure in the area of injection.

Indications

Where both pain control and hemostasis are desired for soft tissue and osseous periodontal treatment.

Contraindication

Infection and severe inflammation.

Advantages

- Lack of lip and tongue anesthesia is appreciable by the patient.
- Minimal volume of anesthetic is required.
- Minimizes bleeding during surgical procedure.
- A traumatic injection.
- Onset of action within 30 seconds after injection.

Disadvantages

- It may require the use of special syringes.
- Multiple tissue punctures are required.
- Short duration of pulpal anesthesia (5 to 55 minute), limited area of soft tissue anesthesia may require repeated injections.

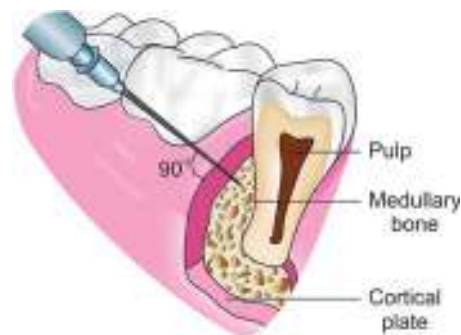


Fig. 27.16: Cross sectional diagram showing site of intraseptal injection



Fig. 27.17A: Intraseptal injection site

Techniques (Fig. 27.17A and B)

A 27-gauge short needle is used. Area of insertion; mid of interdental papilla adjacent to tooth to be anesthetized and local anesthetic is delivered into mid of the interdental papilla adjacent to tooth to be anesthetized.

Landmarks

- Needle is inserted in mid of interdental papillary triangle, about 2 mm below tip of interdental papilla, and this point is equidistant from adjacent teeth.
- The bevel of needle face toward apex of tooth.

Procedure

- Patient should be in supine or semi supine position.
- Prepare the site for penetration and in frontal plane, needle position should be at 45 degree to long axis of tooth. In sagittal plane, at right angle to soft tissue with bevel facing apex of tooth. Slowly inject few drops of anesthetic solution and deposit 0.2 ml of solution in 30 seconds.
- The success of injection is indicated by feeling resistance of injection; solution should not come in patient mouth and ischemia of soft tissue adjacent to injection site may occur.



Fig. 27.17B: Sketch diagram of intraseptal injection site

Sign and Symptom

- There are no concrete symptoms as the area is so circumscribed, but ischemia of the soft tissue at the injection site is seen.
- Resistance to solution.

Precautions

- Keep needle against tooth to prevent insertion into soft tissues on lingual aspect.
- Do not inject rapidly (30 seconds).
- Do not inject too much solution (0.2 ml).

Complications

- Pain during insertion of needle; if the tissue is inflamed or needle is not proper against the tooth.
 - Pain during injection of solution; slow down the rate of injection, i.e 0.2 ml per 30 seconds.
 - Post injection pain; due to rapid injection of solution or excessive volume of solution.
- Advice warm saline rinses and mild analgesics, usually problem resolve with in 2 to 3 days.

Duration of Anesthesia

- Duration of anesthesia is extremely variable, utilizing lidocaine with epinephrine 1:50,000 duration ranges from 3 to 30 minutes. PDL injection may be repeated to obtain expected anesthesia.

Intraosseous Technique (Figs 27.18 and 27.19)

It is a very frequently used technique. The injection can produce adequate anesthesia to open pulp chamber.

Procedure

- Anesthetize soft tissue and bone at the site of injection through local infiltration.



Fig. 27.18: Intraosseous LA delivering technique



Fig. 27.19: Cortical bone driller, intraosseous syringe and injection site

- The point of penetration is identified, it should lie in attached gingival and is determined by imagining two lines perpendicular to one another. The horizontal line passes along the buccal gingival margins of the teeth. The vertical line bisects the distal inter dental papilla of the tooth that is being anesthetized.
- The site of perforation is 2 mm apical to the intersection.
- Using a small no. ½ or 1 round bur with high speed hand piece, open a hole through the dense cortical plate of bone to the cancellous bone.
- Insert a 27 gauge (6 mm) needle into the opening; fit of the needle should be quite snug.
- Deposit approximately 1 ml of anesthetic solution slowly, under pressure for over a 2 minute period.
- Concentration of vasoconstrictor should not exceed 1: 100,000 or the volume of anesthetic solution should exceed that recommended, because absorption of injected drugs into the cardio vascular system is more rapid.
- In case, of hot tooth where all other techniques prove inadequate, the intraosseous technique may follow sequence as follows, if high speed instrumentation proves highly traumatic, low speed, high torque instrumentation, although more time consuming, may be less traumatic.
- Conscious sedation with inhalation or intravenous sedation may help to allay the patient's anxieties and moderate responses to painful stimuli.
- Once the pulp chamber has been opened, direct intra pulpal anesthesia can be administered.

Duration and Spread of Anesthesia

- The onset of anesthesia is rapid, ranging from 10 to 120 seconds. The success fall off rapidly over an

hour. Decline of anesthesia is more rapid with anterior teeth.

- Factors governing the success: The efficacy of intraosseous anesthesia depends upon the concentration of vasoconstrictor, inclusion of which increases both, efficacy as well as duration of anesthesia.
- Type of tooth: Intraosseous is more successful in maxillary than mandibular due to difference in the cancellous space between sites.

Advantages

- A smaller dose is required.
- A smaller area of soft tissue anesthesia is produced.
- The method aids in overcoming failure of conventional techniques.

Disadvantages

- Technically more difficult as the entry point made by the perforator, must be accurately located. This is simplified by with systems including a locator that remains in position after removal of the perforator and directs the needle into the channel created.
- Entry of local anesthetic and vasoconstrictor into the CVS through medullar spaces may be a risk for heart patient.
- Post injection trauma may be produced.

Intrapapillary Techniques (Fig. 27.20)

Intrapapillary injections may be used to obtain localized anesthesia and hemorrhage control during periodontal surgery.



Fig. 27.20: Site of intrapapillary local anesthesia delivering technique

Technique

- A short or ultra short needle should be fitted to the syringe.
- The needle is inserted at the buccal aspect of the papilla, about 2 mm apical to the tip of the papilla.
- This target should be approached with the needle parallel to the occlusal plane.
- Small amount of solution around 0.1 ml is required.
- Blanching of the tissue indicates successful deposition.

Intrapulpal Anesthesia (Fig. 27.21)

To obtain profound anesthesia in pulpally involved teeth is a potential problem especially in mandibular teeth in the presence of infection and inflammation. Deposition of local anesthetic directly into the pulp chamber of a pulpally involved tooth provides effective anesthesia for pulpal extirpation and instrumentation. The intra pulpal injection can be used on any tooth but it is most commonly required on mandibular molars.



Fig. 27.21: Site of pulpal anesthesia

The intrapulpal injection provides pain control both by the pharmacological action of the local anesthetic and by applied pressure. This technique may be used once the pulp chamber is exposed, either surgically or pathologically.

- Nerves anesthetized are terminal nerve endings at the site of injection in the pulp chamber and canals of the involved tooth.
- Areas anesthetized are tissue within the injected tooth.

Indications

Pulpal anesthesia is indicated, when pain control is required during pulpal extirpation in the absence of adequate anesthesia from other techniques.

Advantages

- Lack of lip and tongue anesthesia which is appreciated by most patient.
- Minimum volumes of anesthetic is required.
- Immediate onset of action.
- No postoperative complications.

Disadvantages

- Traumatic as solution is deposited for a longer period of time.
- Bitter taste of drug if leakage occurs.
- Difficult to enter certain root canals, e.g. Curved canal
- Need a small opening in to pulp chamber for optimum effectiveness.

Technique

- Insert a 25 or 27 gauge short or long needle in to the pulp chamber or root canal.
- Ideally, wedge the needle firmly into the pulp chamber or root canal so that it snugly fits into the canal and anesthetic should be deposited into the chamber.
- Deposit anesthetic solution under pressure 0.2 to 0.3 ml of anesthetic is required. Resistance to the injection of the drug should be felt.
- Bend the needle, if necessary, to gain access to the canal.
- When the intra pulpal injection is performed, a brief period of sensitivity ranging from mild to moderate if felt with immediate relief in pain.

- Instrumentation should start approximately after 30 seconds.

Signs and Symptoms

No concrete symptom is seen but tooth is able to be treated painlessly.

Precautions

- Do not inject into infected tissue.
- Do not inject rapidly (minimum 20 seconds).
- Do not inject too much solution (0.2 to 0.3 ml).

Failure of Anesthesia

- Infected and inflamed tissues. Changes in tissue pH minimize the effectiveness of the anesthetic.

Duration of Expected Anesthesia

Pulpal anesthesia of between 15 and 30 minutes can be expected.

Gow-Gates technique (Fig. 27.22A): It was proposed by Dr. George Gow- Gates in 1973 in Australia.

- Nerves anesthetized are: Inferior alveolar nerve, Mental nerve, Incisive nerve, Mylohyoid nerve, Buccal nerve (75%).
- Area anesthetized are: Mandibular teeth to midline, Buccal mucoperiosteum and mucous membrane on injection side, Anterior 2/3rd of tongue and floor of oral cavity, Lingual soft tissue and periosteum, Body of mandible and inferior portion of ramus, Skin over zygoma and posterior portion of cheek and temporal regions.



Fig. 27.22A: Sketch diagram of area anesthetized by Gow-Gates technique

Indications

- Multiple procedure on mandibular teeth
- Where buccal soft tissue anesthesia, from 3rd molar to midline, is required
- When conventional mandibular block is unsuccessful.

Contraindications

- Infection
- Acute inflammation
- Very young or mentally handicapped children
- Patient's who are unable to open their mouth wide.

Advantages

- Requires only one injection for entire block
- High success rate
- Minimum aspiration rate
- Few post injection complications
- Provide successful anesthesia in bifid inferior alveolar canal and nerve.

Disadvantages

- Time of onset is longer.

Technique

- 25 gauge long needle is recommended
- Area of insertion; mucous membrane on medial border of ramus of mandible, at point parallel to line drawn from inter tragus nodes of ear to corner of mouth and distal to maxillary second molar
- Target area; lateral region of condyle neck just below the insertion of lateral pterygoid muscle.
- Landmarks:
 - Extra oral:* Lower border of tragus of ear, center of external auditory meatus which is concealed by tragus and Corner of mouth.
 - Intraoral (Fig. 27.22B):* Height of injection is established by placement of tip of needle just below mesiopalatal cusp of maxillary second molar, penetration of soft tissue occurs just distal to maxillary second molar.

Procedure

- **Position of administrator:** For right side block, administrator is seated in 8 o'clock position facing towards patient. For left side block administrator is

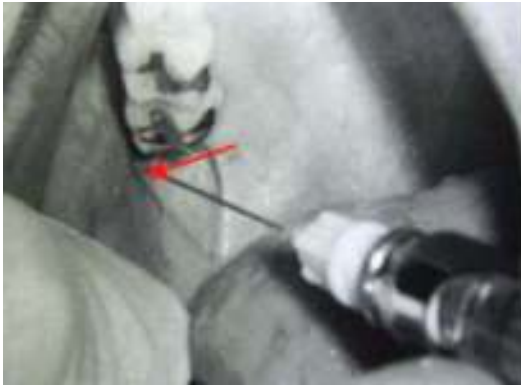
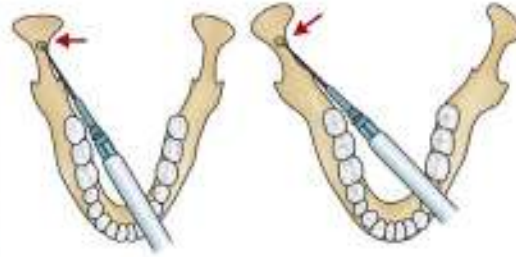


Fig. 27.22B: Intraoral approach for Gow-Gates technique



seated in 10 o'clock position facing in same direction of patient.

- **Position of patient:** Supine and semi supine position is recommended. Mouth is opened widely with extended neck, condyle assume frontal position close to mandibular trunk.
- Locate the landmark and prepare the tissue site for penetration.
- Needle is injected gently distal to maxillary second molar to the height of mesio palatal cusp extending from corner of mouth to inter tragic notch and parallel to angle of ear to face.
- Height of needle is 5 to 10 mm above mandibular plane near maxillary third molar. Slowly advance needle till neck of condyle is contacted.
- Withdraw needle 1 mm and aspirate, if aspiration is negative deposit 1.8 ml solution at the rate of 60 to 90 seconds. Ask patient to keep mouth open for 30 to 60 seconds. The onset time is 3 to 5 minutes.



Fig. 27.23: Teeth in centric occlusion (arrow) during Akinosi technique

Precautions

- Do not deposit solution if bone is not contacted.
- Withdraw needle 1 mm and aspirate.
- Inject if aspiration is negative.

Akinosi closed mouth technique (Fig. 27.23): It was proposed by Dr Joseph Akinosi in 1977 as closed mouth technique.

Common names: It is also known as Akinosi technique, closed mouth mandibular technique or Tuberosity technique.

- Nerves anesthetized are: Incisive nerve, Mental nerve, Lingual nerve and Mylohyoid nerve.
- Area anesthetized are: Mandibular teeth to midline, body of mandible and inferior portion of ramus, buccal mucoperiosteum, mucous membrane in front of mental foramen, and anterior two third of tongue and floor of mouth.

Indications

- Limited mouth opening
- Multiple procedures in the mouth.

Contraindications

- Infection
- Acute inflammation
- Very young or mentally handicapped children.

Advantages

- Relatively a less traumatic
- Few postoperative complications than conventional technique

- Lower aspiration rate
- Provide successful anesthesia in bifid canal
- When patient is unable to open mouth because of trauma, infection, trismus, etc.

Disadvantages

- Difficult to visualize the path of needle insertion
- No bony contact, depth of penetration is somewhat arbitrary.

Technique (Fig. 27.24)

- 25 gauge needle is used.
- Area of insertion: Soft tissue overlying medial border of ramus of mandible directly adjacent to maxillary tuberosity at the height of mucogingival junction of maxillary 3rd molar.
- Target area: Soft tissue on medial border of ramus of mandible in the region of inferior alveolar, lingual and mylohyoid nerve as they run inferiorly from foramen ovale towards mandibular foramen.

Landmarks

- Mucogingival junction maxillary 2nd or 3rd molar.
- Maxillary tuberosity.
- Coronoid notch on ramus of mandible.

Procedure

- Administrator sits on 8 o'clock position for both right and left side block.
- Patient is made to sit in supine or semi supine position.
- Place index finger or thumb of left hand on coronoid notch reflecting the tissue which aids in visualization of injection site and look for landmarks of

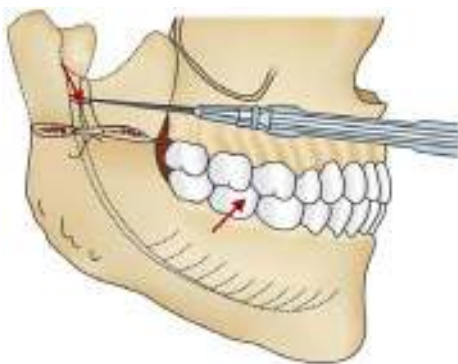


Fig. 27.24: Sketch diagram of Akinosi technique used for dental anesthesia (teeth in occlusion and site of injection).

mucogingival junction of maxillary second and third molar and maxillary tuberosity.

- Prepare tissue for penetration, ask patient to bring his teeth in occlusion with cheek and muscles of mastication relaxed. Barrel of syringe is held parallel to occlusal plane with needle directed posteriorly and laterally so that it advances at a tangent to posterior maxillary alveolar process.
- Advance needle 25 to 30 mm in tissue in pterygomandibular space, close to mandibular nerve.
- Aspirate, if negative, deposit 1.5 to 1.8 ml approximately in 60 seconds.
- Onset time is 40 to 90 seconds.

Precautions

- Do not over insert the needle in smaller patient.

Complications

- Hematoma less than 10 percent.
- Trismus is very rare.
- Transient facial nerve paralysis may be caused due to over insertion.

Electronic Dental Anesthesia

Electrotherapy came into being from 46 A.D. when Scribonius Largus, physician to the emperor Claudius, used the torpedo fish to relieve the pains of gout.

Electroquackery also became popular during the late 1700s. In 1883, Erb et al wrote *“At the present time we possess in the electrical current one of the most certain and brilliant remedies for neuralgia, although we must admit that much progress has not been made in our knowledge concerning its mode of action in these forms of disease.”*

In 1970, electroanesthesia equipment was developed as Desensor handpiece, a high speed device that carried low voltage electrical current through a bur directly onto the tooth being treated (Fig. 27.25).

In 1967, Shealy, et al reported that on direct stimulation of the dorsal column of the spinal cord, intractable pain could be suppressed without the need for an irreversible surgical procedure. In early 1970s, Shealy and Long, working with electrode pads placed on the patient's skin over the spinal cord, were able to eliminate pain without the need for implanting electrodes into cord.



Fig. 27.25: Desensor hand-piece used for dental anesthesia

Mechanism of Action

It can be used for both acute and chronic pain.

- *In management of chronic pain:* It works on low frequency of 2Hz (hertz or cycle per seconds). It produces measureable changes in the blood levels of L-tryptophan, serotonin and beta endorphins. L-tryptophan, precursor of serotonin, is present in decreasing levels as the duration of TENS increases, by contrast serotonin levels in the blood increases with time. It possesses analgesic action thus elevates the pain reaction threshold with increased in cerebral circulation after a period of 10 minutes after start of TENS or EDA stimulation.

The blood levels of serotonin and beta-endorphins remains elevated for several hours following the termination of TENS therapy. Patients may be benefited from residual analgesic action in the immediate post treatment. Opioid agonist analgesic prescribed for post treatment pain is rarely required when TENS or EDA has been used.

- *In management of acute pain:* The mechanism of EDA to prevent acute pain in surgery or dentistry is different. It is explained by Melzack and wall gate theory. When used at high frequency, i.e 120 Hz or greater, EDA causes the patient to experience a sensation as vibrating, pulsing, throbbing or twitching. This involves the selective stimulation of larger diameter sensory nerves fibers (A fibers-A α and A β fibers) which transmit the sensation of touch, pressure, and temperature. It prevents pain stimulus produced by the high speed drill, scalpel, or curette, which is transmitted to the central nervous system more slowly along the smaller A delta and C fibers by closed gate mechanism, which are thus unable

to reach the brain, where it is translated into physical pain. Thus, large fiber input is said to inhibit central transmission of overall effects of small fiber input. When pain impulse fail to reach brain, the sensation of pain does not occur. Elevated levels of serotonin and endorphins are also likely to play a secondary but important role in controlling pain.

Dental uses of EDA

- *Temporal mandibular joint pain;* When using EDA for treatment of chronic pain, as in TMJ/MPD, a low frequency setting is used. This range is 2.5 Hz. Electrodes are placed bilaterally, extra-orally, over the TMJ region and intensity is slowly increased until visible muscle contraction is noted. A cotton roll is placed between maxillary and mandibular teeth so as to prevent them from continually coming in contact as the skeletal contract.

The duration of treatment is from 40 to 60 minutes depending upon degree of limitations. When there is severe pain, after 40 minutes of low frequency treatment the frequency levels are increased to as high as possible and yet comfortable to sustain, but to a maximum level of 120 Hz. The patient remains in this level for up to 1 hour session. Low frequency treatment increases the range of motion and increases the level of serotonin and beta endorphins which relieves the pain.

Initially, patient is called for 1 hour/twice in a week and latter, for 1 hour/once in a week.

- **In acute pain:** It is used for management of acute pain, i.e. in operative, periodontics, endodontics, crown and bridges, the conductive electrodes are placed into the buccal folds bilaterally in the arch being treated intraorally or extraorally. It can be placed unilaterally into buccal or lingual folds of maxilla or mandible, but bilateral placement is more effective.

The frequency control is set to 120Hz with maximum output of 17.5 volts. The patient managed controller limits the output to the electrode in mouth. When EDA unit is initially turned on patient does not feel any sensation, but once the control is moved patient feels sensation as pulsing, tingling, and vibrating it should be continued till threshold is reached, which is intense sensation but not painful. The threshold levels are reached in 30 seconds to

4 minutes. After reaching the threshold level treatment procedures are started. At the completion of dental treatment, turn off the EDA unit before removing the electrode pads from patient mouth.

- *Administering of local anesthesia:* EDA can be used effectively for the intra oral administration of local anesthesia. A hand held electrode is placed at the site where needle is to be inserted, providing a much localized area of intense anesthesia, thus permitting the pain less penetration of needle and local anesthetic.
- *In Pediatric dentistry:* EDA dental anesthesia requires a considerable degree of patient cooperation and participation in order to be successful. Patients are responsible for determining when threshold has been achieved and are to understand that they must increase their level of stimulation should they experience any pain during the dental procedure. EDA in younger populations, though not contraindicated, requires a more intensive evaluation of patient abilities to both understand the concept of EDA and their ability to perform their task properly. Duits et al. used 27 children between the ages of 6 to 12 years for restorative dentistry. Two opposing teeth were treated one with local anesthesia and other with EDA, there was no difference in pain perception between two modalities of treatment.

EDA Indications

- It is the best technique for patient with needle phobia
- Ineffective conventional local anesthesia
- When local anesthesia cannot be administered due to allergy etc.
- TMJ/MPD pain
- Non surgical periodontal procedures like root planing, scaling, comprehensive probing
- Restorative dentistry
- Fixed prosthodontics procedures like crown and bridges
- Endodontic treatment especially in anterior teeth
- When two injection probes are used, on buccal as well as lingual side, primary teeth with 50 percent or greater root resorption can be extracted.

EDA Contraindications

- *Cardiac pace makers:* EA current could interfere with demand pace makers, they could stimulate either very fast or slow cardiac rate. However, it occurs only

when electrodes are placed over thorax. But asynchronous pacemakers provide signals that result in heart depolarization at a fixed rate.

- *Cardiac plexus and carotid body:* It is currently thought that electrical stimulation of cardiac plexus or the carotid body could provoke hypotension. It can stimulate recurrent laryngeal nerve, resulting in upper airway obstruction from laryngospasm. So, it should not be placed on neck.
- *Pregnancy:* While TENS has been used in labor and delivery, its effect on pregnancy are not known. Release of endogenous opioids is a natural phenomenon, the mechanism by which EA works. But care should be taken.
- *Cerebrovascular problems:* EDA increases blood flow in extremities and theoretically in other areas of body also. So, it should be avoided in aneurysms or cerebrovascular problem.
- Epilepsy
- Very young patients
- Older patient with senile dementia.

EDA Advantages

- No need for needle
- No need for injection of drugs
- Patient is in control of anesthesia
- Residual analgesic effect for several hours.

EDA Disadvantages

- Cost of the unit
- Training is required.

BIBLIOGRAPHY

1. Bennett CR. Monheim's local anesthesia and pain control in dental practice, ed 7, St Louis, Mosby, 1984.
2. Cho, et al. Effectiveness of electronic dental anesthesia for restorative care in children. *Pediatric Dentistry* 1998;20: 105-11.
3. Duits, et al. The effectiveness of electronic dental anesthesia in children. *Pediatric Dent* 1993;15:191-6.
4. Friedman, et al. A 21st century computerized injection system for local pain control. *Compend Contin Educ Dent* 1997;18:995-1004.
5. Jones, et al. Dental electroanesthesia in children: A pilot study. *Int Paediatric Dent* 1996;6:107-10.
6. Lilienthal B. A clinical appraisal of intraosseous dental anesthesia. *Oral Surg* 1975;39:692-7.
7. Malamed SF. The periodontal ligament (PDL) injection: An alternative to inferior alveolar nerve block. *Oral Surg* 1982;53:117-21.

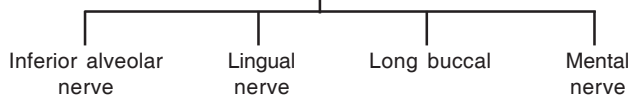
Conventional Local Anesthesia Technique

INTRODUCTION

The most common method of delivering local anesthesia is with the injection. The needle used for this purpose is usually 25 gauges in diameter. It is usually agreed that anesthetic solution should be injected slowly and dental surgeon should observe the patients for any evidence of allergy or hypersensitivity.

Technique for Maxillary and Mandibular Nerve Block

Complete mandibular anesthesia can be obtained by



Inferior alveolar nerve block: The complete mandibular primary and permanent teeth can be anesthetized by

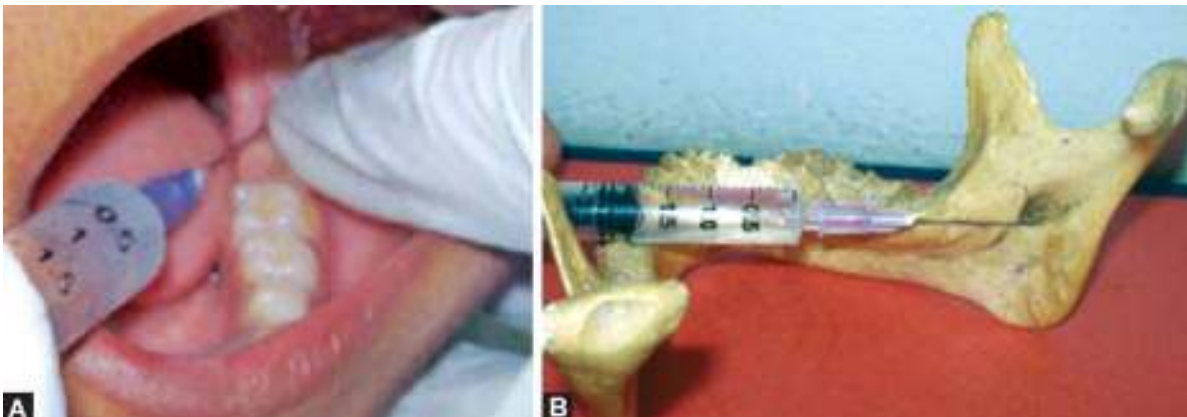
inferior alveolar nerve block. Oslen observed that mandibular foramen is located at a level lower than the occlusal plane of primary teeth. Therefore, the injection must be made slightly lower and more posteriorly than for an adult patient.

Method

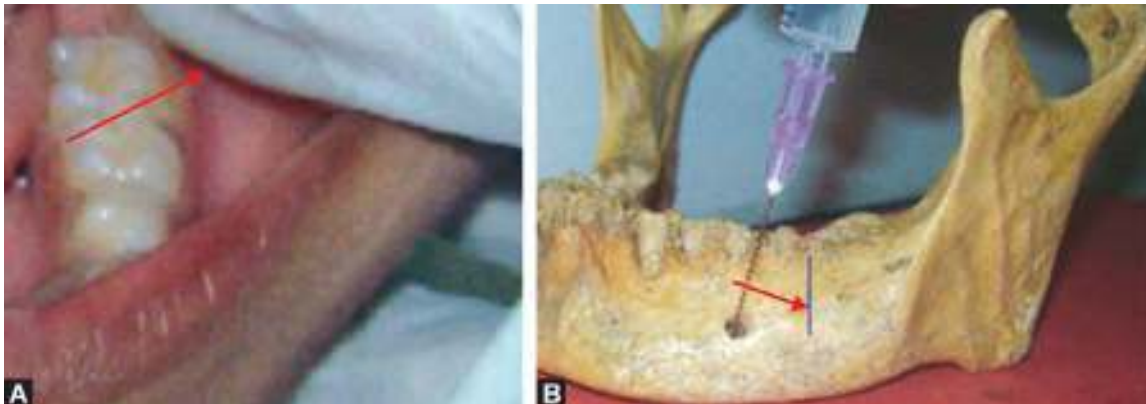
The mandible is supported by the thumb and middle finger as shown in (Figs 28.1A and B) and tip of the thumb resting on the internal oblique ridge. The syringe's barrel should be rested over the occlusal plane of opposite sides of primary molars and the needle is directed towards the inferior alveolar nerve (Mandibular foramen).

Lingual Nerve Block

Since, lingual nerve located near the inferior alveolar nerve (mandibular foramen) so, if small amount of



Figs 28.1A and B: (A) The mandible is supported by the thumb and middle finger, while needle is penetrated through the soft tissues towards inferior alveolar nerve, (B) Relation of inferior alveolar foramen of mandible and needle during inferior alveolar nerve block



Figs 28.2A and B: (A) Arrow shows buccal and distal surface of 1st permanent molar in the mucobuccal fold; the location for long buccal nerve block. A small quantity of LA solution may be deposited in the mucobuccal fold adjacent to the 1st permanent molar, (B) Site for long buccal nerve block on mandible (blue line)

anesthetic solution is injected during insertion or withdrawal of needle for inferior alveolar nerve block, the lingual nerve will automatically anesthetized.

Long Buccal Nerve Block

Long buccal nerve can be anesthetized by depositing local anesthesia in the mucobuccal folds adjacent to the 1st permanent molar as shown in Figures 28.2A and B.

- All facial surface of mandibular gingiva will be anesthetized with the help of long buccal nerve block except gingiva facial to the mandibular central and lateral incisors of one side which is also receiving few nerve terminals from the opposite side.

Infiltration anesthesia for

1. *Mandibular primary molars:* Mandibular infiltration technique is less effective than mandibular block for extraction and pulpotomy. Infiltration anesthesia is only effective for restorative procedure.
2. *Mandibular incisors (Fig. 28.3):* Since, each side of the inferior alveolar nerve terminals crosses the midline of the mandible and supply to the incisors of the opposite side of the same arch. Therefore, a single inferior alveolar nerve block may not be adequate for the surgical procedures on incisors. The labial cortical plate of anterior mandibular is thin, so suprapariosteal LA infiltration is effective.

Example: If inferior alveolar block anesthesia is used for mandibular Lt. quadrant. LA solution is infiltrated over the Rt. mandibular incisors by insertion of the needle just to the left side.



Fig. 28.3: Infiltration anesthesia for mandibular anterior teeth; this is used in conjunction with inferior alveolar block

- Bilateral inferior alveolar nerve block is not used in young children, unless it is absolutely necessary.

Suprapariosteal (infiltration) Technique for Maxillary Primary, Permanent Incisors and Canine (Figs 28.4 and 28.5)

- This technique is used to anesthetize the anterior primary maxillary incisors. The injection should be closed to the gingival margins and solution should be deposited close to the bone and adjacent to the root apex.
- In case of permanent central incisors, the injection site is at the mucobuccal fold so; solution may be deposited slowly and slightly above and near to the



Fig. 28.4: Anesthetizing permanent central incisors. The suprapariosteal injection should be close to the bone and adjacent to the tooth apex



Fig. 28.5: Position of needle for anesthetizing a maxillary canine

root apex. Since, nerve fibers of the one side cross the midline and form a plexus as well as supply to the other side of central incisors. Therefore, it is necessary to infiltrate small amount of anesthetic solution across the midline to obtained adequate anesthesia in primary and permanent central incisors during surgical procedure.

- Nasopalatine infiltration anesthesia is required for anesthetizing palatal soft tissues of all four incisors and partial anesthesia for palatal side of canine region.

- For extraction of maxillary anterior teeth, suprapariosteal as well as nasopalatine LA injection is required to obtained adequate anesthesia.

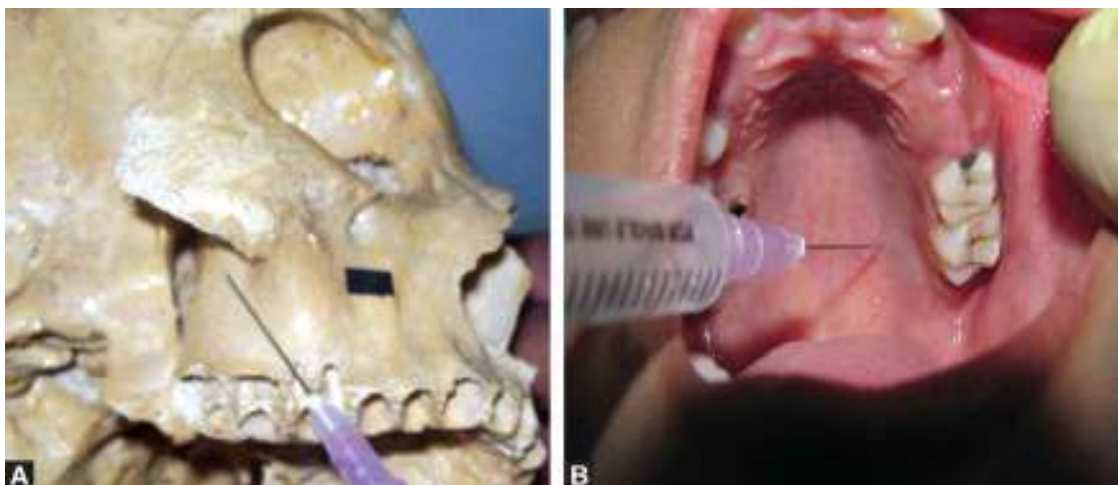
Anesthesia for Maxillary Primary Molars and Premolars (Figs 28.6A and B)

Jorgensen, et al. have observed plexus formation of middle and posterior superior alveolar nerve in the maxillary primary molar area on child's cadaver dissection.

- The suprapariosteal injection at the apices of second primary molar roots is much less effective. This



Figs 28.6A and B: (A) LA solution is injected opposite the apices of buccal root of 1st primary molar to anesthetize them, (B) It is used along with palatal local anesthesia to anesthetize palatal tissues



Figs 28.7A and B: (A) The injection puncture point is in the mucobuccal folds above and distal to the distobuccal root of the 1st permanent molars. The injection inserted upward distally with needle bevel directed towards bone for posterior superior alveolar nerve block. This injection will be done in conjunction with greater palatine nerve block to obtained complete maxillary molar region anesthesia (Bony landmark), (B) Site for greater palatine nerve block

injection should be supplemented with second injection superior to the maxillary tuberosity area to block the posterior superior alveolar nerve.

- This second injection will help to compensate additional bone thickness in the tuberosity and posterior middle superior alveolar nerve plexus in the area of 2nd primary molars.
- To anesthetize the maxillary 1st and 2nd premolars, a single injection is made at the mucobuccal folds to deposit LA solution in the maxillary premolar area above the tooth apex.

Local Anesthesia for Maxillary Permanent Molars (Figs 28.7A and B)

- Ask child to partially close the mouth to allow the cheek and lips to be stretched laterally. The injection puncture point is in the mucobuccal folds above and distal to the distobuccal root of the 1st permanent molars. The injection inserted upward distally with needle bevel directed towards bone.
- To anesthetized maxillary 1st permanent molars; one more LA injection is required into the mucobuccal fold at the apex of mesiobuccal root of 1st maxillary permanent molars to compensate plexus formed by middle and post superior alveolar nerve.

Nasopalatine Nerve Block (Figs 28.8A and B)

- The path of insertion of needle is along the side of incisive papilla, just posterior to the maxillary central incisors. The needle is directed upward into the incisive canal. This is a very painful injection so usually avoid and it anesthetizes palatal tissues of maxillary anterior region.
- When anesthesia is required in the palatal area of canine region, it is necessary to inject a small amount of anesthetic solution into the gingival tissues adjacent to the palatal side of canine to anesthetize overlapping branches of greater palatine nerve.

Greater Palatine Nerve Block (Figs 28.9A and B)

- The greater palatine nerve block injection will anesthetize the mucoperiosteum of the palate from the tuberosity to the canine area. This block is used in conjunction with middle or posterior superior alveolar nerve block before surgical procedure.
- When only primary dentition is erupted, the injection should be made approximately 10 mm posterior to the distal surface of the second primary molars. A few drops of LA solution are enough for anesthetizing greater palatine nerve.



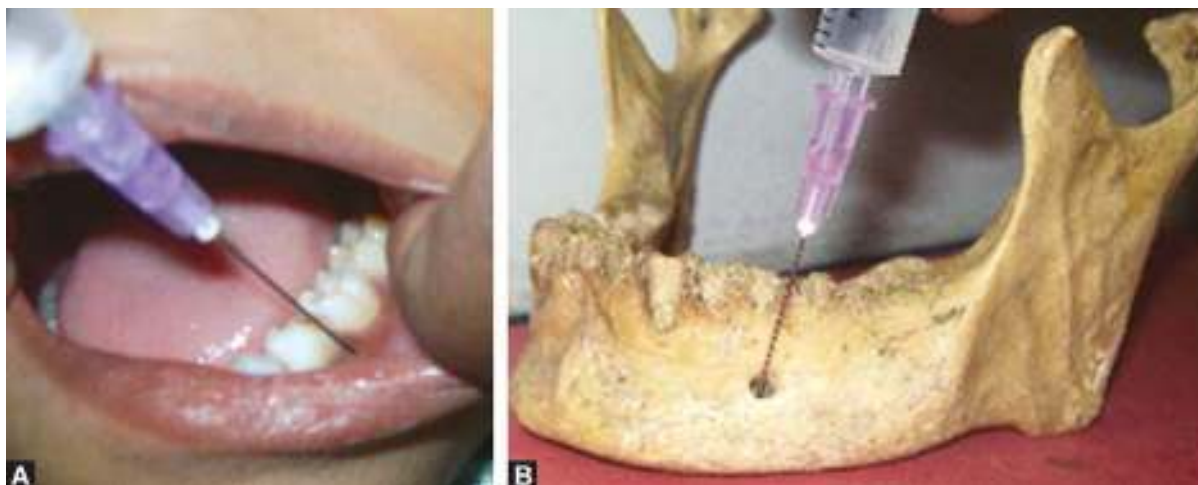
Figs 28.8A and B: (A) Nasopalatine nerve block can be accomplished by injecting LA solution along side of incisive papilla and needle is directed upwards into the incisive canal, (B) Bony landmark for nasopalatine nerve block



Figs 28.9A and B: (A) The greater palatine injection is used in conjunction with middle or posterior alveolar nerve block before removal of maxillary primary molar, (B) Bony landmark for greater palatine nerve block



Fig. 28.10: Bony landmark for infraorbital nerve block. See the position of needle which is parallel to the long axis premolar root in the mucobuccal fold



Figs 28.11A and B: (A) See the site for mental nerve block, (B) Bony landmark for mental nerve block

Infraorbital Nerve Block (Fig. 28.10)

This nerve block anesthetizes the branches of the anterior, middle and superior alveolar nerves. Areas anesthetized are soft tissues below the eye, half of the nose and oral musculature of the upper lip on the injected side of the face. This technique is usually preferred for removal of impacted canine, 1st premolars, large granuloma, cyst, etc.

Mental Nerve Block (Figs 28.11A and B)

Area anesthetized by mental nerve block is all mandibular teeth in the quadrants except permanent molars. Thus, mental nerve block is usually used for routine operative procedure on all primary teeth.

Conscious Sedation in Children and Adolescents

Concepts of conscious sedation: To perform excellent quality dental treatment for the pediatric uncooperative patient, one may need to utilize pharmacologic means to obtain a quiescent, cooperative patient. The conscious sedation techniques produce in a patient a minimally depressed state or level of consciousness in which the patient retains the ability to maintain a patent airway independently and continuously and to respond appropriately to physical stimulation and verbal command. All the reflexes are essentially intact in conscious sedation.

If patient is incapable of response by virtue of being very young or severely disabled, one should exercise care not to depress that particular patient to a point where such determination is difficult to make. The technique and drugs used to produce this state should possess a margin of safety of ample width so as to preclude unintended loss of consciousness. The goals of conscious sedation for the pediatric patient are:

1. To provide the most comfortable, efficient and high quality dental service of the patient.
2. To control inappropriate behavior that interferes with treatment.
3. To develop positive psychology attitude towards future care.
4. To promote patient welfare and safety.
5. To return the patient to a psychology state in which safe discharge is possible.

Before starting conscious sedation procedure the practitioner should possess:

1. A thorough knowledge of agents to be used and be trained in the proper method of their administration.

2. There should be carefully planned and documented rationale for the use of sedation for each patient.
3. The patient should be carefully evaluated to ensure that no condition exist that might alter the expected response to the sedation agents or technique and pose added risk to the patient.
4. Dentist should take informed consent from the patient or guardian.
5. Sedation room should be well equipped for monitoring the patient's vital signs and to avoid any emergency.
6. Mobile emergency medical services should be readily available.

Consideration of Anatomic and Physiologic Differences between Adult and Child Patient before Conscious Sedation

1. Basal metabolic activity is greater in children, which ultimately affects not only drug response but also important physiologic parameters as well. Because oxygen demands are greater, along with a less mature alveolar system, the respiratory rate is far greater in children than adults. This is an important consideration.
2. Children usually have narrow nasal passages, and glottis combined with hypertrophic tonsils and adenoids enlarge tongue and a greater secretion produces a much greater risk of airway obstruction.
3. Children with sleep apnea are not good candidates for conscious sedation.
4. The heart rate is faster and blood pressure is lower in children in comparison to the adult. Children are more susceptible to bradycardia, decreased cardiac output, and hypotension (Table 29.1).

Table 29.1: Normal vital sign with variations at different age groups

Age	Heart rate beats/min.	Blood pressure (Systolic)	Blood pressure (Diastolic)	Respiratory rate (Breath/min.)	Tidal volume (ml.)
3 years	101±10	100±20	67±20	24±5	112±5
5 years	90±10	94±15	55±10	23±5	270±7
12 years	70±15	109±15	58±10	19±5	480±5
Adult	77±5	122±30	75±20	12±3	575±10

± shows variations

Note: The effect and duration of drugs is much more variable for children. For agents that of more lipophilic there may be prolong retention, especially in children who may be obese. All these consideration of the differences between at different age level and adult lead one to the conclusion that doses is not simply an application of formula for derivation of a percentage of the adult dose of any agents. Drugs doses for children should be carefully individualized for each patient.

Criteria of Patient Selection for Conscious Sedation

A thorough medical history is required to determine the suitability of patient for conscious sedation. This includes physical examination, constitute a risk assessment or physiologic status evaluation. This health evaluation should be utilized to place the patient in one of the categories set forth by the American society of anesthesiologist (ASA) (Table 29.2).

Table 29.2: ASA classification of conscious sedative patients

Class	ASA classification
Class 1	There is no organic, physiologic, biochemical or psychiatric disturbance. The pathologic process for which operation is to be performed is localized and is not a systemic disturbance.
Class 2	Mild to moderate systemic disturbance caused either by condition to be treated surgically or by other pathophysiologic process.
Class 3	Severe systemic disturbance or disease.
Class 4	Indicative of the patient with severe systemic disorders that are already life threatening.
Class 5	The moribund patient who has little chance of survival without the planned procedure.

Note:

1. ASA Class 1 and 2 are usually acceptable as candidates for conscious sedation.
2. Children in ASA Class 3 may be benefit from conscious sedation under the guidance of child's physician.
3. Generally patient in Class 3 and 4 are better managed in hospital setting.

Informed consent: The parents or caretaker must be agreeable to the use of conscious sedation for the child. Parents must be informed about the risk factor, benefits and alternative method available.

Instructions to Parents before Conscious Sedation

A. Dietary instruction:

- I. No milk or solid food after midnight before the scheduled sedation procedure.
- II. Children ages 6 months to 3 years – clear liquid up to 4 hours before the procedure.
- III. Children ages 3 to 7 years – clear liquid up to 6 hours before the procedure.
- IV. Children ages 7 years or older – clear liquids up to 8 hours before the procedure.

Note: These dietary instructions are important because emesis during or immediately after a sedative procedure is a potential complication in that aspiration of stomach content can cause laryngospasm or severe airway obstruction which ultimately leads to aspiration pneumonia or even death. Since most conscious sedative agents are administered by the oral route, drug uptake is maximized when the stomach is empty. After treatment the child should first be offered clear liquids and may advance to solid foods as tolerated.

B. Transportation instruction: A third person should accompany the parent, so that person caring for the child may be free to attend to the child's needs during the trip home.

Discharge Criteria

The patient should not be discharge until the presedation levels of consciousness have been achieved. At the time of discharge following condition of patient should be noted.

1. Airway patency uncompromised and satisfactory.
2. Patient easily arousable and protective reflexes should be intact.

Table 29.3: Conscious sedation levels and its sign and symptom

Mild sedation Level 1	Interactive Level 2	Non-interactive/arousable with mild irritation Level 3	Deep sedation Level 4
- Decreases anxiety - Patients complete in awake condition - No monitoring instrument is required at this level.	- Total elimination of anxiety - Mild depressed level of consciousness - Half closed eye - Well responds to verbal commands. - Emergency equipment is required to assess the status of patient.	- Loss of anxiety and induce sleep - Eye closed - Inappropriate response to verbal command - Heart, respiratory rate, BP, cardiogram is required.	- Sleep like status - depressed level of consciousness - Patient does not responds to verbal command - Airway management and monitoring is required. - Heart, respiratory rate, BP, cardiogram is required.

- State cardiovascular function should be satisfactory and stable.
- Airway of hydration should be adequate.
- For the child who is very young or disabled, incapable of usually expected responses, the presedation level of responsiveness or the level as close as possible for that child should be achieved (Table 29.3).

Emergency Equipment (Table 29.4)

Following emergency equipment must be present in the sedation as well as GA room.

Sedation technique: Sedative drugs may be administered by inhalation or by the oral, rectal, submucosal, intramuscular or intravenous routes. Combination of

Table 29.4: Emergency resuscitative equipment

- Oxygen
- Suction
- Airway management
 - System capable of delivering 100 percent at 10 L/min. for at least 30 min.
 - Apparatus capable of producing continuous negative pressure of 150 torr.



- Laryngoscopes *
- Facemask (all sizes)
- Oral and nasal airways



Endotracheal tube

- Monitors



- Pulse oximeter with both visible and audible displays

Contd...

Table 29.4 Contd...



- Cardiac monitor and Automated blood pressure device

5. Resuscitative equipment/medication



Emergency drug Kit

- Ambu bag
- Defibrillator with EKG recorder capabilities
- Emergency drugs including naloxone, flumazenil, ephedrine and epinephrine
- Emergency drug card and ACLS protocols.

6. Blood coagulating instrument



- Electrocautry

drugs and specific selection of routes of administration to maximize effect and increase safety as well as patient acceptability are common. Inhalation of a nitrous oxide-oxygen mixture is often coupled with any of the other routes.

The only classification of drugs for sedation acceptable to be administered preprocedurally outside of the treatment facility are minor tranquilizer only (i.e. Diazepam, Hydroxyzine, etc.). These agents can be given well before the actual procedure by the parents at home to calm the patients apprehension on the arrival in the dental office.

Oral sedation: Oral route is most acceptable and easiest method of drug administration. The method is dependant on absorption through the GIT mucosa. This means that condition of the stomach, the absorption, characteristic of drug, and the bioavailability are all considerations.

Precaution: All sedative agents (except minor tranquilizers) should be administered in the dental office by trained personnel. A suitable recovery area should be available in the office so trained personnel can monitor the recovery of patient until discharge criteria have been met.

Technique:

1. Selection of sedative agents.
2. Proper dose calculated for a child.
3. After administration of drugs patient should be kept in an area of clinic that allows for continuous monitoring.
4. When desired effect is obtained (usually a period of 30 to 60 min), the patient is transferred to the operating area.
5. For small children or with children who may become physically combative, it is advisable to place the patient in a recline restraint Ex. Papoose board (the chest must not be restraint to avoid obstruction of respiratory muscle. A shoulder roll should be adequately positioned to keep the head slightly rolled up and back, allowing for a more patent airway. Nitrous oxide and Oxygen may be started at this time for added effect as well as for oxygenation.

Note: If the patient is not adequately sedated to the point that treatment can be accomplished the attempt should be aborted and considered a sedation failure. The patient should be reappointed for another attempt, either by altering the dose or technique. Increments of medication should not be administered to avoid the risk of an overdose caused by variables and unpredictable absorption.

6. Patient should be monitored carefully during the procedure to ensure responsiveness.
7. Discharge patient when minimal criteria of discharge have been met.
8. Post sedative instruction should be given.

Intramuscular Sedation

1. For the most patients the upper outer quadrant of gluteal (glutea maximus muscle) region is safest.
2. The anterior aspects of thigh utilizing the vastus lateralis muscle is the safest for small children.
3. For older patient with adequate upper arm development, the deltoid muscle can be utilized.

Submucosal Sedation

Submucosal sedation involves the deposition of drug beneath the mucosa. The site is usually chosen for injection is the buccal vestibule, particularly in the area of maxillary primary molars or canine teeth.

Precaution

Use only those sedative that is not irritating to tissue. Ex. The drugs most commonly administered by this technique are the narcotics meperidine and fentanyl.

Intravenous sedation: The use of intravenous conscious sedation in pediatric dentistry is somewhat restricted to certain types and ages of patient. The onset of action of drugs in intravenous sedation is approximately 20 to 25 seconds only.

Disadvantages

1. High incidence of phlebitis.
 2. Hematoma formation at the site of venipuncture.
 3. Drugs reversal effect not present in IV sedation.
- Note:* The single drugs usually benzodiazepine is probably the most adoptable to pediatric practice.

Combination of Methods and Sedative Agents

The combination of methods and agents might be used to enable the operator to reduce the doses of a strong drug, such as narcotic, and thus reduce the possibility or degree of a side effect, such as severe respiratory depression.

- A. Conscious sedation is usually most effective with combined use of local anesthesia. Sedative techniques are not pain control technique and are often overridden when intraoperative pain is experienced by the patient. To overcome this circumstance with sedative agents alone requires a use of a very high dose or the addition of a narcotic to the regimen, thus producing deeper level of sedation than might be required together with the increasing possibility of side effect. The technique should not be used simply to escape the need to inject a local anesthetic.
- B. Inhalation sedation (N_2O) is the next most frequently combined technique with other method of conscious sedation.

Advantages

1. Increased sedation
2. Increases the availability of oxygen for patient
3. Since, N_2O is CNS depressant. It can be controlled easily when sedation level becomes deeper than desired.

- C. Oral sedation is the next most commonly employed in combination. Most commonly combined include sedative/ hypnotic, narcotic and/or antihistamines. *Note:* Regardless of the method of administration, agents given in combination should be approached with great caution because of the possibility of additive effects. Individual drug doses should be reduced by 20 to 30 percent when given in combination.

Ideal Feature of Inhalation Sedation Equipment

1. All equipment must be adoptable to children of all ages and sizes.
2. Equipment must have a capability of immediate delivery of 100 percent, oxygen with minimum delivery of 20 percent.
3. The system have 'fail safe' system that accomplishes complete shut down when the oxygen supply drops below the 20 percent level.
4. Always use double mask type scavenger system. This system exhaust into the vacuum waste system which should be vented to the outside to prevent dispersal of gases to the other area of the office.
5. Ambubag should be present at the time of conscious sedation. It is an oxygen delivery system (E-650 L) cylinder used during transfer of the patient for medical facility. With this apparatus oxygen from the cylinder mixed with room air can be delivered to the patient.

Inhalation sedation: Nitrous oxide is the only inhalation agent that meets the requirements of conscious sedation. N_2O is sweet smelling, colorless and inert gas. It is compressed in cylinder as a liquid that vaporizes on release. This is an endothermic reaction, means cylinder will become cool when in use.

Pharmacokinetics of N_2O : Specific gravity of N_2O is 1.53, and has a blood: gas partition coefficient of 0.47. It is very low soluble in blood, so it has a very rapid onset and recovery time. N_2O will become saturated in blood within 3 to 5 min following administration. There is no biotransformation, and the gas is rapidly excreted by the lungs when concentration gradient is reversed. Diffusion hypoxia may occur as the sedation is reversed at the termination of the procedure. To minimize this effect, the patient should be oxygenated for 5 min after sedation procedure.

Pharmacodynamics of N_2O : N_2O produces non specific CNS depression. Minimum alveolar concentration (MAC) of N_2O is 105. The MAC of an inhalation agent shows its potency. It is a concentration required to produce immobility in 50 percent of patients. At concentration 30 to 50 percent, N_2O will produce a relaxed, somnolent (almost asleep) patient who may appear dissociated and easily susceptible to suggestion. At concentration more than 60 percent, patient may experience discoordination, ataxia, giddiness, and increased sleepiness. In dental practice only 50 percent concentration of N_2O is used.

Advantage: N_2O can be used safely in asthma patient without fear of broncospasm.

Disadvantage

1. N_2O decreases cardiac output
2. It increases peripheral vascular resistance.

Adverse Effect of N_2O

1. Nausea and vomiting
2. Prolong use may cause neurotoxicity, impotency, renal and liver toxicity.

Controlling ambient nitrous oxide level

Cross ventilation: N_2O room must have good cross ventilation.

- Exhaust vent should be located in ceiling near the head rest of dental chair.
- N_2O Exhaust must be vented to the outside of clinic.

Daily work practices:

- Check N_2O equipment everyday and before starting sedation procedure.
- Use double scavenger system and adjust the scavenger flow rate to 45 L/min.
- An appropriately sized mask should be selected to ensure a sealed but comfortable fit.
- Adjust the N_2O - O_2 flow rate to keep the bag from overfilling. The bag should collapse and expands as the patient breaths.
- At the end of the sedation procedure, flush the patient and system by administering 100 percent oxygen to the patient for at least 5 min.

Maintenance:

- Schedule period inspections every three months of all aspect of the system, paying particular attention to area of potential leaks.
- Documented the results of all inspection as well as corrective action taken.
- Periodic personal sampling of dental personnel with a dosimeter should be considered.

Technique

1. Mask should be carefully placed over the nose.
2. The gas delivery tubes are tightened behind the chair back in a comfortable position.
3. The bag is filled with 100 percent oxygen and delivered to the patient for 2 to 3 min. at an appropriate slow rate, typically between 4 to 6 liter/min.
4. Introduce the nitrous oxide by slowly increasing the concentration at increment of 10 to 20 percent to achieve the desired level.
Note: The operator should encourage the patient to breath through the nose with the mouth close.
5. Explain the sensation as they begin to be felt. This is the best described as a floating, giddy, and feeling with tingling of the digits. The eyes will take on a distance gages with sagging eyelids. When this state is reached the local anesthetic may be given. Once this is completed, the concentration can be reduced to 30 percent N₂O/70 percent oxygen or lower.
6. The patient can now be maintained and monitored, and contemplated procedure carried out.
7. The dentist should communicate with the patient throughout the procedure paying particular attention to the maintenance of an open relaxed airway.
8. The patient can be recovered quickly by reversed titration. Once reversed, patient should be allowed to breathe the 100 percent oxygen for at least 5 min.
9. The patient should be allowed to remain in the sitting position for a brief period to ensure against dizziness on standing.
10. The patient is now ready for discharge (If he fulfills the discharge criteria).

OTHER AGENTS USED FOR CONSCIOUS SEDATION

Benzodiazepines Group

Diazepam (valium): A benzodiazepine is lipid soluble and water insoluble drug. It is rapidly absorbed from GIT with peak level at 2 hours. The drug has three active metabolite, one of which is also very lipophilic and has a half-life 96 hours. It showed rebound effect and has strong anticonvulsant activity.

Diazepam can be administered orally, rectally or parentally. If the IV route is to be utilized, a large vein and slow administration is recommended because of high chances of thrombophlebitis.

Adverse reaction: Ataxia and prolong CNS effect when diazepam used for conscious sedation.

Dosage: 0.2 to 0.5 mg/kg- oral or rectal
0.25 mg/kg- IV
Maximum single dose is 10 mg.

Midazolam

The parental form of this benzodiazepine is similar to diazepam but with twice the potency. Significant advantage of midazolam over diazepam is its high water solubility and minimal thrombophlebitis. After IV administration sedation occurs in 3 to 5 minutes. Recovery occurs in 2 hours. No rebound phenomenon present. Since this drug is lipophilic in nature, rapidly absorbed from the GIT and showed rapid entry into brain tissues. It may produce respiratory depression with higher doses.

Disadvantage

1. Apnea
2. Hypotension.

Dosage: Oral- 0.25 to 1.0 mg/kg to a maximum single dose of 20 mg.
IM- 0.1 to 0.15 mg/kg to max. Dose of 10 mg.

Syp- 2 mg/ml

Benzodiazepine Antagonist

Flumazenil has been shown to be effective in reversing the sedative effect of benzodiazepines but not amnesic or anxiolytic qualities of benzodiazepine. This drug is recommended for intravenous use only and is not recommended for children younger than 18 years of age.

For reversal of conscious sedation, the initial dose should be 0.2 mg given over 15 seconds. If the desired level of consciousness not occurs after waiting an additional 45 seconds, another dose of 0.2 mg should be administered and repeated at 60 seconds intervals to a maximum total dose of 1 mg. Most of patient will respond to doses in range of 0.6 to 1.0 mg.

Note: Patient should be carefully monitored for resedation and respiratory depression throughout the period of reversal. If resedation occurs, repeated dose at no less than 20 minutes intervals may be used.

Antihistamines

A. Hydroxyzine: Rapidly absorbed from GIT, Clinical effect seen in 15 to 30 minute, with peak level at 2 hours. Route of administration is oral.

Note: Care must be exercised in small child. It should not be injected IV or subcutaneously because of potential tissues necrosis and hemolysis.

Dosage – 0.6 mg / kg – oral

1.1 mg /kg IM (In deep and large muscle preferred).

B. Promethazine (phenergan): Well absorbed from GIT. Onset is within 15 to 60 minutes, with a peak at 1 to 2 hours. Promethazine should be used with caution in children with history of asthma, sleep apnea or a family history of sudden infant death syndrome. *Adverse reaction:* Dry mouth, blurred vision, thickening of bronchial secretion, etc.

Dosage: Oral/IM – 0.5 to 1.1 mg /kg

Maximum recommended single dose is 25 mg.

C. Diphenhydramine (Benadryl): Rapidly absorbed from GIT with maximum effect in 1 hour. It produces a mild sedative effect but with additive effect to other CNS depressants.

Dosage: Oral/IM/IV-1.0 to 1.5 mg/kg

Maximum single dose is 50 mg.

Sedative Hypnotics

A. Barbiturates are of very limited value in pediatric patient.

B. Chloral hydrate: Chloral hydrate is a well known and widely used drug for pediatric sedation. It has onset of action within 15 to 30 minutes when given orally. The primary metabolites of chloral hydrate are trichloroethanol (TCE), which is responsible for most of the CNS effects that occurs. Children will often enter a period of excitement and irritability before becoming sedated.

Adverse Effect

1. Drowsiness, sleep
2. Respiratory depression
3. Arrhythmias (This drug is contraindicated in cardiac patient).

Lethal dose of chloral hydrate is stated 10 g in adult, yet ingestion of 4 g has caused death. It is recommended that young children receive not more than 1g as a total dose. Risks are increased when chloral hydrate is combined with nitrous oxide, narcotics or local anesthesia.

Recommended dose—25 to 50 mg/kg to maximum of 1 g.

Narcotics

Meperidine

Meperidine is a synthetic opiate agonist. It is least effective by orally, so preferred route is IV or IM. Parental route shortens the time of onset and duration. Meperidine should be used caution in patient likely to accumulates or be sensitive to its metabolites (Ex. Hepatic, renal, or history of seizures).

Dosage: Oral or IM 1 to 2.2 mg / kg, not to exceed 100 mg.

Fentanyl

It is very potent narcotic analgesics. A dose of 0.1 mg is approximately equivalent to 10 mg of morphine and 75 mg of meperidine. It has a rapid onset of action. When using fentanyl, one should be attentive to and competent in airway management.

Fentanyl can be administered by intramuscular, intravenous or submucosal route. When used with other CNS depressant, the dose should be reduced. The drug works well with orally administered diazepam and nitrous oxide – oxygen. It is not recommended for use in children under 2 years of age.

Dosage: 0.002 to 0.004 mg/kg.

Supplied: 0.05 mg/ml in 2 and 5 ml ampules.

Narcotic Antagonist

Naloxone

This drug is semisynthetic opiates antagonist used for the sole purpose of reversing the effect of narcotic drugs. It acts within 2 to 5 minute after subcutaneous or IM injection and 1 to 2 minute IV injection. After IV administration, the duration of reversal is about 45 minutes and it is slightly longer when administered intramuscularly or subcutaneously. Repeated dose of

Naloxone may be necessary to establish patient stability. Naloxone administration should never take precedence over basic resuscitative measures.

Adverse Effect

1. Nausea, vomiting, hypotension and hypertension.
2. Ventricular tachycardia, fibrillation and pulmonary edema.

Dosage: IV/IM/SC Initial dose: 0.01 mg/kg; subsequent dose 0.1 mg/kg (2 mg maximum) every 2 to 3 minutes.

Note: Narcotic are the heavy surgical strike of pediatric conscious sedation. It produces sedation and euphoria to a greater degree in children than in adults. Local anesthesia is still required for intraoperative pain control. One should remember that, local anesthetic are additional CNS depressant.

The maximum dose of local anesthetics must be reduced when used in combination with a CNS and respiratory depressant (Ex. narcotics). The combination of other sedative drugs including nitrous oxide oxygen will reduce the need for larger doses of narcotics and thus reduce the potential for toxicity or unwanted effect of these potent drugs. A practitioner employing the narcotic should be thoroughly familiar with their action and interaction and should have had some supervised experienced anesthetist in their use and management of airway and patient resuscitation procedure.

Risk Management

To minimize the risk of adverse events occurring during the treatment of patient with conscious sedation, the practitioner should consider the following things in their mind.

1. Use only those techniques that are thoroughly understood as to indication, contraindication, adverse reaction, its management, drug interaction and proper dose for desired effect.
2. A careful preoperative evaluation of each patient including medical history, current physical and psychological status, age and past experience with sedation and anesthesia.
3. A continuous physiologic and visual monitoring is required of sedated patient during onset through recovery.
4. Emergency kit should be available.
5. Keep fully documented records of drugs used, dosage, vital sign monitored, adverse reaction and any emergency procedure employed.
6. Assistant should be highly trained for the function they are assigned to perform.
7. Treat high risk patient in a hospital or similar setting equipped to provide for their care.

BIBLIOGRAPHY

1. American Academy of Pediatric Dentistry: Guideline for the elective use of pharmacologic conscious sedation and deep sedation in pediatric dental patient. *Pediatric Dent* 1997; 19(7):48-52.
2. American Dental Association: Report of council on scientific affairs; Nitrous oxide in dental office. *JADA* 1997;128:364-5.
3. American Dental Association: The use of conscious sedation, deep sedation and General anesthesia in dentistry. Chicago, 1986.
4. Dunn-Russel T, et al. Oxygen saturation and diffusion hypoxia in children following nitrous oxide sedation, *Pediatric Dent* 1993;15(2):88-92.
5. Moore, et al. Sedation in Pediatric Dentistry: A Practical Assessment Procedure. *JADA* 1984;109:564-9.
6. Reeves, et al. Midazolam: Pharmacology and uses: *Anesthesiology* 1985;62:310-24.

General Anesthesia in Pediatric Dentistry

General anesthesia for dental care in children is sometimes necessary to provide safe, efficient, and effective care. Depending on the patient, this will be done in an ambulatory care setting or inpatient hospital setting. It should be only one component of the dentist's over all treatment regimens.

Only hygiene and preventive care must be implemented at the onset of treatment with parent or guardians and patient to eliminate the etiology of dental problem.

Indications for GA in the Treatment of Children

1. Patient with dental needs for whom local anesthesia is ineffective because of acute infection, anatomic variation, or allergy.
2. Patient with certain physical, mental or medically compromising conditions.
3. Uncooperative, fearful, anxious or uncommunicative child or adolescent with dental needs that are deemed sufficiently important for which dental care cannot be deferred.
4. Patient who have sustained extensive orofacial and dental trauma.
5. Patient requiring dental care for whom the use of GA may protect the developing psyche.

Contraindication

Patient usually contraindicated for general anesthesia include those with a medical contraindication to general anesthesia and healthy and cooperative patient with minimal dental needs.

Psychology of Hospitalized Children

Hospitalization is a frequent source of anxiety in children. 20 to 30 percent of hospitalized children shows some degree of behavioral changes. Separation of the child from the parent appears to be a significant factor in post hospitalization anxiety. Allowing the parent to stay with the child during the hospitalization and especially to be present when the child leaves for and returns from surgery, can reduce anxiety for the child and parent alike.

After receiving GA, children showed some type of positive behavioral changes including less fuss about eating, fewer temper tantrum and better appetite and some showed negative behavioral changes like biting the fingernails, needing more attention and being afraid of the dark. To minimize negative behavioral changes after GA administration, following things should be done:

1. Involving the child on the operating room tour.
2. Allowing the child to bring along a favorite doll or toy.
3. Giving preinduction sedation.
4. Providing a non-threatening environment.
5. Allowing parent to rejoin their children as early as possible in the recovery area.

Note: Before the admission of child patient to the hospital, a proper pediatric medical history, dental history and physical examination should be done as given in Tables 30.1 and 30.2.

Operating Room Protocol

Personnel involving in the care of patient in the operating room and recovery area should follow the guidelines

Table 30.1: Component of pediatric medical history for GA indicated patient

<i>Pediatric history</i>	<i>date.....</i>	<i>Time.....</i>
1. Identification: Age, sex, profile		
2. Informant and estimate of reliability		
3. Problem leading to admittance		
4. History of present illness: date of onset, chronologic description of illness, presence or absence of previous similar episodes, treatment given prior to admittance		
5. Medical survey		
a. Immunization against diphtheria, pertussis, tetanus, polio, measles, mumps, rubella		
b. Previous hospitalizations, operations, major illnesses, or injuries		
c. Allergies, including food and drugs		
d. Dietary history-under 2 years of age		
e. Current medications.		
6. Developmental status		
a. Infants less than 2 years: Statement and language development		
b. Preschool children: General statement development		
c. Children in school: Statement school performance.		
7. Family history		
Physical examination: Following examination should be done before operation under GA patient.		
1. Vital signs: TRP, BP if more than 12 months of age		
2. Mouth: Teeth, pharynx, and tonsils lymph nodes		
3. Measurements: Weight, height or length, head circumference if less than 12 months of age		
4. Neck: Mosses		
5. Lungs: Auscultation		
6. Head: Describe fontanel if present		
7. Eyes: Pupils, extraocular movements		
8. Ears: Tympanic membranes		
9. Nose: Potency, secretions		
10. Cardiovascular: Heart sounds, rate rhythm, murmurs; femoral pulses		
11. Abdomen: Mosses, viscera		
12. Genitalia		
a. Moles testes		
b. Female introitus.		
13. Skin: Eruption		
14. General observations: Nutrition, color, distress, <i>Skeleton: Joints, spine</i>		
15. Nervous system: State of consciousness, gait (if walking)		
16. Summary list of problems on tentative diagnosis.		

of OSHA (occupational safety and health administration). They must wear appropriate attire designed to prevent contamination of the surgical suite, hallways and recovery room.

Table 30.2: Components of the dental history and intraoral examination to be completed before hospitalization

1. Past dental history
2. Examination of head and neck
 - a. General
 - b. Head
 - c. Neck
 - d. Face
 - e. Lateral facial profile.
3. Examination of oral cavity
 - a. Lips
 - b. Tongue
 - c. Floor of mouth
 - d. Buccal mucosa
 - e. Hard and soft palate
 - f. Oropharynx
 - g. Periodontium.
4. Dental Examination
 - a. Caries
 - b. Sequence of eruption
 - c. Occlusion molar, cuspid, overbite, overjet, and midline.
5. Oral habits
6. Behavior
7. Recommendations.

Properties of Inhalation General Anesthesia

All inhalation anesthetic agents produce anesthesia by depressing specific area of the brain. The magnitude of depression is proportional to the partial pressure of the inhalation agent reaching specific site in CNS, after entering through the lungs and being distributed by the circulation to the tissues.

The modern inhaled anesthetics are extremely potent. Induction of anesthesia occurs quickly and passage through the stages of anesthesia is quite rapid (Fig. 30.1).

Technique of Inhalation

The semiclosed system is most often used in modern anesthesia. Exhaled gases mingled with fresh gas and are rebreathed after all the CO₂ is removed by a chemical absorber. Inhaled gases are humidified and a reservoir bag or ventilator allows assisted respiration.

Advantages of semiclosed inhalation anesthesia:

1. Reduce loss of body heat and water vapor
2. Increased economy of flow
3. Decreased environmental contamination.

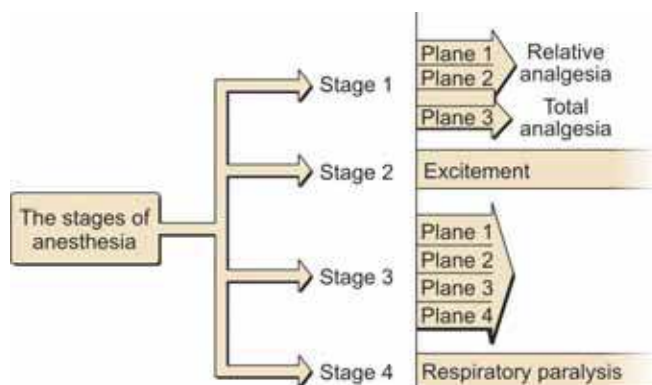


Fig. 30.1: Stages of general anesthesia

An anesthetic's potency is defined as concentration of the agent required to inhibit response to a standard surgical stimulus. The potency is expressed in term of a minimal alveolar concentration (MAC) value for the agent. MAC is very useful, since it provides an estimate of anesthetic agent requirement for each patient. Fine adjustment of anesthetic agent administration can then be made by monitoring the patients physiologic response (such as heart rate, BP, respiratory rate). MAC value of different anesthetic agent showed in Table 30.3).

Commonly used inhalation anesthetic agents are nitrous oxide, halothane, enflurane, isoflurane, desflurane, and sevoflurane. Halothane associated hepatitis is much rarer in children than in adult. Enflurane is similar to halothane but can produce seizure activity, and hyperventilation occurs.

Isoflurane is newer anesthetic agent also similar to the halothane but with less liver toxicity, more potent muscle relaxation and less CNS electroencephalographic activation.

Preparation of Child for General Anesthesia

After wearing surgical suite, the dentist should inform the anesthesiologist for any special request concerning the procedure. Nasotracheal intubations are preferred to ensure good access to the oral cavity. The child's eyes should be protected during general anesthesia. The anesthesiologist is responsible for starting intravenous fluids, securing the necessary monitoring equipment, performing the intubations, and stabilizing the tube. The monitoring equipment should include:

1. An automatic sphygmomanometer
2. A precordial stethoscope
3. Temperature monitoring device
4. Electrocardiographic leads
5. A pulse oximeter
6. A capnography device.

The anesthesiologist must confirm that the child is in a stable condition for anesthesia and that the equipment is functioning properly.

Perioral cleaning, draping and placement of pharyngeal throat pack: Before the dental procedure begun, the patient Perioral area is washed with three sterile 4 × 4 inch gauze pads. The 1st gauze saturated with bacteriostatic agent, 2nd with sterile water and 3rd with alcohol. This procedure is not intended to sterilize the area but only to remove gross debris. The head is draped with towel securing the access space for the mouth.

The patient's mouth is opened with the aid of a mouth prop. Care should be taken not to impinge on the lips or tongue with the prop. The mouth is thoroughly aspirated. The pharyngopalatine area is sealed off with a strip of moist 3 inch sterile gauge approximately 18 inch long. This packing reduces the escape of anesthetic

Table 30.3: Physical and chemical properties of commonly used inhalation anesthesia

Agent	Vapor pressure mm of Hg at 20°C	Blood gas partition coefficient at 37°C	MAC (minimum alveolar concentration) in adult
Nitrous oxide	—	0.47	104
Enflurane	175	1.91	1.7
Halothane	243	2.5	0.76
Isoflurane	238	1.43	1.15
Desflurane	665	0.42	6.0
Sevoflurane	157	0.63	2.1

agents and prevents any object from entering the pharynx. The gauge should be tightly packed around the tube, so that a good seal is ensured. Once the pack is in place, a thorough intraoral examination and dental procedure is performed.

Note

1. Instruments for restorative dental procedure in the operating room are the same as those for procedure in the dental operatory. The use of quadrant isolation with a rubber dam is preferred. After completion of each quadrant, a topical fluoride treatment should be applied before the removal of rubber dam during dental treatment.
2. Anesthesiologist should be notified 10 minutes before the completion of the procedure so that the child can begin to be aroused and preparation can be made for extubation.
3. On completion of the dental procedure, the oral cavity is thoroughly derided and throat pack is removed carefully to prevent aspiration of any material that might be lodged against it.
4. The dentist should accompany anesthesiologist and provide assistance during the transportation to the recovery room.

5. When child arrives in the recovery room, the dentist should inform the nursing staff about the procedure accomplished and of any special request or instructions.

Postoperative Care

Postoperative orders and the operative note for the staff should be completed by the dentist and recorded in the medical chart while the child is in the recovery room.

BIBLIOGRAPHY

1. Ferreti GA. Guidelines for outpatient general anesthesia to provide comprehensive dental treatment. *Dent Clin North Am* 1984;28(1):107-20.
2. Guedel AE. *Inhalational anesthesia*. New York 1937, Mac Millan, Hill Morris PJ. *general anesthesia and sedation in dentistry*. Bristol, JWand sons Ltd., 1983.
3. Roberts GJ. Relative analgesia in clinical practice. In: Coplans MD, Green RA. *Anesthesia and sedation in dentistry*. Amsterdam, 1983:12.
4. Scott JG, Allen D. Anesthesia for dentistry in children: A review of 101 surgical procedure. *Can Anesth Soc J* 1970;17:391-402.
5. Thompson R. Howto establish baseline for hospitalized dental patient. *J Hosp Dent Prac* 1970;4:74-80.
6. Trapp LD. Special consideration in pedodontics anesthesia, *Dent Clin North Am* 1987;31(1):131-8.

Commonly Used Drugs in Pediatric Dentistry

GENERAL PRINCIPLES OF PEDIATRIC DRUG THERAPY

Important Physiological Considerations Associated with Medications in Children

- Because of higher metabolic rate, children usually require higher dose per unit body weight as compared to adults.
- Due to higher BMR, some drugs are metabolized more rapidly in children as compared to adults.
- The infants have relatively lower glomerular filtration rate and renal plasma flow than adults. Therefore, drugs may be excreted more slowly with increasing risk of drug accumulation within the body.
- Low concentration of plasma proteins and diminished protein binding capacity in children as compared to adults; allow drugs to be more available in circulation, increasing chances of toxicity.
- Rates of drug absorption in infants and children are lower as compared to adults.
- Prolonged gastric transit time and variable gastric pH in children may alter drug absorption (a child's gastric pH is equal to adult at 2-3 years of age).
- Low peripheral perfusion and immature heat regulation in children can decrease absorption of IV, IM or SC medications.
- In children, body water is 80 percent as compared to adult, so higher doses of water soluble drugs may be needed to achieve therapeutic effects.
- There is increased permeability of skin and blood-brain barrier in children, so topical absorption of drug

is more and there is increased CNS distribution of drug leading to chances of neurotoxicity.

- The preterm babies/newborn are liable to be relatively intolerant to many drugs because the organs responsible for disposing off the drugs (immature kidney and liver function) are less efficient.
- Accurate drug dose is critical in pediatric patients since they do not have mature physiological responses to compensate for drug errors.

Bioavailability

- Bioavailability is measure of fraction of administered dose of a drug that reaches the systemic circulation in the unchanged form. Bioavailability of drug injected intravenously is 100 percent.
- Oral formulation of same drug from different manufacturers of different batches or from the same manufacturer may not yield same blood levels, i.e. biologically in equivalent.
- Bioavailability variation assumes practical significance for drugs with low-safety margin. It may be responsible for success or failure of an antimicrobial regimen.

Drug potency and efficacy

Drug potency	Drug efficacy
• Amount of drug needed to produce a certain response • Refers to position of dose response curve on dose axis	• Maximal response that can be elicited by the drug • Refers to upper limit of dose response curve

CALCULATION OF DRUG DOSAGE

Dosage Forms

Some Important Definitions

1. *Delayed release*: Available other than immediate after administration.
2. *Sustained release*: Slow release as governed by the delivery system (iron, potassium).
3. *Controlled release*: At constant rate to maintain unvarying plasma concentration (nitrates, hormone replacement therapy).

CALCULATION OF DOSAGE IN PEDIATRIC PATIENTS

Even in favorable setting, a substantial proportion of dentist make mistake while calculating the drug dose. It is, therefore, not surprising that dosing errors are most common errors made by dentist. There is no simple formula for calculation of dosage in pediatric patients. The exact dose is determined by various experimental and/or clinical studies. The manufacturer usually provides separate guidelines for pediatric and adult dosage.

However, there are two ways of assuring the safety of dose in pediatric patients:

1. By using weight of child
2. By using body surface area.

Use of Weight for Determination of Dosage

For the sake of convenience, the dose of drug is calculated on the basis of body weight (because of their

higher metabolic rate, children usually require higher dose per unit body weight compared to adults).

By Clark's Rule

$$\text{Child's dose} = \frac{\text{Child's wt in lbs}}{150} \times \text{adults dose}$$

By Young's Rule

$$\text{Child's dose} = \frac{\text{Age of child}}{\text{Age} + 12} \times \text{adults dose}$$

- The pediatric and adolescent dose is usually given for infants and children weighing less than 40 kg or 88 lb. When the child is more than that weight, an adult dose may be used.

Using Body Surface Area for Dosage Calculations

When child dose is not known, but the adult dose is known, this formula can be used for calculation of pediatric dosage.

$$\text{Child body surface area in m}^2 = \frac{\text{Child dose} \times \text{Adult dose}}{1.7}$$

The body surface area can be calculated either by formula given below or by using **normogram**.

Body surface area (in m ²)	
0-5 kg	0.05 × body wt (kg) + 0.05
6-10 kg	0.04 × body wt (kg) + 0.10
11-20 kg	0.03 × body wt (kg) + 0.20
21-30 kg	0.02 × body wt (kg) + 0.40

Commonly used analgesics in pediatric dentistry

Drug	Mechanism of action	Uses	Doses	Contraindication	Side effects
Ibuprofen	It inhibits prostaglandin synthesis by interfering with cyclooxygenase enzyme	Mild to moderate pain	10-15 mg/kg/day in divided doses	Asthma, peptic ulcer, severe renal failure Hypersensitivity	Nausea, vomiting, cholestatic jaundice, peptic ulcer, nephrotoxicity
Diclofenac sodium	It also inhibits prostaglandin synthesis by interfering with cyclo-oxygenase enzyme	Moderate pain	1-3 mg/kg/day in divided doses	Hypersensitivity, bronchial asthma, peptic ulcer	Cholestatic jaundice, dry mouth. Blood dyscrasias, nephrotoxicity, broncospasm

Contd...

Contd...

Drug	Mechanism of action	Uses	Doses	Contraindications	Side effects
Nimesulide	This drug inhibits selectively prostaglandins synthesis and inhibits platelets activating factor, tumor necrosis factor, metalloproteases	Mild to moderate pain	5 mg/kg/day in 2 divided doses	Hypersensitivity, pregnancy, lactation, renal failure	Allergy, gastric bleeding in active peptic ulcer patients.
Paracetamol	Inhibits prostaglandins synthesis by inhibiting cyclooxygenase enzyme	Mild pain	14 mg/kg, QID	Jaundice, analgesic nephropathy	Acute toxicity, hepatic failure, methemoglobinuria, nausea, vomiting, epigastric distress.
Aspirin	It also inhibits prostaglandins synthesis	Mild pain	30-65 mg/kg at 4 to 6 hours interval	Gastric and duodenal ulcers, hepatic and renal disease, patients on anticoagulant therapy, children less than 12 years	Hypersensitivity, epigastric distress, asthma, nausea, vomiting, tinnitus, vertigo.

Commonly used antibiotics in pediatric dentistry

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
Penicillin V (Phenoxymethyl Penicillin)	Bactericidal, acts by interfering the synthesis of bacterial peptidoglycan cell wall it is gastric acid stable, so suitable for oral use	To treat mild to moderate superficial infections by highly susceptible organisms Lyme disease Skin infections Following splenectomy for pneumococcal prophylaxis Rheumatic fever prophylaxis (less reliable than intramuscular benzathine penicillin)	Hypersensitivity	*Infant, 60 mg, QID. *Children 125-250 mg, QID. *Syrup-125 mg/5 ml. QID orally	Same as benzyl penicillin
Ampicillin	Extended spectrum penicillin Bactericidal, interferes with cell wall mucopeptide synthesis. Stable in presence of gastric acid Inactivated by penicillinase producing organism (these bacteria are resistant to ampicillin)	Infections caused by susceptible Gram-ve and Gram+ve organisms (respiratory tract infections, soft tissue infections, gonococci, genitourinary infections and gastroenteritis) Cholecystitis Septicemia Meningitis Salmonellosis	Hypersensitivity infectious mononucleosis	*Children 25-50 mg/kg/day *125-250 mg/5 ml, dry syrup. *100 mg/ml pediatric syrup	Decreased dose needed with Probenecid. Synergistic effect with clavulanic acid Bacteriostatic agents (erythromycin, tetracycline) when used with Ampicillin may reduce its potency Beta-blockers: Ampicillin may reduce bioavailability of atenolol.

Contd...

Contd...

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
Cloxacillin	It acts on penicillinase resistant beta lactam bacteria Bactericidal, acts by interfering with synthesis of bacterial peptidoglycan cell wall	Useful against penicillinase producing staphylococci (Gm+ve) soft tissue infections Burns, Mastitis, Osteomyelitis, Tonsillar abscess, Pneumonia Endocarditis (Staph.) Prophylaxis against surgical infections	Hypersensitivity to penicillin Jaundice in neonates	*50 to 100 mg/kg/24 hr divided into every 6 hrly.	Food interferes with absorption of Ampicillin, so Ampicillin should preferably be taken on empty stomach Probenecid increases blood level of cloxacillin Erythromycin, tetracycline, chloramphenicol antagonize the bactericidal effect of penicillin Clavulanic acid: synergism Loss of potency of cloxacillin solution is reported with erythromycin, gentamicin, kanamycin, chlorpromazine, vitamin C and polymyxin sulphate Acetylsalicylic acid inhibits serum protein binding of cloxacillin, thereby increasing its concentration.
Amoxicillin	Broad spectrum bactericidal, inhibits bacterial cell wall synthesis active against many Gram-positive and Gram-negative microorganisms Less incidence of diarrhea as compared to Ampicillin Stable in presence of gastric acid	Infections caused by susceptible organisms Biliary tract infections Bone and joint infections, Bronchitis Bronchiectasis, Endocarditis Gonorrhea Infections of oral cavity Otitis media Pneumonia, Enteric fever Urinary tract infections Peptic ulcer (<i>H. pylori</i>) Listerial meningitis	Hypersensitivity to penicillin	*Children 20-50 mg/kg/24 hr divided every 8 hrly × oral	Decreased dose may be needed with Probenecid Erythromycin, tetracycline reduce efficacy of amoxicillin

Contd...

Contd...

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
Cephalexine	First generation oral cephalosporin Bactericidal, inhibits bacterial cell wall synthesis Less active against penicillinase producing <i>Staph aureus</i> .	Respiratory tract infections, sinusitis, otitis media Skin and soft tissue infections Genitourinary infections ENT infections Dental infections	Hypersensitivity to penicillin	25-100 mg/kg/24 hr × Oral to be divided every 6-8 hrly	Probenecid increases cephalexin blood level. With aminoglycosides, increased risk of nephrotoxicity
Cefazolin	Bactericidal, inhibits bacterial cell wall synthesis Active against <i>S. aureus</i> , <i>Streptococcus</i> , <i>E.coli</i> , <i>Klebsiella</i> , <i>Proteus</i> .	Surgical prophylaxis Infection of genitourinary tract Infection of bone and joint Skin and soft tissue infections Biliary tract infections Respiratory tract infection (lung abscess, empyema) Endocarditis Liver abscess	Hypersensitivity to cephalosporin Pseudo membranous colitis Premature newborn Porphyria	*Children 50-100 mg/kg/24 hr × IV/IM to be divided every 8 hrly	With aminoglycosides (gentamicin, tobramycin): Nephrotoxicity of aminoglycosides potentiated. Bacteriostatic agent like chloramphenicol decreases efficacy of cefazolin. Probenecid slows tubular excretion and enhances efficacy of cefazolin. Furosemide: Potentiate nephrotoxicity.
Cefadroxil	Bactericidal, inhibits bacterial cell wall synthesis Active against <i>S. aureus</i> , <i>Streptococcus</i> , <i>E. coli</i> , <i>Klebsiella</i> , <i>Proteus</i> .	Soft tissue and infections caused by <i>Staphylococcus</i> or <i>Streptococcus</i> Pharyngitis caused by Group A beta hemolytic streptococci, Otitis media Urinary tract infections caused by: <i>E. coli</i> , <i>Proteus</i> , <i>Klebsiella</i> , Osteomyelitis	Hypersensitivity	*Children 30 mg/kg/24 hr × Oral to be divided every 12 hrly	
Cefaclor	II generation cephalosporin bactericidal, inhibits bacterial cell wall synthesis Cefaclor is active against <i>S. aureus</i> , <i>Streptococcus</i> , <i>Pneumococcal</i> , <i>H. influenzae</i> , <i>E.coli</i> , <i>Klebsiella</i> , <i>Proteus</i> .	Respiratory tract infection (URTI and LRTI) Ear, nose and throat infections Skin infections (cellulites, pyoderma, impetigo, subcutaneous abscesses) Traumatic and surgical incision wound UTI (cystitis, pyelonephritis)	Hypersensitivity to penicillin	*Children 20-40 mg/kg/24 hr × Oral to be divided every 8-12 hrly	Aminoglycosides: nephrotoxicity of aminoglycosides potentiated Probenecid: Slow tubular excretion and this enhances efficacy of cefaclor Furosemide: potentiates nephrotoxicity of cefaclor

Contd...

Contd...

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
Cefixime	Oral III generation cephalosporin Bactericidal, inhibits bacterial cell wall synthesis. Highly active against <i>enterobacteriaceae</i> , <i>H. influenzae</i> , <i>Strep. pyogenes</i> , <i>Strep pneumoniae</i> and is resistant to many β lactamases No anti-staphylococcal or anti-pseudomonal activity	Respiratory tract infection Otitis media, Pharyngitis Tonsillitis, Bronchitis Biliary tract infection UTI, Uncomplicated gonorrhea	Hypersensitivity to penicillin	Usual Dose: 8 mg/kg/ 24 hr $\times$ Oral to be given in single or two divide doses Enteric fever 8 mg/kg/24 hr once/twice in a day	Synergistic action with aminoglycosides Decrease dose with Probenecid, furosemide and aminoglycosides
Ciprofloxacin	First generation fluoroquinolone bactericidal, inhibits bacterial DNA gyrase. Spectrum includes both Gram-negative and Gram-positive bacteria (most susceptible are Gram-negative bacilli) (<i>Pseudomonas</i> is moderately susceptible to ciprofloxacin) High tissue penetrability. Does not effect anaerobes in GIT-diarrhea is infrequent. Active against Gram-negative bacteria, specially coliforms	UTI, LRTI, Bacterial diarrhea Skin and soft tissue infections Bone and joint infections, Septicemia Intra-abdominal infections, enteric fever Ciprofloxacin to be used in children with caution. Use only when benefits clearly exceed risks	Hypersensitivity	* Children Oral dose: 15-30 mg/kg/ 24 hr $\times$ oral to be divided every 12 hrly	Theophylline warfarin: Plasma concentration increased by ciprofloxacin. NSAID:CNS toxicity may occur Antacid, sucralfate: Interfere with ciprofloxacin absorption Iron: Decreased absorption of ciprofloxacin with oral iron preparations Rifampicin: Decreases serum concentration of ciprofloxacin Chloramphenicol: antagonizes effect of ciprofloxacin
Norfloxacin	First generation fluoroquinolone Bactericidal, inhibits bacterial DNA gyrase Metabolized as well as excreted unchanged in urine (very effective in genitourinary tract infections)	Urogenital infections Acute bacterial gastroenteritis Enteric fever Prophylaxis against sepsis in neutropenic patients	Hypersensitivity	Oral dose: 10-15 mg/kg/24 hr to be divided 12 hrly	Theophylline: increased plasma level of theophylline Oral anticoagulants: enhanced effect of oral anticoagulants Antacids: Interferes with absorption of norfloxacin

Contd...

Contd...

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
Ofloxacin	First generation fluoroquinolone Bactericidal, inhibits bacterial DNA gyrase	Enteric fever Urinary tract infections Respiratory tract infections Gastrointestinal infections Skin and soft tissue infections Reinforcing II line ATT Peritonitis	Hypersensitivity	*Children Oral dose: 15 mg/kg/24 hr divided 12 hrly	Oral anticoagulants: the effect of anticoagulant may be increased Theophylline: increased plasma level of theophylline resulting in toxicity NSAID: CNS excitation may occur. Antacids containing magnesium and aluminum reduce absorption of ofloxacin Sucralfate reduce absorption of ofloxacin
Gatifloxacin	Second generation fluoroquinolone Bactericidal, inhibits bacterial DNA gyrase Broad spectrum, enhanced Gram-positive activity with some anaerobic coverage	Acute bacterial exacerbation of chronic bronchitis Acute sinusitis Community acquired pneumonia Urinary tract infection (complicated/Uncomplicated) Acute pyelonephritis	Hypersensitivity and pregnancy	* Children 10 mg/kg/24 hr Oral × single dose	Antacids, ferrous salts, sucralfate, bismuth subsalicylate, zinc salt reduce bioavailability of gatifloxacin Digoxin: Gatifloxacin increases plasma level of digoxin
Erythromycin	Macrolide antibiotic Bacteriostatic, binds to 50 S ribosomal subunit of bacteria and inhibits protein synthesis It is an alternative to penicillin, if patient is allergic to penicillin	Whooping cough, Diphtheria Acute bacterial pharyngitis, tonsillitis, sinusitis, otitis media, mastoiditis, epiglottitis Cellulitis/carbuncle/pyoderma Legionnaire's disease Infected eczema, Acne vulgaris, Wound and burn infections, impetigo unresponsive to topical antibiotics and in folliculitis	Hypersensitivity, jaundice	Erythromycin base 30-50 mg/kg/24 hr to be divided every 6-8 hrly × Oral Max dose 2 gm/24 hr	Theophylline: Increased theophylline side effects Carbamazepine: Increased blood levels of carbamazepine Digoxin: Increased blood level of digoxin may lead to digoxin toxicity Antihistamines: e.g. terfenadine, astemizole: Severe QT prolongation, ventricular arrhythmias may occur
Roxithromycin	Macrolide, bacteriostatic, binds to 50 S ribosomal subunit, inhibits bacterial	Upper and lower respiratory tract infections (acute sinusitis, pharyngitis, tonsillitis)	Hypersensitivity	*Children 2.5-5 mg/kg BD	Digoxin: Increase Roxithromycin absorption Terfenadin: Increase half life of

Contd...

Contd...

Antibiotics	Mechanism of action	Indications	Contraindications	Route and doses mg/kg	Drug interactions
	protein synthesis Long acting, acid stable macrolide Less effective in whooping cough as compared to erythromycin	Acute bronchitis Pneumonia Skin and soft tissue infections			roxithromycin Disopyramide: Displaced from protein bound sites Ergotamine derivatives: Possible provocation of arterial spasm leading to ischemia when administered with ergotamine or its derivatives.
Metronidazole	5-nitroimidazole derivative Bactericidal, causes cytotoxicity to bacteria probably by damaging DNA Highly effective for treatment of anaerobic infections Onset of effect within few hours (full benefit may take 24-48 hrs)	Prevention and treatment of infections due to anaerobic bacteria (Bact, fragilis, <i>Fusobacterium</i> , <i>Clostridium perfringens</i> and anaerobic <i>streptococcus</i> and also <i>H. pylori</i>) in anaerobic infections Such as: Colorectal/pelvic surgery Appendectomy Osteomyelitis, Tetanus Abscess of brain or lung Also have cidal activity against protozoa Giardia, Entamoeba, Trichomonas Ulcerative gingivitis Dental infection	Hypersensitivity Active CNS disease Blood dyscrasias Sever hepatic failure	* Children 30-50 mg/kg/ day divided into 6 hourly anticoagulants	Phenobarbital and Phenytoin: Increased metabolism of metronidazole resulting in decreased efficacy Enhances action of warfarin and other coumarin Alcohol: A disulfiram like action Cimetidine: Decreased metronidazole metabolism.
Ornidazole	5-Nitroimidazole derivative antibacterial Active against protozoa and anaerobic and anaerobic bacteria. It is similar to metronidazole expect that it has much longer half life as compared to metronidazole, which is of particular advantage as dosage frequency and duration of therapy are reduced. Onset of effect Peak plasma level-2 hrs	Giardiasis, Amoebiasis Amoebic dysentery Treatment of anaerobic infections Trichomoniasis Bacterial vaginosis	Hypersensitivity	Giardiasis 40 mg/kg single dose × Oral for 2 days Amoebic dysentery: 40 mg/kg single dose/day × Oral for 3 days Amoebiasis 25 mg/kg single dose × Oral for days	Oral anticoagulants: increased risk of hemorrhage

Dental Injuries and their Management

INTRODUCTION

Traumatic injuries of the dentoalveolar region include injuries of the teeth and associated surrounding soft and hard tissues. Young children are often faced this type of injuries which are tragic but often are an ignored problem. Children with injuries to their anterior teeth, and their concerned caretaker/parent present a challenge for the Pedodontist that is often worse than anything else like it. There is perhaps no single dental injury that has a greater psychological impact on both the parents and child than the fracture or loss of child's anterior tooth especially if the injuries involve an extensive loss of tooth structure.

Etiology

There are following common causes of child's dentoalveolar injuries:

- Fall
- Accidents
- Sports
- Battered child (This is a tragic cause of injury to the young child who has suffered from serious physical abuse. There is a difference between injuries history provided by the parent and obtained injuries finding. This is also known as battered child syndrome).

Predisposing Factors

1. Children with convex profile like:
 - a. Increased over jet with protrusion of upper incisors
 - b. Angle Class II division I
 - c. Angle Class I.
2. Children with cerebral palsy lead to abnormal muscle tone and poor skeletal and muscular coordination.

3. Epileptic patient
4. Dentinogenesis imperfecta.

Clinical Evaluation

Clinical evaluation begins with history from the parent/patient followed by thorough systematic physical examination. Evaluation of child with maxillofacial injuries is often difficult and requires both patience and sympathy for patient who is suffering from injuries.

Dental History

History taking and examination leads to diagnosis. Personal data includes, name, age, sex and address of the patient. History of trauma includes following questionnaires:

1. When injury did occur?
 - Since time lapse between injuries and treatment influences the prognosis.
 - Place of injuries indicate need of prophylactic antitetanus toxoid and antibiotic prophylaxis.
2. How injury did occur?
 - Nature of accident can yield valuable information about type of injuries.
 - Any treatment given elsewhere or not. If yes, then what?
 - History of previous injury-repeated teeth injuries may influence vitality of the pulp.

Medical History

Brief medical history is essential before starting treatment. For example history of:

- Allergic to medication
- Bleeding disorder

- Cardiac disorder
- Epilepsy
- Liver or kidney disease.

Examination of Maxillofacial Injuries

An adequate clinical maxillofacial examination of entire injured area after cleaning all debris and blood. This examination is meant for:

- Area and nature of pain.
- Presence/absence of bony crepitation.
- Area of paresthesia or anesthesia.
- Mandibular opening.
- Tooth examination for presence of fracture or pulp exposures.
- Tooth displacement, mobility of teeth.
- Abnormalities in occlusion.

Radiographic Evaluation

A radiographic evaluation of maxillofacial injuries reveals bony fracture and helps in diagnosing and clinical suspicion of the lesions. For fracture of the dentoalveolar region, the commonly used radiographs are:

1. IOPA (intraoral periapical) X-ray
2. Orthopantomogram (OPG).

Tooth Vitality Test

Following tooth vitality test are done for the injured tooth:

- Heat test with gutta-percha
- Carbon dioxide snow
- Electric pulp tester
- Ethyl chloride.

Special Tooth Vitality Test

1. Mechanical vitality test for example-
 - Test cavity
2. Other diagnostic tools, for example-
 - CT scan
 - MRI (magnetic resonance imaging)
 - Laser Doppler flowmetry
 - Pulse oximetry.

Treatment Plan

1. Emergency care by:
 - A. *Initial contact:* Initially, parent should be discussed emergency care with Pedodontist by telephonic conversation. Dental surgeon tries to make less

severe the anxiety of caller after a brief history. Pedodontist should provide especial instruction about avulsed tooth.

- B. *Parent management:* The injured child's parent may be in hysterical or nervous condition. Dental surgeon should communicate with child's parent to alleviate their nervous condition.
2. Intermediate treatment: This treatment helps in alleviating pain and other concerns of patient till a permanent restoration can be made.
 3. Permanent procedure: This includes the final restoration of the injured tooth.

ELLIS AND DAVEY CLASSIFICATION OF TOOTH FRACTURE

Class I: Simple fracture of the crown involving little or no dentin.

Class II: Extensive fracture of crown involving considerable dentin but not the dental pulp.

Class III: Extensive fracture of the crown involving considerable dentin and exposing the dental pulp (Fig. 32.1).

Class IV: The traumatized teeth becomes nonvital with or without loss of crown structure.

Class V: Teeth lost as a result of trauma.

Class VI: Fracture of the root with or without a loss of crown structure.

Class VII: Displacement of the tooth without fracture of the crown or root.

Class VIII: Fracture of the crown en mass and its replacement.

ELLIS CLASS I FRACTURE AND ITS MANAGEMENT

In this class usually only enamel part of tooth are chipped off. It often occurs in central portion of incisal edge or incisal proximal angle. The great danger in these apparently benign fractures lies in underestimation of possible deleterious effect of concussion of pulp.

Objective of treating enamel fracture are:

- Removal of any discomfort
- Maintaining vitality of pulp
- Restoration of fractured crown.

Clinical Features

Tooth is usually asymptomatic. Sometime sensitivity can be reported.

Management

1. *Reattachment of the fractured tooth segment:* The fractured segment can be esthetically restored by reattaching it with the help of dentin bonding agent and composite resin.
2. *Recontouring of the fractured enamel:* Sharp edges of the fractured tooth are rounded off as a prophylactic measures to reduce stress and to help to prevent again fracture of tooth. This can be accomplished by shortening the adjacent central incisors and reshaping both the teeth to a symmetrical outline.
3. Fluoride varnish is applied to prevent sensitivity.
4. Missing tooth structure can be restored by using an acid etch technique with composite resin, if the lost structure is more.

Note: Various observations are done at different time interval during the course of Class I fracture treatment.

1. **Pulp vitality:** Vitality test should be performed at the time of treatment and are repeated after every 6 to 10 weeks. Discolorations of tooth may indicate loss of vitality.
2. **Radiograph:** To check for the development of any periapical pathology. Radiograph is repeated after 6 to 8 weeks.

ELLIS CLASS II FRACTURE AND ITS MANAGEMENT

In this class, there is a horizontal or diagonal fracture line usually involving considerable amount of dentin and incisal proximal angle without pulp exposure. An emergency treatment is necessary to protect already traumatized pulp from further insult by placing a dentin stimulating layer of calcium hydroxide overexposed dentin. To insure that calcium hydroxide dressing is retained until the pulp has retreated from proximity of fracture and adequate layer of secondary dentin has formed, a suitable retainer in the form of orthodontic band, adhesive sealing, celluloid crown, or stainless steel



Fig. 32.1: Right and left maxillary central and left lateral incisors shows Class I, II and III fracture respectively



Fig. 32.2: Right, left, central and left lateral fracture incisors were restored with composite restoration (pre- and postoperative photograph)

crown may be employed. After secondary dentin formation, composite restoration or permanent esthetic restoration can be done.

Retainer of $\text{Ca}(\text{OH})_2$ dressing over fractured tooth:

1. Orthodontic band
2. Celluloid crown
3. Stainless steel crown
4. Adhesive sealing (Fig. 32.2).

Secondary dentin formation can be insured by 4 to 6 weeks interval of repeated radiograph. Permanent esthetic restoration can be done over fractured site if secondary dentin has been formed.

ELLIS CLASS III FRACTURE AND ITS MANAGEMENT

A careful clinical diagnosis with the help of subjective pain symptoms and radiograph should be made to determine the exposure of pulp. The treatment of Ellis Class III fracture will depend on number of factors like:

- Size and location of the pulp exposure
- Pulp contamination depending on duration of pulp exposure
- Pulp vitality
- Stages of root development.

In cases of pulp exposure, following pulp therapy may be undertaken:

1. Direct pulp capping through $\text{Ca}(\text{OH})_2$ and MTA
2. Pulpotomy and apexogenesis through $\text{Ca}(\text{OH})_2$ and MTA
3. Apexification through $\text{Ca}(\text{OH})_2$ and MTA.

Direct pulp capping: Dressing of the exposed pulp involves placing the hard anhydrous setting calcium hydroxide cement over the exposed pulp. Direct pulp capping is indicated in following condition:

- Size of pulp exposure is less than 1 mm
- Duration of pulp exposure is less than 24 hours
- Pulp showed minimal bleeding
- Wide open root apex or normal apex.

Pulpotomy: It can be defined as removal of the inflamed coronal pulp and healthy radicular pulp helps in physiological root end development and formation. This phenomenon is known as apexogenesis. The indications of pulpotomy are:

- Relatively large pulp exposure
- Duration of pulp exposure is within 72 hours
- Pulp showed moderate bleeding.

An incisor with an incomplete root is a good candidate for the above procedure because of better reparative potential of young pulp and because of the difficulty in performing conventional endodontic procedure.

Procedure

1. Adequate local anesthesia is administered.
2. Injured tooth is isolated with rubber dam.
3. A conventional access is prepared by using a sterile round bur and roof of the pulp chamber is removed.
4. A sterile sharp spoon excavator is used to remove the coronal pulp.

5. Control the pulp bleeding.
6. Place layer of anhydrous $\text{Ca}(\text{OH})_2$ over pulp stump.
7. A composite resin restoration can be placed to restore esthetic and function. After apical closure has occurred, RCT of the tooth should be performed and crown form restored.

Restorative Treatment

Various restorative treatment options for the treatment of Class II and III fracture include:

- **Pin retained composite restorations:** These restorations can be utilized in Class II and III fracture. It can be placed in one sitting and can be esthetically satisfactory. This type of restoration is economical and requires minimal tooth preparation. In this technique, pins are placed in holes drilled in dentin which serve to retain composite restoration.

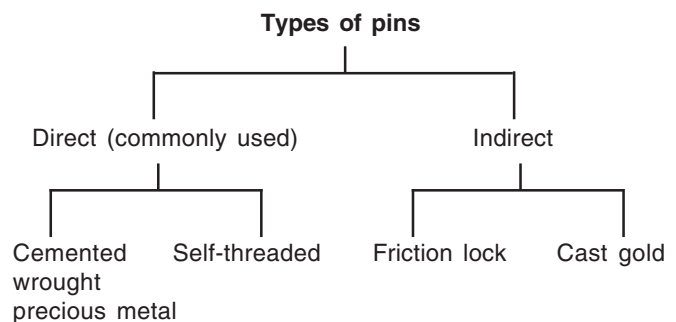
Advantages

- a. Minimal tooth preparation
- b. Less time consuming
- c. Less expensive.

Disadvantages

- a. Induces stress in dentin
- b. Chances of pulp perforation
- c. Chances of microleakage exist.

TYPES OF PINS (Table 32.1)



Cemented Pins

Cemented pins are smaller than their pin holes so they are likely to be seated to the full depth of hole. Since, they are passively retained in the dentin so they virtually place no stress on the surrounding dentin. Cements are

used to hold the tooth in pin holes and it reduces the chances of microleakage.

Disadvantages

- It offers less retention as compared to other types of pins.
- It is difficult to insert cement into the pinhole.
- Poorly cemented pins are easily dislodged.
- More time consuming as compared to other pin system.

Self-threaded Pins

Advantages

- Easy of insertion.
- Maximum retention is offered.

Disadvantages

- Excessive craze is developed in the form of craze lines.
- Pins may need to be bent, cut before insertion.
- Pins may fail to seat.
- Microleakage is higher.

Friction Lock Pins

Advantages

- Cement is not required.
- Pins acquire stability from the time of insertion.
- Retention is better than cemented pins.

Disadvantages

- Length of pins is judged by trial and error.
- Bending of pins leads to further stresses.
- Pins may not reach the full depth of channels.
- Microleakage is higher than cemented pins.

Tooth preparation: Loose enamel rods or an external bevel along the line of fracture are removed with fine diamond bur or disk. The remaining cavosurface margin of the fracture is left as rough as possible to aid in retention of restorative materials.

- Two holes are drilled approximately 2 mm into the dentin. Before digging holes proper evaluation is done about relative positions of pulp chamber by means of IOPA X-ray.
- Holes are drilled in such a way that the pins are at least 1 mm from labial surface in order for the pin to be masked by restorative material.
- The distance between two pins should be at least 5 mm.
- Holes are drilled with above mentioned diameter drill (cemented pins) and cemented pins of respective company will be fitted in to the prepared holes with the GIC or zinc phosphate cement.
- The pins are positioned such a way that it will lie at least 1 mm from labial surface and 1 mm below the incisal edge.
- After cement hardens, the excess cement is removed and calcium hydroxide is placed over dentin. Placement of restoration depends upon operator's choice of restorative material.

Reinforced crown along with core: After accomplishing therapeutic part and temporary restoration of Class III fracture, the temporary restoration may be replaced by more permanent one. In Class III fracture there is an extensive loss of coronal part of crown, a jacket crown is usually indicated.

If the remaining part of the crown is insufficient to support a fabricated crown, it may require building up the core or reinforced post core crown. The core upon which the jacket crown may ultimately rest may be built with pins and amalgam.

Porcelain veneer full gold crown: From esthetic and durability stand point of view, the porcelain veneer full gold crown is very satisfactory. In children when some pulpal recession has occurred in the vital tooth and the gingival tissues level is not unduly coronal.

Modified three quarter crown: This restorations is indicated when loss of tooth structure is more than 1/3rd area of crown. This can be used as temporary permanent restorations. Gold three quarter crown have

Table 32.1: Different pin system specification

Pin type	Pin diameter (inches)	Drill diameter (inches)	Manufacturer
Cemented	1. 0.0018	1. 0.021	1. EA beck, calif 2. K and R dental product, Philadelphia 3. 0.025
	2. 0.022	2. .024	
Self-threaded	0.023	0.021	Whaledent, brooklin, NY Unitech, calif
Friction lock	0.022	0.021	

the advantage of requiring minimal removal of tooth structures. However, this is less esthetic as compared to full gold crown.

Full acrylic crown: This is a temporary type of restoration. The main disadvantage of this restoration is exposure of cervical margins as the gingival level changes and does not provide appropriate esthetics.

ELLIS CLASS IV FRACTURE AND ITS MANAGEMENT

Ellis Class IV fracture is characterized by fracture of crown with nonvital pulp. The therapeutic management of this class is done by conventional root canal treatment or pulpectomy (closed root apex), apexification (nonvital pulp with open root apex) and restorative treatment by, reinforced crown along with core, porcelain veneer full gold crown, modified three quarter crown and full acrylic or porcelain crown.

Pulpectomy: Complete removal of pulp is known as pulpectomy. Indications of this procedure are:

1. Degenerated pulp
2. Pulp exposure greater than 72 hours, after fracture of crown
3. Questionable pulp vitality.
 - This is a method of choice when a tooth with a closed apex is non vital. Anesthetize and isolate the tooth, prepare conventional access and extirpate the pulp completely. Mechanically cleanse, prepare and obturate the canal with gutta-percha and root canal sealer. The crown form can be restored after completing this procedure by above mentioned restorative methods.

Apexification

It is a procedure of inducing apical closure by the formation of osteocementum or similar hard tissues of the roots of an incompletely formed nonvital tooth. Since, immature nonvital permanent teeth have a blunder buss root apex that makes canal. Obturation by a non-surgical approach or orthograde filling difficult or impossible.

Procedure

1. Anesthetize and isolate selected tooth.
2. Prepare conventional access and extirpate the necrotic pulp.

3. Instrument the canal 0.5 mm short of the radiographic apex.
4. Irrigate the canal with saline.
5. Fill the canal with $\text{Ca}(\text{OH})_2$ and camphorated monochlorophenol.
6. Seal the canal with zinc oxide eugenol/IRM.
7. The dressing should be changed every 3 months and radiograph is obtained to check the completion of apexification.
8. If apical closure has been completed, reopen the canal and obturate with conventional endodontic procedure.
9. The other material used for apexification procedure is mineral trioxide aggregate.

Uses of mineral trioxide aggregate:

1. For root end filling (apexification)
2. Root perforation repairs
3. As a pulp capping.

• Composition of MTA

- Tricalcium silicate and Tricalcium aluminate
- Tricalcium oxide and silicate oxide
- Bismuth oxide as a radio opaquer.

Note: Electroprobe analysis of MTA powder showed that calcium and phosphorus are the main ions present in this material.

- Mineral trioxide aggregate having great value in dentistry. It is commercially available as pro-root MTA. It has high pH, similar to calcium hydroxide. MTA helps in tissues repair similar to repairs seen with calcium hydroxide. MTA provides a hard setting resorbable surface with cavity adaptation comparable to super EBA.

Properties of MTA

1. MTA has high pH similar to calcium hydroxide cement which helps in induction of hard tissues.
2. The sealing ability of MTA is superior to that of amalgam.
3. It is not adversely affected by blood contamination.
4. MTA in contrast with Periradicular tissues forms fibrous connective tissues and cementum, causing only low levels of inflammation. The regeneration of new cementum over MTA is a unique phenomenon that has not been reported with other root end restorative materials.

Mechanism: MTA possibly activate cementoblast to produce a matrix for cementum formation. This might

be caused by its root end sealing ability, its high pH and the release of substances that activate cementoblast to lay down a matrix for cementogenesis.

Advantages

- Highly biocompatible.
- Least toxic among all root end restorative materials.
- Hydrophilic (water loving).
- Radiopaque.

Disadvantages

- MTA manipulation is difficult
- Long setting time.

MTA manipulation technique for root end restoration: After exposing the root apex, the cavity is prepared on it by ultrasonic machine. The surrounding bony crypt should be packed with a sterile pellet and exposing only the root end cavity.

MTA mixing: To prepare the MTA, a small amount of liquid and powder are mixed to putty consistency, because MTA mixture is a loose granular aggregate, it does not stick very well to itself or to any instrument. MTA is carried with amalgam carrier to the prepared root end cavity.

Once the MTA is placed into the prepared root end cavity, microball burnisher and microplugger are used to gently condense it. A small cotton pellet is used to slowly and gently clean the resected root surfaces and to remove any excess MTA from the root end.

Note: The bony crypt surrounding the root end should not be irrigated after placing the MTA to avoid washing it out.

MTA for Root Perforation

- MTA have excellent biocompatibility and can be used as a nonresorbable root end barrier and restorative materials.
- It is a established facts that MTA is material of choice for root perforations repairs.
- MTA can be used as the sole restorative radicular material or can be used as a barrier against which to pack other materials.

MTA as pulp capping agent: Excellent result have been reported with MTA as a pulp capping agent.

Advantages

- It is a biocompatible pulp capping agent
- It significantly produces more dentinal bridging in a shorter period of time
- Dentin deposition also began earlier
- Prevents microleakage.

Disadvantage

- 3 to 4 hours are needed for MTA setting.

ELLIS CLASS V FRACTURE AND ITS MANAGEMENT

In Ellis Class V fracture, there is complete loss of teeth as a result of trauma or an unfavorably crown or root fracture may necessitate extraction.

Treatment

If tooth socket is healed—RPD, bridge fabrication or space maintainer.

ELLIS CLASS VI FRACTURE AND ITS MANAGEMENT

These are relatively uncommon type of tooth fracture. The fracture may involve apical, middle or coronal 1/3rd of root.

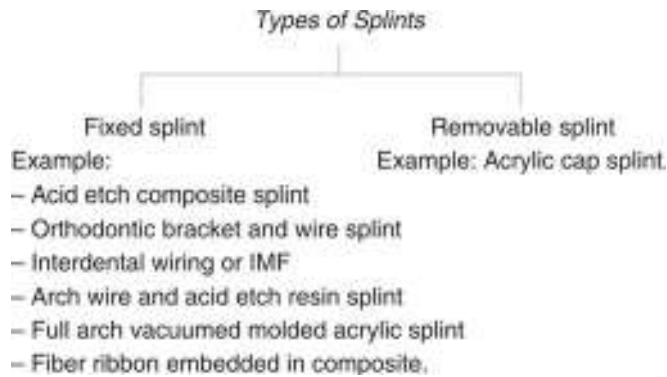
Investigations and Management

- Pulp vitality test
- Radiograph to check the location of fracture site.

After radiographic and clinical assessment, these teeth are usually subjected to digital reduction under local anesthesia. After reduction check the occlusion and fractured tooth stabilized by splinting.

Functions of splinting: (Splinting period 2 to 3 months for root fracture).

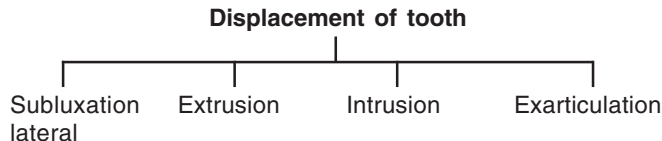
- Immobilize the loose tooth
- Hold the stabilized teeth in established occlusion.
- Protect the damaged tissues from occlusal forces.



Removable splint (Fig. 32.3): It is a removable appliance fabricated in acrylic. It is constructed such that the acrylic extends over the occlusal/incisal surface of the tooth, thereby fixing and stabilizing it.

ELLIS CLASS VII FRACTURE AND ITS MANAGEMENT

Ellis Class VII fracture is characterized by displacement of tooth without fracture of crown or root. Dental displacement injuries can be classified in following ways:



Subluxation and its Management

- No treatment is required, if the tooth is slightly mobile
- The patient is advised to take a soft diet for few weeks
- Healing usually occurs in 1 to 2 weeks
- Tooth is splinted if marked loosening is present.



Fig. 32.3: Fracture of the mandibular bone along with teeth were splinted with removable acrylic splint

Lateral Displacement and its Management

- A laterally displaced tooth should be repositioned into the occlusion with the help of fore finger and thumb under the effect of local anesthesia.
- If the root apex is locked in the bone, the tooth should be extruded slightly before it is repositioned and can be splinted for 2 to 3 weeks. If alveolar fracture is associated with it, splinting should be kept for 4 to 8 weeks.
- Splinting can be fixed or removable, and it provides stability to the displaced tooth in to the occlusion.

Extrusion: A tooth that has been extruded from its socket should be gently but firmly pushed into its original position, check the occlusion and splinted for 2 to 3 weeks.

Intrusion: The traumatized intruded young permanent teeth have potential to reerupt, so they should be left for 3 month to see if it erupts. If it does not erupt, orthodontic extrusion is the choice of treatment (if tooth is not ankylosed).

Exarticulation: Treatment of choice is replantation. This procedure required recall on regular basis for a period of at least 3 years.

REIMPLANTATION (REPLANTATION)

Replantation: It is the reinsertion of a tooth in its socket after its complete avulsion as a result of trauma or accidental extraction (Figs 32.4A to E).

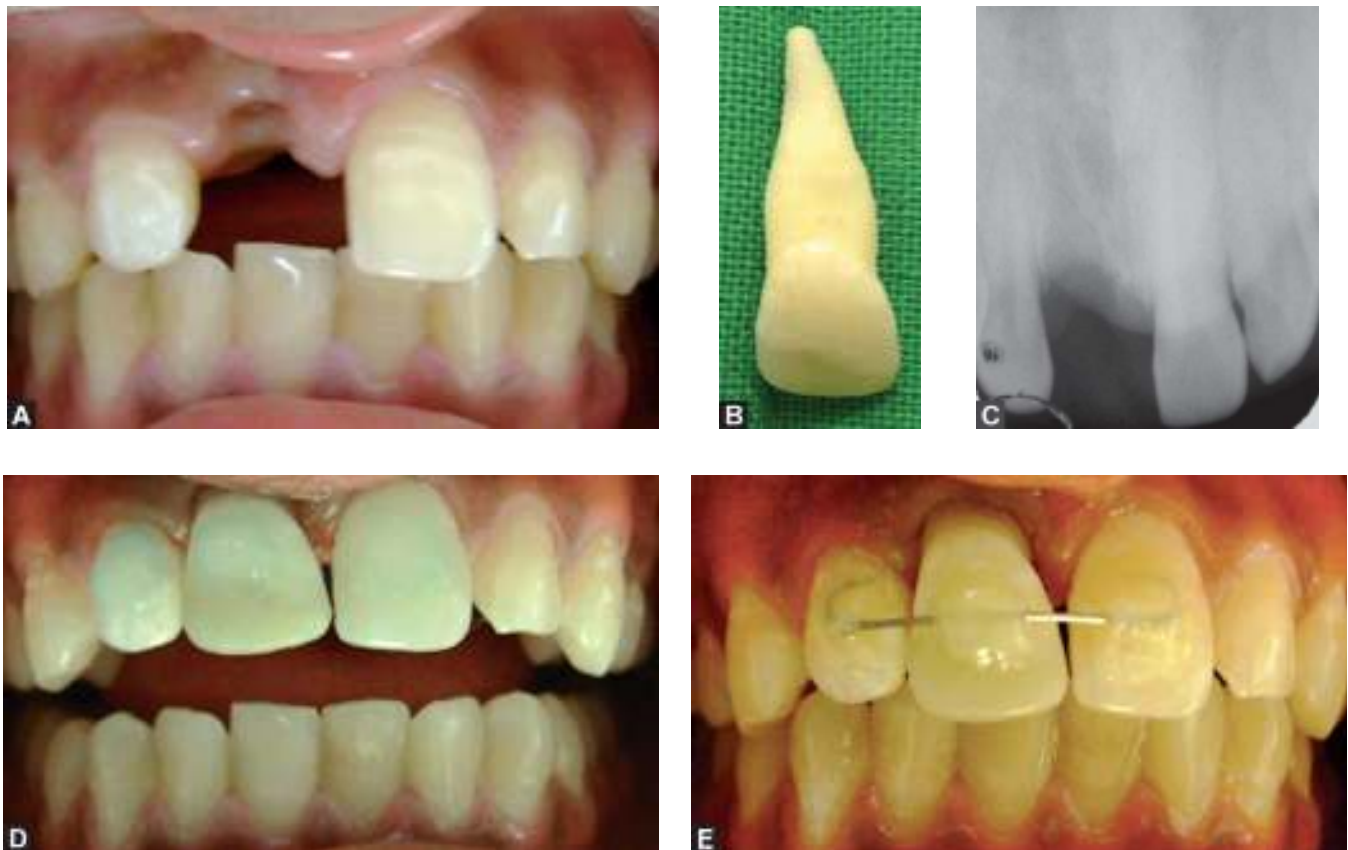
Transplantation: It is the removal of a tooth or tooth bud from one socket and transplanting it into another socket.

a. Autotransplantation: It is the transplantation of the tooth in the socket of the same individual.

b. Allotransplantation: It is the transplantation of the tooth from a socket of one individual and inserting it into another individual.

Intentional replantation: Was defined by Grossman as removal of a tooth and it's almost replacement with the object of obturating the canal apical while the tooth is out of its socket.

Implantation: It is the insertion of an artificial tooth or stabilizer into a surgically prepared socket.



Figs 32.4A to E: Steps of reimplantation in 13-year-old child. Photograph (A) Avulsed tooth, (B) Avulsed tooth outside the mouth, (c) Radiograph of avulsed tooth area, (D) Endodontically treated tooth placed into the original socket and echants were placed on the labial surface of avulsed tooth with neighbor tooth, (E) Composite-wire splint were used to splint avulsed tooth along with adjacent tooth

Use of transport medium for avulsed tooth.

- 1. Hanks balanced salt solution (HBSS):** Composed of sodium chloride, glucose, potassium chloride, sodium bicarbonate, sodium phosphate, calcium chloride, magnesium chloride and magnesium sulfate.
- 2. Viaspan:** It is newly developed storage medium for organ transplantation.
- 3. Saliva:** Patients own saliva is the least transport medium for an avulsed tooth. Tooth may be placed in the patient's mouth under the tongue.
- 4. Milk:** Normal milk can be used as a tooth transport medium.

- 5. Water:** Water is the last resource used as transport medium.

Note: The basic purpose of use of transport medium is to maintain the viability of periodontal ligament (Table 32.2).

Preparation of the Socket

- The socket should be gently aspirated, if a blood clot is present.
- If the alveolar bone has collapsed and may prevent replantation, a blunt instrument should be inserted carefully into the socket in an attempt to reposition the wall.

Table 32.2: Extraoral dry time and preparation of the root surface

Less than 20 minutes, closed apex	Less than 20 minutes, open apex	20 to 60 minutes, closed and open apex both	More than 60 minutes, open and closed apex
1. The chances of pulp revitalization is not possible 2. The chances of periodontal healing is excellent 3. Replant the tooth as soon as possible	1. In open apex, revascularization and continued root development is possible 2. Revascularization of pulp significantly enhanced by soaking the tooth in 1 mg of doxycycline in 20 mg of physiologic saline for 5 minutes before reimplantation. * Doxycycline inhibits bacteria in pulpal lumen and helps in revascularization. Before insertion, tooth is rinsed with normal saline.	1. Some evidence reveals that soaking such teeth in storage medium HBSS for 30 minutes and additional soaking in doxycycline for 5 minutes can reduce chance of ankylosis.* The survival of remaining PDL cell in the periodontal ligament may be improved in this fashion.	1. When root have been dried for more than 60 minutes or more, the PDL cell have died and soaking is ineffective * in these cases, the root should be prepared to be as resistant to resorption as possible * Remove the debris of the root. * Conditioning of root by soaking in citric acid for 5 minutes. * After conditioning, soaking of teeth into 2 percent fluoride for another 5 minutes * After fluoride treatment, teeth put into doxycycline solution for next 5 minutes, then replant the avulsed tooth.

- Socket should not be curetted to maintain the viability of periodontal ligament.

Splinting: A splinting technique should allow slight movement of the tooth during healing. It should be in place for a minimum recommended time period, results in a decreased incidence of ankylosis.

- Semirigid fixation for 7 to 10 days is recommended.
- The acid etch resin and arch wire splint is probably the most commonly used splint for traumatic dental injuries. A passive wire with dia. 0.0015 to 0.030 inch is shaped to the facial aspect of the avulsed tooth and one or two teeth on either side.
- The middle 1/3rd of the facial surface of the teeth is acid etched and light cured with composite resin along with contoured wire to the teeth on either side of the affected tooth.
- After splinting, check the patient's bite for any occlusal immaturity.

Management of Soft Tissues

1. Soft tissues lacerations of the socket gingiva should be tightly sutured and clean the wounds.

Adjunctive therapy: Systemic antibiotic recommended at the time of replantation and prior to the endodontic treatment are effective in preventing bacterial invasion

of the necrotic pulp and therefore subsequent inflammatory resorption.

Recall visit: The recall visit should take place 7 to 10 days after emergency visit, and splint is removed.

Temporary restoration: Coronal access is filled with ZOE or GIC to prevent infection of the canal between visits.

Obturation visit (Table 32.3): This occurs 7 to 10 days after the second visit or in the case of long-term calcium hydroxide therapy, when laminadura is intact.

Replantation resorption: The major cause of failure in replantation of avulsed teeth appears to be resorption of the root frequently followed by ankylosis. There are three types of root resorption:

1. Surface resorption
2. Inflammatory resorption
3. Replacement resorption.

Permanent restoration: After endodontic treatment, permanent restoration in the form of crown should be given to strengthen the weak tooth.

Follow-up Care

Recall patients every 6 months to 3 years to check the resorption and conditions of the obturated canal.

Table 32.3: Endodontic treatment for reimplanted tooth

<i>Tooth with open apex and extra-oral time is less than 60 minutes</i>	<i>Tooth with an open apex and extra-oral time is more than 60 minutes</i>	<i>Tooth with closed apex</i>
• Patient recalled every 3 to 4 week for sensitivity testing and radiographic evaluations for resorption. • At the 1st sign of pathosis, endodontic treatment should be initiated and after disinfection of the root canal an apexification procedure should be completed.	• A chance of pulp revascularization is extremely poor. • An apexification procedure initiated at the second visit	• No chance exists for the pulp revitalization of avulsed teeth. • Endodontic treatment should be initiated at the second visit at 7 to 10 days after replantation. • Root canal thoroughly irrigated and filled with calcium hydroxide and sterile saline. Calcium hydroxide is changed every 3 months within a range of 6 to 24 months

ELLIS CLASS VIII FRACTURE AND ITS MANAGEMENT

Ellis Class VIII fracture is characterized by fracture of crown en mass. Sometimes tooth may be fractured horizontally near the cemento-enamel junction. If the line of fracture is such that restoration of tooth is impossible, extraction is indicated.

But now-a-days, such type of fracture is treated by:

- A gingivectomy is performed first to expose sufficient tooth structure to allow for proper endodontic procedures. It may require to remove a small amount of bone as well.
- Conventional root canal is done and the apical 1/3rd of root is filled.
- A post hole is prepared into the root canal.
- Post and core is fabricated and cemented into the prepared post hole.
- A porcelain jacket crown is cemented over this core.

Post and core: Fractured teeth have always presented challenge to the dentist, as far as reconstruction is concerned. The success of dentist lies in being able to restore badly broken tooth to its maximum biting efficiency. One of the widely accepted techniques involving restoration of endodontically treated extensively carious fractured teeth is fabrication of post and core along with porcelain crown, utilizing the root canal space for anchorage.

Post is the part inserted into the canal space and core is the retentive component that behaves like a prepared crown for placement of retainer.

CRITERIA FOR SUCCESS OF POST AND CORE RESTORATION

Introduction

The restoration of the root canal treated teeth is an important aspect of dental practice involving a range of treatment options of varying complexity. The dental surgeon must be able to predict the probability of restoring such teeth successfully.

Since, endodontically treated teeth become brittle so there is a chance of tooth fracture. There is evidence that these teeth have a reduced level of proprioception, which could impair normal protective reflexes. The successful management requires an assessment of the role of the restored tooth in the overall dentition, the load it will have to bear and the status of the adjacent teeth. Compromised treatments may have to be considered, due to the cost of treatment or patient discomfort.

Suprabony tooth structure: The bulk of suprabony tooth structure is the most critical factor determining the restorative prognosis for a restored root canal treated tooth.

Biologic width: A small space (2.5 mm, average) is required between margins of the crown restoration and the crest of the bone for healthy gingival attachment.

The ferrule effect: The ferrule is the encircling band of cast metal that acts as a reinforcing sleeve around the coronal portion of the tooth. Sorensen and Engelman

define the ferrule effect as 360° metal collar of the crown surrounding the parallel walls of dentin extending coronal to the shoulder of the preparation. The result is an elevation in the resistance form of the crown from the extension of the dentinal tooth structure. 1 mm long ferrule is only effective when the walls are very close to parallel, and allowing for a somewhat rounded transition from ferrule wall to the preparation margins, it seems carefully to accept 2 mm of ferrule length as a minimum clinically.

Need for a Post

Nayer et al have described the use of amalgam as a core, retained in pulp chamber of posterior teeth or extension of amalgam 2 to 4 mm into the canal space (post). This type of post and core is known as Amalgapin.

Endodontically treated teeth require some build up of some sort, if only to close the tooth access preparation and fill the pulp chamber. The retention of the build up is often accomplished by placement of a post which engages tooth structure. The requirement of the post depends upon how much tooth structure is lost and post is required to build up.

Apical seal: Apical seal play an important role in the success of endodontically treated teeth with post and core. 3 to 5 mm gutta-percha should be left apical during post hole preparation. Gutta-percha can be removed by heated plugger or chemically like turpentine oil or chloroform.

Post length: Ideally, the post length extending into the root canal space should equal the length of the crown with adequate apical seal.

Load Experienced by Endodontically Treated and Restored Tooth

Based on the available data, the use of an endodontically treated tooth to support a precision attachment, a distal extension RPD, or cantilever FPD can not be considered highly predictable. In addition, RCT treated teeth to support non cantilevered FPD must be assessed carefully on an individual basis. RCT treated tooth may not be suitable as abutments in individual with a history of bruxism, or those requiring long span fixed bridges.

Principal of Tooth Preparation

During post space preparation, care must be taken to remove minimal tooth structure from the canal. Excessive enlargement may perforate or weaken the root that may split during cementation of post or subsequent function. Studies reveal that teeth with thicker post fractured more easily than those with thinner one.

Root can be compared with a ring. Strength of ring is proportional to the difference between the fourth powers of its internal and external radii.

$$\text{Strength} = r_1^4 - r_2^4$$

r_1 – outer radius
 r_2 – inner radius

Therefore, gutta-percha should be enlarged only enough to enable the post fit accurately yet passive while ensuring strength and retention.

Preparation of coronal tissues: Reduction of coronal part is headed to accommodate a complete crown and removed undercuts from the pulp chamber and internal walls. This may leave less coronal dentine. Every effort should be made to preserve as much of the coronal dentine as possible, because this helps to reduce stress concentration.

Ferrule effect: See above.

Retention form: Dislodgement of the post crown is frequently seen and results from inadequate retention form of prepared root. Post retention is affected by:

1. **Preparation geometry:** More retention is observed in cavity with parallel walls or minimal taper. Parallel sided post are more retentive than tapered post, and threaded post are more retentive because retention is proportional to total surface area.
2. **Post length:** Ideally, post length should be as long as possible without jeopardizing root structure. Most endodontist advocates maintaining 5 mm apical seal during post length consideration. Minimal post length should be equal to the crown length.
3. **Post diameter:** Although, increased post diameter increases retention but it is not recommended because it may unnecessary weaken the remaining root.
4. **Post surface texture:** A serrated or roughened post is more retentive than smooth one.
5. **Luting agents:** Adhesive resin luting agents have the potential to improve the performance of post and

core restoration. Resin cements are affected by eugenol containing root canal sealer which should be removed by irrigation with ethanol or etching with 37 percent phosphoric acid.

Resistance Form

- a. **Stress distribution:** One of the function of post and core is to improve resistance to laterally directed forces by distributing them over a large area as possible. The post design should distribute stresses as evenly as possible. The incidence of radicular fracture increases with use of threaded post as they don't distribute stress concentration during function.
 - The greatest stress concentrations are found at the shoulder, particularly interproximal and at the apex. Dentine should be conserved in these areas if possible.
 - Parallel sided post may distribute stress more evenly than tapered post, which may have wedging effect. However, parallel post generates high stresses at the apex. Sharp angles should be avoided.
- b. **Rotational resistance:** A small groove be made in root canal space that can serve anti rotational groove and may auxiliary pin design incorporated into the metal post.

Types of Post

- Prefabricated posts
- Example:*
- Tapered smooth sided
 - Tapered serrated post
 - Tapered threaded post
 - Parallel smooth sided
 - Parallel serrated post
 - Parallel threaded post
 - Custom made posts.

Techniques for Fabrication of Post and Core

- Direct technique
- Indirect technique.

Direct technique: Post space is lubricated before impression. A plastic dowel is used to take the impression of prepared post space with the help of acrylic resin. After the resin has set, the pattern is removed, if there

are any voids in the acrylic in dowels, soft beading wax is placed in voids and pattern is reinserted in the canal space and remove the acrylic pattern. A core is build up over the post which replaces missing, coronal tooth structure, thereby forms the shape of tooth preparation (within the mouth). The pattern is then invested and cast in metal of preference. Fabricated metallic post and core is cemented into the canal space with the help of GIC or ZnP cement.

Indirect technique: A loose fitting plastic or metal dowel is placed into the prepared canal space. The coronal end of plastic or metal dowel is notched or made rough surface to hold the impression materials. If dowels is too tight in the canal, the impression material will strip away from the dowels when the impression is removed.

Procedure

- Coat the dowel with tray adhesive and lubricate the canal space to facilitate easy removal of impression without distortion.
- Impression material is injected into the canal space with the help of lentulo spiral.
- Dowel is coated with impression material and inserted into the canals. An additional impression material is injected around the tooth and into gingival crevice, and tray with impression material is seated over this inserted dowels.
- Remove the impression and pour in die stone. Remove the die from impression tray.
- Another loose fitting dowel is carefully inserted into die's canal without abrading the internal aspect of canal space. The stone die is lubricated with die lubricant. Molten beading wax is flown over the loose fitting dowel and reinserted into the canal space to form the dowel pattern. Remove the canal pattern and check it for any irregularities. Reinsert the pattern and coronal portion of pattern is completed with inlay wax.
- The complete pattern is sprued and invested into investment material. Metal castings is done, remove the casting, finishes it and cemented into canal space of the tooth with the help of GIC or ZnP cement.

Post and core fabrication with resin based material and reinforcing fibers: This is a newer system for fabrication of post and core. This system eliminates all the

intermediate step of conventional post and core fabrication. It is less time consuming and esthetically satisfactory.

Procedure

- Prepare the canal space of endodontically treated teeth by conventional method.
- Bondable reinforcement ribbon are cut in pieces, each piece was folded over the half of its length and soaked in resin mix.
- Entire length of prepared canal and incisal edge of remaining coronal tooth structure is acid etch with 37 percent phosphoric acid for 15 seconds. Rinsed and the excess water blown away. Bonding agents applied on etched surface.
- The canal space was filled with resin mix. The soaked, folded ribbon strips were inserted into the canal space one after another with the help of blunt ended instruments, till the folded end forms a straight pattern. This results in entire canal space being occupied with bulk of resin strips and surrounded and soaked by composite resin and cured it with the help of light cure machine.
- After filling the canal space, the emerging reinforced fiber from the canal orifice will act as pillar for core build up. Approximately 3 mm height of pillar is required for core build up to replace the lost coronal tooth structure.
- This results in single piece post and core which was bonded on to the root, creating a solid structure without any wedging effect on the root.
- The monobloc tooth and reinforced composite is then prepared in usual fashion to receive a metal free crown.

Primary Tooth Fracture and their Management

Primary Tooth Injuries

- Crown fracture
- Root fracture
- Displacement injuries.

Crown Fracture

- a. Enamel fracture:** Usually no treatment is required. The sharp edges are rounded and smoothened and fluoride application is done. Acid etched composite

may be used to restore the fractured part of crown. If there is considerable loss of tooth then stainless steel crown is indicated.

- b. Enamel and dentin fracture:** A layer of $\text{Ca}(\text{OH})_2$ or GIC liner is applied as soon as possible. This can be covered by composite restoration. 3 to 6 months recall visit is recommended to check the condition of pulp. If a tooth shows nonvital sign then endodontic procedure is recommended.
- c. Fracture with pulp involvement:** If 3/4th root is present then pulpectomy is done. If there is a risk to the developing permanent tooth from periapical pathology, extraction of traumatized teeth is considered.

Root Fracture

Fracture at apical 1/3rd have best prognosis, if the coronal 1/3 is stable. Fracture at middle 1/3rd or cervical 1/3rd results in a mobile tooth and requires extraction.

Displacement Injuries

This is frequent injuries in primary dentition due to resiliency of alveolar bone and short roots of tooth.

- a. Intrusion:**
 - If intruded primary tooth is interfering to the permanent tooth bud, extraction is indicated.
 - Wait and watch strategy may be used; teeth may erupt within 6 months.
 - If ankylosis is observed then extraction is indicated.
- b. Luxation:**
 - If luxation is mild with no risk of tooth avulsion then patient left as such and patient is advised to take soft diet.
 - If tooth is luxated palatally, repositioned with thumb and fore finger and splint it.
 - If improvement is not observed in 2 to 4 weeks then it is extracted.
- c. Extrusion:** If extrusion is slight, the tooth may be left intact and periodic monitoring is done. If there is severe extrusion and loss of vitality then extraction is indicated.
- d. Exarticulation:** Usually discarded but now a days it is reimplanted if it does not hamper the permanent tooth bud.

Complications of Traumatic Injuries of1. *Primary teeth:*

- Failure of eruption
- Color changes
- Infection
- Space loss
- Ankylosis
- Abnormal exfoliation
- Injuries to developing permanent tooth bud.

2. *Permanent teeth:*

- Poor esthetics
- Difficulty in phonetics
- Color changes
- Infection
- Loss of space
- Ankylosis
- Abnormal root development
- Resorption of root
- Loss of alveolar bone support.

Considerations of Maxillofacial Injuries in Growing Patient

INTRODUCTION

Maxillofacial injuries in children are much less common than in adults particularly during the 1st 5 years of life. When child reaches at the age of puberty, the frequency and pattern of such injuries begins to conform to those generally observed in adult life.

The principles involved in the treatment of facial trauma are the same whatever the age of the patient. However, during the treatment of children, the techniques used are necessarily modified by certain anatomical, physiological and psychological factors related to the children. Maxillofacial injuries of children may hamper the normal orofacial development. The facial deformity may results not only from the displacement of the bony structure, but also from impaired growth which is sometimes attributable to the injury.

Incidence

Facial fracture is less common in children than in adults. Recent literature on the incidence of pediatric facial trauma reports that 1.5 to 8 percent of all facial fractures occur in children younger than 12 years, and 1 percent or less of such trauma occurs in children younger than 5 years. Facial fractures are more common in boys than girls.

Hall, et al (1983) found that nasal bone fracture accounted for 46.6 percent, and mandible for 24.2 percent. The condyle is the commonest site for mandibular fracture.

Etiology

Since, parental supervision reduces the risk of serious injuries in preschool children. Although, falls are frequent but it is usually from a small height results less chances of facial fracture. The development of the maxillary antra and other paranasal sinuses are a major factor in increasing the liability of the maxilla and associated bones to fracture. The facial growth continues until about the twentieth year when the incidence of facial fracture equates with that of the adult population. Factors which also enable the children facial fracture less common are:

1. High elasticity of the bone
2. Short thick condyle neck which tends to resist fracture.

Note: Since, the presence of primary and permanent teeth results in a high tooth: bone ratio and it encourages fracture through the developing tooth crypts. The commonest causes of maxillofacial injuries in the children are road traffic accidents, fall, and play. Child sporting and fights are less common cause for facial fracture.

Classification of Fracture

Kelley's (1981)

1. Dentoalveolar fractures
2. Zygomatic complex fractures
3. Nasal complex fractures
4. Le-fort I, Guerin or low level fractures
5. Le-fort II, pyramidal or infrazygomatic fractures
6. Le-fort III or suprazygomatic fractures.

Kelly's classification of mandibular fracture

1. Simple
2. Compound
3. Complicated
4. Comminuted
5. Impacted
6. Green Stick
7. Pathological.

Jackson's classification (1989) of zygomatic fracture

1. Zygomatic body
 - a. Intact
 - b. Undisplaced
 - c. Localized segmental
 - d. Displaced tripod
 - e. Comminuted.
2. Zygomatic arch
 - a. Intact
 - b. Undisplaced
 - c. Segmental
 - d. Displaced
 - i. Inferiorly with depression
 - ii. Laterally with outward bowing.

Important Features Associated with Jaw Fracture in Children

1. The fear, apprehension and strange surroundings of a traumatized child may make the initial clinical and radiographic examination difficult. This child should examine under heavy sedation or anesthesia. Under these circumstances, the treatment plan must be designed to incorporate a minimum number of separate procedures; a one stage technique is preferred.
2. The reparative process in children is rapid due to the high metabolic rate and high osteogenic potential of the periosteum. This results in early union of fractured bone, usually within 2 to 3 weeks.
3. Nonunion and fibrous union is almost absent in children and excellent remodeling occurs under the influence of masticatory stresses, even when there is imperfect apposition of bone surface.
4. Child's jaw usually showed greenstick fracture due to inherent elasticity of bone and developing bone.
5. Before eruption, the developing permanent teeth occupies most of the maxilla and body of the mandible. Fracture of the jaws, frequently involves

these unerupted crypts of permanent teeth, but it is seldom, necessary to remove them.

6. Fracture of the jaws involving crypts may results delayed eruption and varying degree of teeth damages.
7. Precaution must be taken during miniplates or transosseous wiring of fractured mandible. The fixation must be placed near the lower border of the mandible, remembering to avoid the developing lower canine teeth which are very deeply placed before eruption.
8. During the period of mixed dentition, the frequent absence of teeth and immature root associated either with resorption of the primary teeth or partial formation of permanent teeth present difficulty when utilizing the dentition for fixation of the jaws.
9. Condylar fracture should get special consideration in growing children. It may leads to impaired facial growth.

Emergency Treatment

Well equipped emergency treatment (Fig. 33.1) of facially injured patient include:

1. Adequate airway maintenance
2. Arrest of hemorrhage.

Since, child have a small size of airway in comparison to the adult. Laryngeal edema or retroposition of the base of the tongue may produce sudden obstruction. If there is an evidence of laryngeal obstruction, there should be no hesitation in performing a tracheostomy



Fig. 33.1: Emergency equipment, monitors fixed on the Boyl's apparatus trolley. See the dental surgeon with surgical attire in the OT

in a child with a fractured mandible or maxilla who is unconscious or who is showing respiratory distress.

During tracheostomy in a young child, care should be taken to avoid relatively high position of the left innominate vein in a low approach to the trachea. Caution must be exercised to avoid incising through the 1st tracheal ring because of the danger of the subsequent tracheal stenosis. It is generally agreed that a vertical tracheal incision is the simplest and best technique in children, resulting in less chances of stenosis and airway resistance (Rogers 1987).

When hypovolemic shock is present in injured child, it is important to restore the circulating blood volume before operating. Two intravenous access lines should be inserted in the body, one above and one below the diaphragm.

If loss of blood is less than 20 percent of blood volume: Physiological saline (15 ml/kg) should be transfused intravenously, if crossmatched blood is not available. The blood volume deficit is replaced with human plasma protein fraction (HPPF) to a maximum volume of 15 ml/kg. The hemoglobin deficit can be replaced over several hours when crossmatched blood is available.

If loss of blood is more than 20 percent of blood volume: Crossmatched blood should be transfused through vein until the normal blood pressure achieved.

Soft tissues injuries: Soft tissues wounds in children heal rapidly and so require early primary suture. It heals with considerable hypertrophic scarring. The scar usually softens and loses their red color with the passage of time, thus becoming less visible; they tend to widen, as the face grows.

Guideline for Treating Soft Tissues Injuries (Lackmann, et al 1992)

1. The wounds should be treated under General anesthesia between 12 and 24 hours after injury.
2. Careful wound cleaning with H₂O₂ 3 to 6 percent and subsequent irrigation with physiological saline solution is necessary prior to conscientious wound debridement. This can reduce the risk of wound infection 30 times.
3. Wound closure should be done with very fine suture (5/0 to 6/0).

4. Tissue defects should be covered by skin grafts or pedicled flaps. Separated tissues or part of organs are replanted as early as possible.
5. Provide prophylactic antibiotic therapy.
6. Oral burn results microstomia, permanent face disfigurement and altered facial growth. Burn appliance should be inserted in the oral cavity within 3 to 10 days after burn injuries and used for 6 to 12 months thereafter.

Fracture of the Mandible (Figs 33.2A to G)

- An undisplaced hairline fracture at the body or angle of the mandible may be treated without fixation, but a careful diagnosis is needed in such cases.
- Unilateral/bilateral condylar fracture with absence of occlusal derangement respond well to muscle training exercises. The child is encouraged to close the mouth with the teeth in their correct occlusal relationship. Head cap and chin strap may be useful prior to the muscle training exercise.
- Unilateral or bilateral fracture of condyle with occlusal derangements (Posterior displacement of mandible or anterior open bite) or mechanical interference with mandibular movement requires open reduction and fixation in centric relationship until stability of occlusion is achieved. It takes 2 to 3 weeks after which active exercises are encouraged.
- Titanium miniplate or microplates are usually used for fracture of the mandible and maxilla in children. Rowe (1969) establishes a guideline for immobilization or fixation of fractured jaws, based upon the state of the dentition (Table 33.1) at the time of injury.

0 to 2-year-old Child

Immobilization of the fractured mandible at this age groups depends upon the location of fractured line, whether fracture is in the tooth bearing part of the mandible or symphysis region.

Treatment

Mac Lennan technique (1956) – gunning type prefabricated lower splint with a thick lining of softened gutta-percha is pressed down over the lower teeth and alveolar bone following reduction of any displacement. The splint is retained in place by two circumferential wires placed one on either side of the fracture line.



Figs 33.2A to G: (A) Step in mandibular anterior teeth region, (B) On radiographic examination (OPG) shows step formation in anterior mandibular bone base and extrusion of primary lower anterior teeth, (C) Radiograph of Condylar region shows normal condyle, (D) Surgical insertion of wire for circumferential fixation of fractured mandible in a unconscious child. (E to G) Prefabricated acrylic splint fixed with teeth and circumferential wire

Table 33.1: Dental development as per age

S.No.	Age in year	Dental development
1.	0 to 2 years	Eruption of primary dentition is incomplete.
2.	2 to 4 years	Before the roots of primary incisors show marked resorption, although many of the permanent teeth are partly formed.
3.	5 to 8 years	Before resorption of the primary molars is advanced or the roots of permanent incisors adequately developed.
4.	9 to 11 years	After adequate formation of the roots of the permanent incisors and 1st molar teeth, but before eruption of the premolars. Development of Paranasal sinuses may predispose to fractured of the middle 1/3rd of the facial skeleton.

Caution: Since, the bone at these age groups are extremely soft and the wires can easily cut deeply in to the cortex. Wires should not be too tight over the splint.

- If fracture line passes through the mandibular angle, the two stage plane necessary at this stage.

Stage 1

Immobilization of the mandible- the modified acrylic gunning type block splint in the molar region and these are hollowed out to accommodate soft gutta-percha on the occlusal surface; this occludes with maxillary teeth on alveolus, thus stabilizing the bite.

Stage 2

Open reduction and insertion of a miniplate or transosseous wiring of the mandible.

2 to 4-year-old Child

At this stage, well formed primary dentitions are present, interdental eyelets wiring can be used. If there is a gap in primary dentitions cap splint can be used. The main drawback of cap splint is cap removal and cleaning of the teeth and it requires considerable cooperation between operator and child.

If the fracture line passes through the tooth bud bearing area of the mandible, a single one piece lower splint can be used. If there is any doubt about the security of the cement fixation, this can be achieved with aid of two circumferential wires passes through the external and internal surfaces of fractured mandible.

5 to 8-year-old Child

At this age, focus must be placed primarily on primary molars. Since, the anterior teeth are of little or no use because the roots are either resorbe in case of primary teeth or incompletely formed in permanent teeth, therefore can not be used for splinting purpose. This problem can usually be overcome by fabricating partial maxillary and mandibular gunning type splint with occlusal block. The exact fabrication of splint is dependant on the precise location of the tooth loss. The mandibular splint is secured by the circumferential wires.

Fixation of the splint to the maxilla presents a problem. This splinting problem can be solved by the use of per nasal wire where by the splint is suspended by two wires which rest on the floor of the nose, one either side of the septum.

9 to 11-year-old Child

At this age, the roots of the permanent incisors and 1st molars have been sufficiently developed to the point where they can be safely be employed for arch bar fixation. Bone plating or transosseous wiring is useful, particularly in the external compound fracture of the mandible.

Fracture of the Maxilla

- The classic Le fort fracture lines are rarely seen in children. The child's maxilla is characterized by presence of cancellous bone, unerupted teeth and underdeveloped maxillary sinuses. The piriform aperture and zygomaticomaxillary buttress are much thicker structure in the child than in the adults, and therefore considerable force is required to disrupt the midfacial skeleton of the growing patient.
- If maxillary fracture exhibits minor degree of displacement, it can be managed well by closed reduction. Since, the child has a great capacity for bone remodeling and dentoalveolar compensation of fractured maxilla or mandible. The impression is taken and models are poured and acrylic splint is constructed on it for the closed reduction of the maxilla.
- Surgical intervention into the tooth bearing area of maxilla for placement of stabilizing wires or plates increases the incidence of disruption of developing tooth buds and should be reserved for exceptional

circumstances only. The positions of developing maxillary teeth, particularly canine, can be cephalic in position. For this reason, piriform and infraorbital suspension wires are used. Occlusal grinding or post injury orthodontic correction is highly effective in improving minor occlusal discrepancies, particularly in primary or mixed dentition stage. If perfect restoration of occlusion is not possible, small discrepancies can usually be adjusted following open reduction or surgical bone plating.

Nasal Fractures

- The nose is the most projecting part of the face having maximum probability of trauma to the nasal skeleton. In the early years of childhood, the nasal skeleton is proportionately more cartilaginous than bony and the diagnosis of nasal injury is thus more difficult; an anesthetic is sometime necessary to permit adequate examination. Relatively small nasal bone may not be fractured, but dislocation and hematoma may be present in the cartilaginous part of bone.
- Septal hematoma, if present, should be removed as early as possible to avoid septal necrosis and perforation. Displaced septum should be reduced to the midline. Resection of the septal cartilage must be avoided under all circumstances because it hampers the subsequent facial growth severely.
- Nasal septum is reduced by caudal traction and the nasal bone can be elevated from intranasal approach. The nasal pack can be placed to support the reduced nasal bone and septum during healing. External splinting is helpful in controlling swelling and provides protection to the area after reduction. Nasal bone fracture heals rapidly in children usually with hypertrophic callus, producing a widening of the bony dorsum of the nose.

Nasoethmoidal Fracture

- In this fracture, the nasal bones are pushed back into the interorbital space with involvement of the frontoethmoidal structure. They should be treated by open reduction and are best accessed by means of a bicoronal flap which permits excellent exposure of the Nasoethmoidal area.

Orbital Fracture

Orbital fracture in the children should be managed like those in the adult.

Fracture of Zygomatic Arch

Isolated zygomatic arch fractures are uncommon in growing patient. These fractures are treated by open reduction through Gillies approach. Zygomatic arch fracture are reduced using an incision placed in the hair bearing area of the scalp above the lateral canthus levels and anterior to the tragus.

Caution

After shaving the scalp over the area, an oblique incision is made to minimize the risk of injuries to the frontal branch of the facial nerve. Kelly clamp, double ended periosteal elevator is inserted under the fascia and passed below the fractured zygomatic arch and, reduced it and, sutured. Postoperative trismus is usually present and patient should be encouraged to exercise the lower jaw by opening the mouth widely, protruding and lateral excursion.

BIBLIOGRAPHY

1. Adekeye EO. Pediatric fracture of facial skeleton: A survey of 85 cases from kaduna, Nigeria. *Journal of Oral Surgery* 1980;38:355.
2. Amaratunga NA deS. Mandibular fracture in children- a study of clinical aspects, treatment needs and complications. *Journal of Oral and Maxillofacial Surgery* 1988;46:637.
3. Carroll MJ, et al. Facial fracture in children. *British Dental Journal* 1987;163:23.
4. Gussack GS, et al. Pediatric maxillofacial trauma: Unique features in diagnosis and treatment. *Laryngoscope* 1987; 97:925.
5. Guven O. Fractures of the maxillofacial region in children. *Journal of Craniomaxillofacial Surgery* 1992;20:244.
6. Hall RK. Injuries of face and jaws in children. *International Journal of Oral Surgery* 1972;1:65.
7. Mac Lennan WD. Fracture of mandible in children under the age of six years. *British Journal of Plastic Surgery*, 1956;9:125.
8. McGraw BL, Cole RR. Pediatric maxillofacial trauma. Age related variations in injuries. *Archives of Otolaryngology-Head and Neck Surgery* 1990;116:41.
9. Rowe NL. Fracture of the jaws in children. *Journal of Oral Surgery* 1969;27:497.

Common Pediatric Oral Pathology and their Management

CONGENITAL LESIONS

Ankyloglossia

Ankyloglossia is commonly known as “TONGUE TIE”. This congenital condition is characterized by an abnormally short lingual frenum and inability to extend the tongue. Frenum may lengthen with growth to produce normal functions. Severe ankyloglossia may affect the speech. It does not limit sucking or swallowing of the infants.

Treatment

1. Frenectomy
2. Speech Therapy.

Palatal Cyst

Palatal cyst is a fluid filled lesion of the palatal mucosa. It is common in neonates. New studies showed that 55 to 65 percent of new born have yellow white cysts commonly located at or adjacent to the mid palatal raphe. Palatal cyst is usually 1 mm or less in diameter and 3 to 6 Palatal cyst may be present in one neonate and are more common in white race than Black race. The palatal cyst is known as Epstein's pearls when it is located within the fusion of the posterior palatal segment. When palatal cyst is located near the junction of hard and soft palate, it is known as Bohn's nodules. Epstein's pearls are the result of inclusion of epithelial cells during palatal fusion and Bohn's nodules are derived from epithelial remnants of developing palatal salivary glands.

Treatment

Reassurance to the patient that these asymptomatic lesions regress spontaneously within few weeks to months.

Alveolar Cyst

It develops from cystic degeneration of the dental lamina, also known as Dental lamina cyst or gingival cyst. These lesions appear as small grayish white cyst similar to the palatal cyst. Alveolar cyst are commonly located on the crest of the maxillary or mandibular alveolar ridges and on the facial and lingual borders to the ridges. New study showed that the incidence of alveolar cyst ranges from 26 to 52 percent in white neonates and 12 to 40 percent in black neonates

Treatment

Alveolar cysts are asymptomatic and regress spontaneously within a few months.

Alveolar Lymphangiomas

This is domed shaped, fluid filled, bluish in colors and size ranging from 1 mm to 9 mm. These alveolar lymphangiomas are located posteriorly on the crest of the maxillary ridge or lingual to the alveolar ridge. These lesions have well defined vascular spaces. The cause is unknown. Incidence of lesion is 3.7 percent in newborn.

Treatment

Most of the time these lesions regress spontaneously but surgical treatment may be considered, if lesions become symptomatic.

Median Alveolar Notch

The cause of median alveolar notch is unknown but may be associated to the labial frenum tension which produces a small fissure of maxillary ridge. The incidence of median alveolar notch ranges from 20 to 26 percent and is more common in black neonates. After eruption of the teeth, the frenum attachment may move apical and with alveolar bone growth the defect may be reduced. Sometimes notch may persist, resulting in midline diastemas between primary and permanent central incisors.

Treatment

No treatment is necessary. If frenal tension is high surgical intervention may be needed.

Oral Leukoedema

It is a variant of normal oral mucosa. Leukoedema appears as a diffuse firm, opalescence of buccal mucosa caused by marked intracellular edema of the spinous cell of the epithelial layer. It is bilateral and symmetrical in distribution. The surface texture of the oral mucosa may appear wrinkled and thickened. The characteristic feature of leukoedema is disappearance of edema when oral mucosa stretched. Incidence of leukoedema ranges 11 to 43 percent. Leukoedema has no malignant potential.

Treatment

No treatment is necessary for this anatomic variant of oral mucosa.

Hemangiomas

Hemangiomas are enlarged vascular hamartomas. This is benign in nature. The common sites of oral hemangiomas are dorsum of the tongue, gingiva and buccal mucosa. The congenital hemangiomas are often present at birth and may become more apparent as the child grows. Clinically hemangiomas appear as red or bluish red, slightly raised and moderately firm on palpation. It is slightly more common in girls than boys. It is usually painless but may ulcerate and are hemorrhagic if traumatized. The vascular malformation may be identified by presence of a thrill. When hemangiomas occurs within bone they may be highly destructive.

Treatment

- Surgical removal of hemangiomas. Precaution should be taken before surgical intervention. Since hemangiomas have a potential for severe hemorrhage, cryosurgery, sclerosing agent, carbon dioxide laser, can be used for surgery.

Lymphangiomas

It is a benign tumor of the lymphatic vessels. The most common intra oral site is tongue and lip. Large intra oral lymphangiomas should be surgically removed if speech or swallowing difficulties, disfigurement or when vital neck structures are involved. Recurrences of lymphangiomas are common.

Congenital Epulis

It is the localized tumors of gingiva. There are following type of epulis occurring in children:

1. Fibrous epulis
2. Pyogenic Granuloma
3. Giant cell epulis.
 - The congenital epulis of new born is pedunculated, firm mass of the alveolar ridge present at birth. It occurs most commonly on the maxillary anterior segment and frequently present in girls than boys.
 - *Fibrous epulis*: This is most common type of epulis in which granulation tissue is largely replaced by fibrous tissues. It has a smooth surface and color of normal oral mucosa and covered by oral epithelium.
 - *Pyogenic Granuloma*: Pyogenic granuloma contains dilated blood vessels and its color ranges from dark red to pale red. It may convert into fibrous epulis.
 - *Giant cell epulis*: It contains large multinucleated giant cells in proliferating granulation tissues. The giant cell epulis is soft and easily bleeds on probing and purple in color. It remains localized in gingiva but sometimes leads to superficial resorption of the underlying bone.

Treatment

1. Congenital epulis may regress spontaneously, may be excised if feeding, sucking or respiration is compromised.

2. Epulis must be removed down to bone and bone curetted to minimize the chance of recurrence.
3. Dress the surgical wound of the epulis with a pressure dressing until it is completely epithelialized.
4. Send the tissues in 40 percent formalin filled bottle for histological examination to confirm diagnosis.
5. Check oral hygiene and local plaque retention factors.

Melanotic Neuroectodermal Tumor of Infancy

This is a rare tumor invariably occurs within 6 months of life. It is usually located on maxillary alveolar ridge and malignant in nature. Urine examination showed high level of Vanillylmandelic acid which is suggestive of neural crest in origin. The characteristic feature of melanotic neuroectodermal tumor is alveolar spaces lined by cuboidal cells filled with dark staining round neural type cells.

Natal Teeth

Teeth present at birth are known as natal teeth. Neonatal teeth erupt during the first month of life and early eruption of primary teeth is known as premature teeth. The incidence of natal and neonatal teeth according to Leung ranges from 1 in 700 to 1 in 6000 respectively. New study showed that 85 percent of natal and neonatal teeth are mandibular primary incisors and only small percentages are supernumerary teeth. A radiograph should be made to determine the amount of root development and compared to the adjacent unerupted tooth. Since, prematurely erupted teeth have underdeveloped root so that teeth become hypermobile. This type of teeth should be extracted because there are chances of aspiration. Occasionally natal, neonatal teeth and premature teeth erupting on schedule at 6 to 12 months may cause transient ulceration of the sublingual area of the tongue. This condition is known as Riga Fede disease. If the ulceration becomes symptomatic, treatment may involve covering the sharp incisal edges with tooth colored composite. This type of treatment is also indicated when teeth causes discomfort while breast feeding.

Commissural Lip Pit

It is a blind ended pit at the commissures. It is usually bilaterally present and associated with preauricular pit. Most of the commissural lip pit are asymptomatic and

require no treatment. Lip pit of the vermillion border on each side of the midline of the lower lip are most often associated with cleft lip and palate. Some time surgical intervention may be needed for aesthetic purpose.

DEVELOPMENTAL LESION

Geographic Tongue

It is also known as benign migratory glossitis. This is a common finding during routine intra oral examination of children. It occurs most commonly on the dorsum of the tongue and lateral border of anterior 2/3rd of the tongue. Geographic Tongue appears as single or multiple area of irregular reddened patch with thickened and elevated white borders in an irregular pattern. The erythematous irregular area showed dekeratinization and desquamation of the filiform papillae and remaining unaffected fungi form papilla may be seen as elevated red dot. The geographic tongue continuously changes its pattern, creating a migratory appearance on the tongue. The lesion is usually asymptomatic but may be painful when inflamed. The duration of lesion varies from 7 days to 30 days or more with spontaneous regression and reappearances. The prevalence of geographic tongue is 1.4 percent.

Fissured Tongue

It is a developmental anomaly that is characterized by presence of marked central fissure anterioposteriorly from which numerous small and deep grooves or furrows radiates laterally, on the dorsal surface of the tongue. It is usually painless. Sometimes food debris may get trapped in deep fissure, then it may become necessary to pull out the tongue to brush food debris out of the deeper grooves, if there is a complain of halitosis.

Retrocuspid Papilla

It is a bilateral circumscribed soft tissues enlargement of the mucosa located at the attached gingival lingual to the mandibular cuspid. It is usually 2 to 3 mm in diameter soft sessile nodules that is almost similar in color to the surrounding oral mucosa. The lesions have been reported in 72 percent of the children fewer than 10 years of age. These lesions are composed of normal mucosal connective tissues.

Treatment

No treatment is indicated and most papillae regress with age.

Macroglossia

Enlargement of the tongue due to overdevelopment of the tongue musculature. The causes of macroglossia are Pituitary gigantism, Hypothyroidism, Down's syndrome. Clinician must differentiate between true macroglossia from hypotonia of the tongue and Perioral musculature.

Treatment

1. Remove any systemic cause
2. Surgical excision of enlarged tongue may be considered but may limit the tongue movement during speech due to scarring of wound.

Lingual Thyroid

It is a developmental anomaly 2 to 3 cm. in diameter, located at midline, base of the dorsum of the tongue. The lesions have a smooth surface and appear vascular. Dysphasia is most common complaint associated with lingual thyroid. The lingual thyroid most probably developed by failure of complete migration of the thyroid tissues from the foramen caecum.

Treatment

Surgical excision.

Precaution

Seventy five percent of patient with lingual thyroid have no other functional thyroid tissues so thyroid functional test should be done before surgical excision and location of gland should be checked.

Fordyce Granules

Fordyce granules are small yellow spots slightly elevated and commonly located on buccal mucosa. This lesion is bilaterally symmetrical. They may occur on the inner surface of lip and on the mucosa distal to the mandibular molars. These developmental lesions are heterotrophic collection of sebaceous glands in oral mucosa. Fordyce granule begins to appear by 10 years of age and increases in size and number during puberty.

Treatment

Required no treatment.

Mucocele (Fig. 34.1)

It is a mucous retention phenomenon. The lesion appears as a fluid filled well circumscribed raised bulla several millimeters to centimeters or more in diameter. This retention of the mucous in sub epithelial tissues most commonly occurs in children and adolescents on lower lip and midline and commissure. The cause of mucocele is trauma to a minor salivary gland with pouring of mucous in an obstructed and dilated excretory duct. The lesions are usually asymptomatic and smooth surfaced with bluish or translucent in nature. A mucocele in the floor of the mouth is termed as Ranula. It represents a unilateral mass that is of normal mucosal color if deep seated or bluish in color if superficially seated.

Treatment (Fig. 34.1, Step 1 to 6)

Surgical excision with removal of associated minor salivary gland to prevent recurrence.

Odontogenic Cyst

Parulis

Parulis is also known as Gumboil or Periapical abscess. It is soft solitary reddish papule located on the facial or lingual area of nonvital tooth. It occurs at end point of a dental sinus tract. When sinus tract is obstructed, pain may result. Parulis is caused by necrosis of the pulp due to carious process or trauma. Parulis is common in toddler years through adolescence.

In periapical abscess, tooth may be slightly mobile or extruded out of socket. The systemic sign associated with Parulis are fever, and lethargy. Chronic accumulation of purulent debris finally leads to draining sinus tract. Those cases in which draining sinus do not develop, the infection may spread through facial plane producing cellulitis (Fig. 34.2).

Children with vitamin D resistant rickets develop spontaneous gingival abscess due to defect in tooth formation allowing invasion of microbiota into the pulp tissues with subsequent necrosis. Similar spontaneous periapical abscess is also found in Dentinogenesis imperfecta.

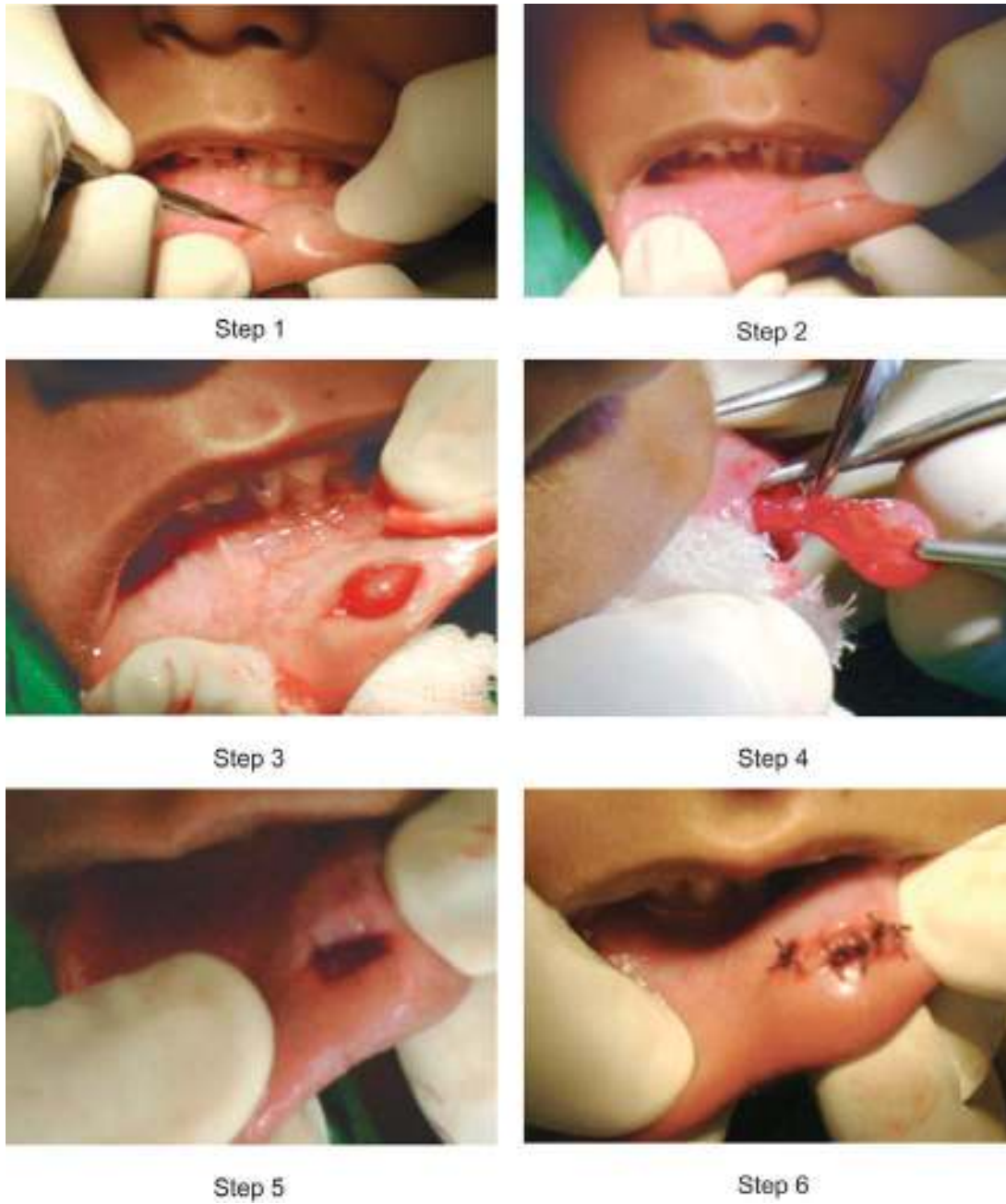


Fig. 34.1: Step by step procedure for surgical excision of mucocoele

Treatment

Root canal therapy or extraction of the teeth with antibiotic therapy.

Eruption Cyst and Hematoma

It is usually translucent smooth painless swelling over the erupting primary or permanent tooth. An eruption



Fig. 34.2: Periapical abscess in relation to right lower 6 region leading to cellulitis on right side of the face

cyst is produced by accumulation of fluid within the normal follicular space that surrounds the developing tooth. If bleeding occurs within the follicular space it may appear blue or blue black and is then termed as an eruption hematoma.

Treatment

Require no treatment.

Factitial Injuries

Traumatic Ulcers

The most common ulcers found in young children are traumatic ulcers. It is caused by mechanical, chemical or thermal insult to the oral tissues. The common sites of traumatic ulcers are peripheral border of tongue, buccal mucosa, lips or palate. Burns on the palate may occur during eating hot food or drinking hot liquid. Young children or infants may develop traumatic ulcers on the soft palate from thumb sucking or trauma to the gingiva with fingernails scratching.

Treatment

1. Remove the cause of trauma.
2. Mucopain ointment (Salicylic acid + lignocaine) to relief pain.

3. Vitamin C supplement in food. Ulcers will heal within 15 days.

Post Anesthesia Trauma

It is common in young children after local anesthesia. It is a self inflicted injury. After an intraoral anesthesia the surrounding soft tissues may remain anesthetized for 1 to 3 hours depending on the type of anesthesia used. The young children have loss of feeling in the anesthetized area. The child begins rubbing picking or chewing the anesthetized soft tissues resulting in soft tissues swelling which resembles like a cellulitis within few hours after anesthetic injection. An intraoral examination reveals mucosa in various stages of ulceration, bruising and tissues tears.

Precaution

A clear professional instruction is given to the parent to watch the child during postoperative period of lingering anesthesia and to stop any chewing activity.

Cheek and Lip Chewing

It is caused by self induced habitual chewing of the mucosa of lip and cheek. The lesion is varying in appearance according to the habitual manner in which the lesions are produced. A buccal mucosa lesion usually appears as diffuse, white thickened linear plaques in areas accessible to the posterior teeth. It is most common in the teenager's group. Biting of the lower lip may be present as reddened chapping of the lower lip.

Treatment

Based on counseling to recognize the condition that trigger the chewing habit.

Bruxism

It is a habit of grinding or clenching the teeth without any chewable food. Bruxism has the potential to cause tooth wear, fracture and periodontal and muscular pain. Most frequently it occurs at night during sleep. Newer study showed that prevalence of bruxism is 15 percent in 5 to 6 years old children and it decreases with age after the eruption of permanent molars and incisors. The diagnosis of bruxism can be made by history given by

the parent and abrasive wear facets on chewing surface of the deciduous teeth. The pathognomic sign of bruxism is Reverse curve of spee (in permanent teeth). The proposed cause for bruxism are malocclusion, mobile deciduous teeth, tooth interference with biting, intestinal parasite, allergies, nutritional deficiency and psychological disorder. Most of the children with bruxism have no intraoral pain or TMJ joint discomfort because most cases of bruxism in young children are self limiting and stop with the eruption of permanent teeth.

Treatment

1. Night guard (Removable occlusal splint made of vinyl plastic bit guard)
2. Removal of any occlusal interference
3. Psychological therapy.

Smokeless Tobacco

Modern children and teenagers frequently use the chewing tobacco and snuff. The most common pathology associated with smokeless tobacco users is oral leukoplakia. This pathology represent as a white patch or plaque on the mucous membrane surface that can not be removed by rubbing. There are 6 percent chances of malignancy in smokeless tobacco associated leukoplakia. The squamous cell carcinoma and verrucous carcinoma frequently related with smokeless tobacco users.

Treatment

1. Educating the patient regarding health hazard associated with smokeless tobacco use.
2. Surgical intervention.

Common Infectious Lesion of Oral Cavity in Child and Adolescent

1. Viral infections
2. Bacterial infections
3. Mycotic infections.

VIRAL INFECTION OF MOUTH

A. **Acute Herpetic Gingivostomatitis:** Etiology of acute herpetic gingivostomatitis is Herpes Simplex Virus (HSV). It is a contagious disease. It occurs most frequently in infants between the age of 1 and 3 years but adult may also be affected. The incubation period is approximately one week and patient complains of fever, malaise, and irritability. Within 24 hours, the patient's feels soreness of mouth and refuses to eat, temperature is raised and cervical lymph nodes become enlarged and tender. Vesicles about 3 to 4 mm in diameter form on gingiva and oral mucosa specially on the dorsum of the tongue and on the hard and soft palate. The vesicles burst and leave shallow painful ulcers. Gingiva is diffusely inflamed. The lesion heals spontaneously within about 2 weeks.

Prevention and Precautions

1. Care should be taken to prevent autoinoculation of the child's eyes, genitalia and finger nails beds, as further Herpes Simplex Virus infection could result.
2. The child should be isolated from other children.

Treatment

1. Tell the parent that disease is self limiting.
2. Recommend soft, cold diet rather than hot, spicy and hard food and advice high fluid intake.

Although, no treatment is required but following methods may be used to treat the case.

Systemic

Acyclovir: 15 mg / kg / day for 5 days.

Topical

1. Carboxymethyl-cellulose gelatin paste that adhere to mucous membrane and by covering mucous membrane and provides some relief from pain.
2. Mucopain ointment having choline salicylate and local anesthetics provides relief from pain.

Mouthwashes

Recommend tetracycline or chlorhexidine mouthwash 3 to 4 times/day. In infants or young children who are unable to rinse with chlorhexidine mouthwash, parents swabbed the child's oral lesion with chlorhexidine saturated cotton pellet for several times.

Herpes Labialis

It is also known as Recurrent Herpetic Stomatitis. Herpes Simplex Virus migrates into the trigeminal ganglion and it remains in a latent state. Since a balance is established in the body between the body immunity and virus. If the balance is disturbed by exposure to sunlight, cold, trauma, stress, a secondary lesion may appear in the form of small clusters of vesicles on the vermillion borders of the lips. The clusters of vesicles also known as Fever Blister.

The prodromal symptoms of Herpes Labialis are tingling, burning and pain at the site. The vesicles rupture to form oozing ulcers and crusts which heal without scarring within about 7 to 14 days.

Treatment

1. Apply acyclovir cream in severe form of herpetic lesion.
2. Sunscreen is recommended to prevent recurrence of herpetic lesions.

Herpangina

Herpangina is a disease of oral cavity, caused by a Coxsackie's group A Virus. The disease affects infants and young children in summer or early fall. The disease is highly contagious and has an incubation period of 4 days. Herpangina patients show fever, malaise, headache, and vomiting, abdominal pain and intraoral lesion.

INTRAORAL LESION

A Herpangina vesicle appears on the anterior pillars of tonsillar fauces, the soft palate, the uvula and the tonsils. The gray pin head size vesicles rupture to form large ulcers covered by fibrins. The lesion heals spontaneously within 3 to 7 days.

Treatment

- No treatment is necessary.
- Mouthwashes, analgesic and antipyretic may be prescribed as symptomatic treatment.

Hand, Foot and Mouth Disease

It is a highly contagious disease caused by Coxsackie's group A and B strains and usually affects children under 5 years of age or preschool age. Occurrence of disease is usually affected by season like spring and summer. The chief complaint of the patient is pain from oral lesion. On intra oral examination lesion can be found anywhere in the oral mucosa. The lesion heals spontaneously within 2 weeks.

Treatment

Symptomatic treatment may be used:

1. Mucopain ointment for local application.
2. Oral rinse like Hexidine (Chlorhexidine mouthwash).

3. Recommended soft fluid diet.
4. Avoid spicy food during disease.

Recurrent Aphthous Ulcers

It is also known as Canker Sore. It is common in adult but children may also be affected. Most common site for aphthous ulcers is vestibular and buccal mucosa, tongue, soft palate and floor of mouth. Aphthous ulcers are usually singular painful and less than 1 cm in size. The cause is unknown. But probable factors for the development of these ulcers are immunological defect, local trauma, food allergies, and stress or may be hormonal changes.

Treatment

1. Aphthous ulcers spontaneously heal in 7 to 10 days without scarring.
2. Mucopain ointment (choline salicylate + lignocaine) helps in relieving pain.
3. Antimicrobial oral rinse (chlorhexidine 0.2 percent) should be recommended.

Human Immunodeficiency Virus

The child usually acquired HIV infection during pregnancy or at birth from an infected mother. Blood transfusion and human milk are another source of pediatric HIV infection. The most common oral manifestation of HIV infection in children are Oral Candidiasis which may progress into esophageal candidiasis, localized or generalized HIV gingivitis may be seen in young children. The HIV gingivitis showed linear erythema of the facial and interproximal gingival margins and is unresponsive to improved oral hygiene.

- Herpes simplex disease is commonly associated with HIV infected children. It may require hospitalization and use of antiviral drug Acyclovir.

Rubeola

Commonly known as Measles. It is caused by Paramyxovirus. Rubeola is a contagious disease. Children suffering from rubeola disease show symptoms like fever, malaise, skin rashes or ocular problems. Oral lesions Koplik's Spots may be observed 1 to 3 days before the onset of systemic manifestation. Koplik's Spots characterized by irregular pattern on buccal mucosa and appear as bluish yellow spot surrounded by erythematous halo.

Treatment

Symptomatic treatment may be given.

Infectious Parotitis (Mumps)

Disease is caused by Paramyxovirus affecting primarily parotid salivary glands. Child reports periauricular pain followed by bilateral periauricular swelling, fever, malaise. Child feels severe pain during talking or eating. Sometimes partial obstruction of stenson's duct of parotid gland may occur as the gland swells.

Treatment

1. Analgesic should be prescribed.
2. Advice hot saline gargles to open any obstruction in stenson's duct.
3. Mouthwash like chlorhexidine should be recommended 3 times/day.
4. Vaccine may be useful as a prophylactic measure in susceptible individuals.

BACTERIAL INFECTIONS

Impetigo

Etiology of impetigo is *streptococci* or *staphylococci aureus*. It is a purulent bacterial infection of the skin that most commonly found in children or adolescent. It is also found peri orally or along the base of the nose where the initial lesion begins as a small vesicle, which may rupture crusts and appear with pus formation. Lesions are usually asymptomatic. Autoinoculation spreads the infection to the other site on the Child's body. It is a highly contagious disease.

Treatment

- Topical or systemic antibiotic should be prescribed to treat the impetigo.

Acute Necrotizing Ulcerative Gingivitis (Vincent Infection) or ANUG

The etiologies of ANUG are *Fusobacterium nucleatum* and *Borellia Vincentia*. This disease is rare in children under the age of 16 years, except in undeveloped countries. The ANUG is common in young adults and number of predisposing factor have been noted which include mental stress, local irritant or smoking.

The disease is characterized by rapid destruction of inter- dental papilla and formation of punched out ulcers and presence of pseudo membranous necrotic tissues of the marginal gingiva. The ANUG may be localized or generalized. In extensive case both free and attached gingival may be affected and patient showed severe halitosis, which is characteristic of ANUG. Clinical manifestation of disease includes inflamed painful bleeding gingiva, poor appetite, fever, general malaise and fetid odor.

Treatment

1. Remove gross calculus and debris from the gingival margins by scaling and irrigation with 20 vol. Hydrogen peroxide.
2. Disease positively responds within 24 to 48 hours after oral prophylaxis and irrigation with oxidizing solution.
3. Prescribed metronidazole and penicillin group or cephalosporin group of drug or erythromycin for 7 days.
4. Recommend 3 percent hydrogen peroxide with equal amount of warm water gargles every 2 hours and chlorhexidine mouth wash three time a day (2 to 3 weeks).
5. Avoid tobacco, alcohol consumption and spicy food.
6. Give detail oral hygiene instruction and an adequate standard of oral hygiene are necessary to prevent recurrence.

Vincent infection vs acute herpetic gingivostomatitis

Vincent infection	Acute herpetic gingivostomatitis
1. Punched out interdental papilla is characteristic of vincent infection.	1. Round ulcers with red areolate are characteristic of herpetic gingivostomatitis.
2. Antibiotic therapy and oral prophylaxis will reduce the acute symptom in the disease.	2. Not respond with antibiotic.
3. Rarely occurs in preschool age group and more common in young adults. Onset of disease is slow.	3. Most frequently seen in preschool children and its onset is rapid.

MYCOTIC INFECTION

Candidiasis

It is also known as oral thrush or Moniliasis. Moniliasis is caused by saprophytic fungus *Candida albicans* which is a common inhabitant of the oral cavity. The fungus grows rapidly and yeast like form of fungus is replaced by mycelia form which grows in the epithelium of the oral mucosa and produce characteristic of lesion, when tissues resistance lowered or compromised immunity (for example, HIV Infection, diabetes or prolong antibiotic therapy).

Young children develop thrush after local an antibiotic therapy, which disturb the balance between different microorganisms of oral cavity and allows the fungus to proliferate. Oral Candidiasis is characterized by raised furry white patches which can be removed easily to produce a bleeding raw underlying surface.

Neonatal Candidiasis

Neonates get infected during passage through the vagina at the time of delivery. Clinical appearance of disease occurs during the first two week of life.

Treatment

Topical

- Miconazole- antifungal drug 25 mg per ml in sugar free gel. Gel is smeared over the affected area with a clean finger.
- For infants and very young children a suspension of 1 ml. (100,000) unit of Nystatin (or mycostatin) may be dropped into the mouth for topical application four times a day.

Systemic

- Miconazole 250 mg 1 tab should be sucked slowly four times daily for 10 days. For young children who will not suck the tablets the oral gel may be used systemically
Child under – 2 year - 2.5 ml/BD/day
2-6 year child – 5 ml/BD/day
Over 6 years – 5 ml/QID/day.
- Advice the parent to wash the infant's feeding utensils carefully after each meal and to store them in an antiseptic solution.

Management of Dental Problems of Handicapped and Systemically Compromised Children

Children with chronic diseases or with congenital or acquired conditions that interfering with normal physical and/or mental development are often called as disabled or handicapped. Handicapped is a disadvantage for an individual, resulting from an impairment or a disability that prevents the fulfillment of a role that is normal for a human being.

The concepts can be described in following manner:

Disease or disorder → impairment → disability → handicap
(Intrinsic situation) (Exteriorized) (Objectified) (Socialized)

During the treatment of disabled children, the dental team must have thorough knowledge about special dental and general health problems associated with certain conditions and our own reactions to disability and disfigurement are important to understand the specific condition.

Risk Factors

Following factors enable disabled children at high risk for dental problem than healthy children.

- a. **Diet:** Many parents experience difficulty in feeding a child who has sucking or chewing problems due to conditions such as congenital heart disease, facial clefts, esophageal defects, generalized hypotonia, muscular dysfunction or mental retardation.
 - Usually liquid or soft non cariogenic foods are recommended in such patients.
 - Since, food is retained in the mouth for longer time before it is swallowed.
 - Frequent high calorie diet may be required.
 - Many disabled children have chronic diarrhea or constipation. Sweets remedies are often used for constipation to cure such conditions with dry fruits,

juices and cold drinks. In those cases where frequent intake of beverages is recommended, parents often use sugar containing drinks which further increases dental caries risk.

- b. **Muscular functions:** Impaired muscular functions like, hypotonic and pareses may influence salivation, cause drooling of saliva, chewing problems, retention of food and reduced self cleansing of oral cavities. Hyper function of muscles results in extensive tooth wear due to bruxism, common in spastic cerebral palsy and mentally retarded children.
- c. Oral hygienic problems – mainly encountered in mentally retarded, autistic and spastic patients.
- d. Sweetened medication proved a caries hazard while drug that reduces salivation increases caries risk.

Management of dental problems

- a. General considerations
- b. Specific management

We discuss it under following headings:

- i. Dental office access
- ii. Patient screening
- iii. First dental visit
- iv. Radiographic examination
- v. Preventive dentistry
- vi. Specialized equipment.

- I. **Dental office access:** One of the first preconditions in management of a handicapped child is the accessibility of dental clinic and dental surgeons. It require establishment of barrier free facilities to accommodate people with any kind of disability in the dental operatory.

Some guidelines have been laid down for modification of dental clinic, examples are:

- i. Wider width of door ways (4½ feet).
- ii. Provision of wheel chair turning space.
- iii. Operatory specifically designed with movable dental chair and adjustable bed along with instrument control unit and suction system.
- iv. Dental chairs adjustable to match different wheel chair designs etc.

II. *Patient screening*: The purpose of screening is to gather basic information which will assist the office in planning the patient's first dental visit. If done in a pleasant, empathic and knowledgeable manner, it establishes credibility and confidence and faith between child and dental team.

Screening includes

- i. Basic general body examinations
- ii. Medical diagnosis
- iii. Present/past medications
- iv. Name of physician and date of visit
- v. Date of last dental treatment
- vi. Financial information.

Note: Apart from this in patients with complicated medical history additional information is required that includes medical summaries, reports of hospitalization and psychological evaluation, laboratory investigation reports, etc.

III. *First dental visit*: The first dental visit sets stage for subsequent visits. Factors to be kept in mind during 1st dental visit are:

- a. Patient's medical status: Since, it affects length of appointments, it is necessary to make appointments, short and stress free for a patient having poor stress tolerance and easy fatigability. Avoid scheduling treatment around sleeping and napping periods.
- b. Appointment is scheduled on day's time where activity is conducive to treatment.
- c. Apart from this, transportation and living condition of the patient influences their ability to keep dental visit at a given time (day or evening).

IV. *Radiographic techniques*: In certain handicapping conditions, such as neuromuscular diseases, mental retardation and spinal injuries, modified radiographic technique may be necessary. Modified

radiographic technique may also be used in following condition:

1. Macroglossia
2. Limited oral access
3. Hyperactive gag reflex
4. Management problem
5. Poor muscle control
6. Inadequate muscle strength.
 - When standard radiographic series is beyond the physical or emotional capacities of the patient the alternatives radiographic technique can be used.
 - a. Anterior occlusal projections
 - b. Lateral jaw projections
 - c. Buccal bite wing projection
 - d. Snap—A Ray biting projections.

These technique compromises image quality to some extent compared to standard projections or technique.

a. Anterior occlusal projections – This radiographic technique helps in visualization of maxillary and mandibular incisors and their supporting bone. For this projection standard occlusal film is used by modified sandwich technique. Advantages are:

- i. It provides information normally obtain from periapical X-rays.
- ii. No discomfort from impingement of film on the soft tissues.
- iii. A single film is sufficient for both maxilla and mandible.
- iv. Child can reliably stabilize the film.

b. The lateral jaw projections (cephalogram): It helps in visualization of overall view of posterior maxillary and mandibular teeth and supporting structures on one side of maxilla. It is useful in the patient who cannot tolerate intra oral technique and those who experience difficulty in maintaining a stable head position.

The projection is best obtained with help of parent, who is seated in a dental chair reclined at 45° and draped in lead apron a 5" × 7" cassette (using intensifying screen) wrapped in a towel is placed on parent's sternum. Patient is positioned on parent lap with head resting on the cassette, in a position where the cassette is tangent to zygomatic area in posterior and tip of nose anterior. The cone is oriented perpendicular to the cassette, ½" below and behind the angle of mandible on the contra lateral side.

Advantages

- It can be used in an uncooperative patient.
- Helpful in orthodontic diagnosis and treatment planning.
- Developmental status of posterior permanent and succedaneous teeth can be evaluated.

Disadvantage

- Loss of radiographic detail.

c. The buccal bitewing: It provides a detailed view of interproximal areas of posterior teeth. It is useful with marginally coping children who tolerate intraoral film placement poorly. For this technique, a N⁰ 2 film is placed in a buccal vestibule with foil backing against the inner surface of cheek and the occlusal tab facing the tongue. The orientation of the cone is similar to the lateral jaw projection. The projection provides the development of posterior permanent teeth, the presence of proximal caries and periapical pathology.

d. Snap-A-Ray bitewing: Only the manner of film stabilization distinguishes Snap-A-Ray from standard bitewing radiographic technique. A N⁰O film is placed in a snap-a-ray holder so that film is bisected lengthwise by jaws of the holder. The film is placed intraorally as is a standard bitewing and the patient is instructed to close on bite table of the holder.

Beaver suggested a modification of Snap-A-Ray technique for children with gagging problems. The film is placed vertically rather than horizontally, thus preventing contact with lingual tissues posterior to second deciduous molar an area that triggers gagging. For a handicapped patient a suitable alternative radiograph survey consists of two posterior buccal bitewing radiographs along with anterior occlusal screening film.

V. Preventive dentistry: An effective preventive dentistry program is important for a disabled child because of the predisposing factors that make restorative dental care difficult to obtain when it is necessary.

Home Dental Care Regime

The parents have the initial responsibility for establishing good oral hygiene in the home. Home dental care should begin in infancy. The parents should gently clean the incisors daily with a soft cloth or an infant toothbrush.

For the older children who are unwilling or physically unable to cooperate, the parents should be taught correct tooth brushing techniques that safely restrain the child when necessary. Use those brushing techniques and positions that permits firm control and support of child, adequate visibility and convenient positioning of the adult, with reasonable comfort. (See chapter *Age Specific Plaque Control*)

To keep the child's mouth open, wrapped tongue blades can be used. Brushing technique for a patient with gross motor deficiency is recommended horizontal scrub brushing technique as it is effective, simple and yield good results. A soft multitufted brush should be used. Few modifications can be made to a tooth brush handle to help person with poor fine motor skills. Electric tooth brush with custom designed handle is commonly used by the poor motor skill patient.

Diet and Nutrition

Balanced diet is essential to a good preventive program for a disabled child. One should assess the diet of disabled child by reviewing a diet survey with the help of parents. Particular emphasis should be placed on discontinuation of nursing bottle and at will breastfeeding by age of 12 months, to decrease the likelihood of nursing bottle caries.

Fluoride Exposure

Emphasis is placed on ensuring judicious and adequate systemic and topical fluoride administration for a disabled patient.

Restorations: A Preventive Approach

Fluoride releasing dental sealants is appropriate in disabled population as preventive measures. A patient, who requires dental work under general anesthesia, should have deep occlusal pits and fissures restored with amalgam or long wearing composites to prevent further breakdown. In patients with severe bruxism and interproximal decay may need their teeth to be restored with stainless steel crowns to increase the longevity of the restorations.

Regular Professional Supervision

Regular recall visits for dental examinations are important in treatment of disabled patients. Recall examinations should be scheduled every 2, 3 or 4 months for

professional prophylaxis, examination and topical fluoride applications.

VI. *Specialized equipment*: If patient cooperation cannot be obtained in the dental operatory the dentist must consider alternatives such as physical restraints and sedation to perform necessary dental procedures. Also specialized equipment like wheel chair head rests and cerebral palsy head support must be available in the dental operatory.

Physical Restraints

Physical restraints are sometime necessary and an effective way to deliver dental care to patients who need help while controlling their extremities; such as infants and patients with certain neuromuscular disorders. These methods are useful for managing the patient who is potentially combative at the time of dental treatment.

Indications

- If a patient can not cooperate because of lack of maturity or very young age.
- If a patient can not cooperate because of mental or physical disability.
- If the behavior modification technique have failed
- When safety of patient or dental personnel would be at risk without use of restraints.

Contraindications

- Cooperative patient
- If there is an underlying medical or systemic problem that is not safe.

Mechanical Devices to Hold Mouth in Open Condition

1. Padded or wrapped tongue blades: These are easy to use, disposable and inexpensive
2. Open-wide disposable mouth props: it has a durable foam core on the end of a tongue depressor. It is easy to use, disposable and available in two sizes.
3. The molt mouth prop: It is made in both adult and child sizes, allows accessibility to opposite side of the mouth and operates on a reverse scissors action. It is helpful in management for prolonged period. Disadvantages are a possibility of lip and palatal laceration, and luxation of teeth if rested on anterior teeth.

4. Rubber bite blocks: These are available in various sizes to fit on occlusal surfaces of teeth and stabilize the mouth in an open position. The blocks should have floss attached for easy retrieval if it becomes dislodged.

Body restraints: For children, who are severely retarded, better working conditions and more predictable patient responses are obtained through the use of physical restraints. The commonly used physical restraints are:

(A) For Body

- a. Papoose board: It is simple to store, use and available in various sizes. It has a wooden back board and attached head stabilizers and is reusable. Since, it does not always fit the contour of a dental chair, and sometime a supporting pillow is needed. A pretracheal stethoscope is necessary to monitor patient's respiration on papoose board, If patient is sedated and having danger of developing hyperthermia
- b. Triangular sheet: It was described by Mink. It is used in controlling an extremely resistant child. It allows patient to sit upright during radiographic position.

Disadvantages

1. Required strap to maintain patient's position.
2. Difficult to use on small patient's due to possibility of airway impingement and hyperthermia.
- c. Pedi-Wrap: It does not have head support or a back board. It is made of mesh fabric so it allows better ventilation permits some movement while confining the patient, so there are less chances of developing hypothermia, but it requires straps to maintain the body position.
- d. Bean-bag: It is a dental chair insert, reusable and washable. It was developed to help accommodate hypotonic and severely spastic person who needs more support and less restraining. These patients tend to feel more relaxed with bean-bag.

(B) Restraints for Extremities

- a. Posey straps: These fasten to arms of a dental chair and extremities to allow limited movement of retarded patient's forearm and hands.
- b. Towel and tape: A towel is wrapped around the patient forearm and fastened with adhesive tape. It is useful for an athetoid-spastic cerebral palsy patient who cannot control body movements.

- c. Velcro straps
- d. Extra assistant.

(C) Head Positioners

Forearm body support: Head position can be successfully maintained through the use of forearm and body pressure by dentist and other head positioners are:

- Papoose board head positioners
- Plastic bowl
- Extra assistant.

WheelChair Head Rest

When a disabled patient lies on a wheelchair, the wheelchair head rest can be used as head positioners. It is an adjustable head rest that attaches to hand grips on the back of wheelchair. It provides secure comfortable head position for the patients who cannot be transferred to dental chair. For procedures on mandibular teeth, easiest approach is from front and for maxillary teeth from 11 o'clock position.

In case wheelchair head rest is not available, an early model dental chair with an adjustable head rest can be used in a similar fashion by placing the dental chair and wheelchair back to back.

Cerebral Palsy Head Support

It is a specially designed head rest that attaches to the upper position of dental chair. It provides lateral support for patient with impaired neck muscle strength. This can also be used in patient who has a neuromuscular disease.

If a child requires extensive dental treatment and cooperation cannot be achieved by routine psychological, physical or pharmacological measures, the use of general anesthesia in a controlled operation theater atmosphere is recommended.

SPECIFIC MANAGEMENT

Nowak's classification for handicapped condition

- i. Physical handicapped
- ii. Mental retardation
- iii. Congenital defects
- iv. Metabolic and systemic disorders
- v. Childhood autism
- vi. Convulsive disorder
- vii. Blind and deaf

- viii. Hemophilia's
- ix. Neoplasias.

We will take the specific management of disabled patients into two broad categories:

- a. Medically compromised patients
- b. Developmentally compromised patients.

MEDICALLY COMPROMISED PATIENTS

These children constitute a group where special knowledge is required to make dental chair as optimal as possible. Not only is the thorough knowledge necessary but also requires knowledge about management of oral complications that may accompany the various diseases.

CARDIAC DISEASES

Cardiac disease can be divided into two general types:

- a. Congenital
- b. Acquired.

Congenital Heart Disease (CHD)

The etiology in most cases is unknown but genetic factors, teratogenic agents (viral disease, drugs, and alcohol) may be the causative agent. Children with Down's syndrome often have congenital heart disease. The CHD can be broadly classified into cyanotic and acyanotic. In acyanotic diseases, blood is shunted from left to right due to cardiac defect. This group mainly includes ventricular and arterial septal defect and defects that causes obstruction. Clinical manifestations include congestive heart failure, pulmonary congestion, heart murmur, labored breathing etc. A cyanotic heart disease is characterized by right to left shunting of blood within heart. Cyanosis is observed even on minor exertion, e.g. teratology and Fallot's clinical manifestation include cyanosis, hypoxic spells, poor physical development and finger clubbing.

Acquired Heart Disease

- a. Rheumatic heart fever: It is a serious inflammatory disease of heart. It is a delayed complication of pharyngeal infection with group A *streptococci*. The infections can involve heart, joints, skin and CNS. Although, it can occur at any age, it occurs most commonly between 6 and 15 years of age. Cardiac

involvement is the most significant pathologic complication of rheumatic fever which can be fatal during the acute phase or may lead to chronic rheumatic heart disease as a result of scarring and deformity of bicuspid or tricuspid heart valves.

- b. Infective bacterial endocarditis: It is characterized by microbial infection of the heart valves or endocardium in proximity to congenital or acquired cardiac defects. It is broadly classified into acute and sub acute forms. The acute form is fulminating disease that usually occurs as a result of microorganisms of high pathogenicity attacking a normal heart, causing erosion or destruction of valves.

Formation of emboli is the characteristic feature of infective endocarditis. Vegetations composed of microorganisms and fibrous exudates develop on damaged heart valves or endocardium. They might dislodge and pass into systemic or pulmonary circulation resulting blockage of a minor artery. (Specially cardiac artery).

Clinical symptoms are:

- Low, irregular fever with sweating and malaise
- Anorexia, weight loss
- Arthralgia, painful fingers and toes, joints and skin lesions develop
- Inflammation of endocardium increases cardiac destruction and murmur develop.
- Laboratory findings can include leukocytosis, neutrophils and anemia with increased E.S.R.

Management

Antibiotic Prophylaxis

Bacterial endocarditis could occur following any dental procedure capable of producing transient bacteremia. Therefore, all patients with cardiovascular system disease should receive antibiotic prophylaxis as recommended. Careful consultation with the cardiologist is essential regarding dental needs, anesthesia, sedation, drug therapy and other medical conditions of cardiovascular diseased patients.

1. Antibiotic prophylaxis is recommended in:
 - Dental procedures likely to induce gingival or mucosal bleeding.
 - Surgical operation involving respiratory mucosa.
 - Incision and drainage of infected tissue.
 - Intraligamentary operations or injections.

2. Dental procedure not requiring prophylaxis:

- Simple adjustments of orthodontic appliances or fillings above gingival level.
- Injection of local intraoral anesthetic (except Intraligamentary)
- Natural exfoliation of primary teeth.
- New denture insertion.

- i. Adequate anesthesia: Anxiety control is essential in cardiac patient. Since, it may lead to precipitation of cardiac symptom. Sometime patient may require sedation. Parental sedation and GA should be used only in a hospital environment. L.A is not contraindicated. Lidocaine 2 percent with 1:100,000 adrenaline is advised. Careful monitoring of patient for vitals signs and oxygen saturation with the help of pulse oxymetry is done.

- ii. Other considerations for cardiac patients: Preventive or minimal interventions are always preferable over surgical treatment.
 - In primary teeth, extraction is preferred over pulp therapy.
 - Permanent teeth with poor or questionable prognosis should be removed.
 - Patients with pacemaker, but without existing heart defects do not require prophylactic antibiotic coverage. In this patient, dental devices like electrosurgical units, pulp tester, ultrasonic cleaning devices, light curing system etc. that may interfere with pacemaker functioning should be avoided.
 - There should be careful assessment of drug intake and adverse reactions considered.
 - In case of complicated cardiovascular disease, palliative treatment is preferred.
 - Following open heart surgery – dental treatment is delayed for a minimum of 3 months.

Coagulation Disorders

Patient with coagulation disorder are identified by history, careful physical examination and laboratory tests. The history should include previous excessive bleeding or spontaneous bleeding. Physical examination includes assessment of signs of coagulation disorders such as jaundice, ecchymoses, petechiae and hematoma. Lab

blood test of both prothrombin time and thromboplastin time are used to examine coagulation phase of hemostasis.

Normal PT = 11-14 sec. Normal PTT = 60-70 sec. Bleeding time is an assessment of platelet phase of hemostasis. Normal BT = 1-6 min. Normal CT = 5-8 min.

Hemophilias: Hemophilia is disorders of hemostasis resulting from a deficiency of procoagulant. Hemophilia A, or classic hemophilia is deficiency of factor VIII also known as anti-hemophilic factor. Factor VIII deficiency is the most common type of hemophilia and is inherited as an X-linked recessive trait. Therefore, males are affected and females are carrier.

Hemophilia B or Christmas disease is caused by a deficiency in factor IX (plasma thromboplastin component) and is also inherited as an X-linked recessive trait. Factor IX deficiency is one fourth as prevalent as factor VIII deficiency.

Factor IX deficiency is inherited as an autosomal recessive traits. Von Willebrand's disease is a hereditary bleeding disorder resulting from an abnormality of the Von Willebrand's factors that is found in plasma, platelets, megakaryocytes and endothelial cells. It circulates in conjunction with factor VIII. It is important in platelet's adhesion to the subendothelium via collagen and thus helps information of platelet plug.

Impaired formation of platelet plug may result in bleeding tendency from skin and mucosa, bruising, epistaxis, prolonged bleeding after surgical procedures and long menorrhagia. In contrast, factor VIII, and IX deficiency involve bleeding into muscles and joints.

Hemophilia A and B are classified on the basis of level of procoagulant present. Severely deficient patient may experience, frequent bleeding episode. The common sites of bleeding include joints, muscles and skin. Hemarthroses are common in knees, elbows, ankles, hip, and shoulders.

Treatment

The treatment for hemophilia is replacement of deficient Plasma hemophilic coagulation factors. The dosage, frequency of administration and duration of therapy depends upon the activity level required and the half life of procoagulant and the location and severity of the

bleeding episodes. The half life of factor VIII is approx. 12 hours and that of factor IX is approx. 24 hours.

Complications

- Uncontrolled bleeding.
- Arthritis and degenerative joint disease secondary to recurrent bleeding.
- Blood borne viral disease like hepatitis and liver disease causes lesser production of coagulant in the liver resulting in deficient concentration of coagulant in plasma.

Precaution During Dental Treatment

- A rubber dam should be used to isolate the operating field and to retract and protect cheek, lip and tongue. Thin rubber dam is preferred. Retainers with sub gingival extensions such as 8A or 14A should be avoided. High speed vacuum and saliva ejectors must be used with caution so that subgingival Hematoma is not formed.
- The preparation of tooth for a cast crown requires caution in the gingival preparation because it may tear subgingival mucosa resulting in subgingival bleeding.
- **Pulp therapy:** A pulpotomy is preferable to extraction and indirect pulp procedures are preferable over pulpectomy. If vital pulp is exposed and intrapulpal injection may be safely used to control pain. Hemorrhaging from pulp chamber does not present a significant problem if readily controlled with pressure cotton pledgets.
- **Oral surgery:** Preoperative evaluation and post operative management of patients with hemophilia undergoing extractions must be coordinated with a team including physician and dental surgeons. Dental clinic must have instruments for infusion and a small coagulation laboratory capable of performing various tests.

For extractions of permanent and posterior primary teeth, antifibrinolytic therapy should be started immediately before the procedure and continued 7 to 10 days. The patient should be placed on a clear liquid diet for 72 hours. Soft pure diet is recommended for next seven days. During this time use of straws or metal utensils are contraindicated. After 10 days the patient

may begin to consume a more normal diet. All extractions should be completed in one appointment because of the factor concentrate.

- After extraction direct topical application of haemostatic agents such as bovine thrombin or collagen hemostat may be used. The socket should be packed with an absorbable gelatin sponge. Topical thrombin or microfibrillar collagen may then be sprinkled on the wound. Direct pressure should be applied to the area.
- Reabsorbing sutures are advisable after surgical extraction of impacted, partially erupted or unerupted teeth. A higher plasma factor activity level may be required. For simple extraction of single rooted primary tooth if there is complete root formation, factor replacement is necessary. If there is only partial root formation, Antifibrinolytic with local haemostatic agents are sufficient.
- The normal exfoliation of primary teeth does not require factor replacement and bleeding can be usually be controlled with direct finger and gauge pressure and topical application of local hemostatic agents.

Surgical Complications

Despite all precautions bleeding may occur 3 to 4 days postoperatively when clot begins to breakdown. After adequate factor replacement the clot should be removed and the area is cleaned to help isolate source of bleeding. The socket should be repacked with microfibrillar hemostat.

Orthodontic treatment: Precaution should be taken in adaptation and placement of bands to avoid laceration of oral mucosa and crevicular mucosa. If bleeding is caused by an accidental scratch or minor laceration of gingiva, it responds well to 5 minute applied pressure.

Sickle-Cell Disease: It is hereditary hemolytic anemia and occurs in those individuals who have homozygous gene for sickle. It is characterized by formation of abnormal hemoglobin which crystallizes within RBC's causing them to assume bizarre shapes. The cells are most susceptible to hemolysis and have difficulty passing through small blood vessels. This may result in ischemic changes and infarctions.

Maxillofacial involvement includes typical facial characteristics of chronic hemolytic anemia, jaundice of

both extra oral and intra oral tissues and protrusive tendency of the maxillary arch.

Precautions During Dental Management

- Minimize stress. Since, stress decreases the child's ability to oxygenate the tissues.
- Infection control. Most patients have generalized osteoporosis of mandible. Infection may precipitate sickle cell crises.
- For sedation use only those drugs which do not depress the respiratory system.
- Local anesthesia with vasoconstrictor is not contraindicated except for Prilocaine that is associated with formation of methemoglobin.
- G.A. is associated with high risk. Appropriate medical and hematological preparation and transfusion should be available.
- Hepatitis precaution should be taken.
- Antibiotic prophylaxis for routine restorative work is not needed but is necessary in case of surgical procedure (RCT or periodontal surgery).

Respiratory Disorders

Cystic Fibrosis

It is a multisystem disorder characterized by chronic nasal and sinus obstruction, upper tract infection, maldigestion caused by pancreatic insufficiency and other abnormality of digestive tract. Sexual development is usually delayed.

Dental symptoms may include variable degree of discoloration of teeth due to tetracycline therapy in early childhood or during pregnancy, enamel hypoplasia, changes in salivary viscosity and composition. Incident of dental caries is lower probably due to frequent antibiotic intake, buffering capacity of excess calcium in saliva and pancreatic enzyme replacement therapy.

Precautions During Dental Management

- There should be clear understanding of pulmonary involvement, antibiotic history, frequent communication with physician and strict oral hygiene programed.
- During complication only emergency treatment is advised.
- Physician should be consulted before administration of N_2O-O_2 sedation.

- The use of sedative agents that interfere with pulmonary functions should be avoided.
- There is high incidence of mouth breathing and open bite malocclusion due to chronic nasal and sinus obstruction.

Asthma: It is a chronic obstructive lung disease involving the large and small airways of bronchotracheal tree. A variety of stimulus may trigger the obstruction of airways. This can be triggered by allergens or irritants, hormonal changes, infections, stress, or medications.

Precautions During Dental Management

- Before initiation of dental treatment, medical history must be gathering related to medications, frequency of wheezing, allergies, and specific trigger agents.
- In patients receiving corticosteroids, the dosage should be doubled or tripled and patient seen soon after medication intake.
- As the half life of bronchodilators is only 2 to 4 hours. It is desirable to treat such patient soon after they receive medication.
- Use at N_2O-O_2 sedation is helpful. Aspirin compounds are contraindicated. If narcotic analgesia is needed, meperidine hydrochloride is the drug of choice. Diazepam is not contraindicated. Pancuronium is considered the most desirable muscle relaxant.

Emergency Treatment

- Administration of 100 percent O_2 .
- Place patient in a sitting position together with forward bending.
- Subcutaneous administration of epinephrine.

Renal Disorders

Chronic Renal Failure (CRF)

CRF may result from progressive and irreversible renal damage. The causes of CRF include chronic glomerulonephritis, chronic pyelonephritis, or congenital renal anomalies, hypersensitivity disease and diabetics. Medical care is directed towards prevention of fluid and electrolyte imbalance in body. Restricted intake of protein diet is advised because it may increase serum creatinin level. Serum hypocalcemia and hyperphosphatemia

may occur. In patient with severe failure peritoneal or haemodialysis become necessary, with renal transplantation as the last course of action.

Precautions During Dental Management

- Patient exhibits growth retardation with mineralization disturbances. Eruption is not affected in CRF patients.
- Prevalence of dental caries is low in CRF cases due to increased concentration of salivary urea and higher pH.
- Administration of cyclosporine may results in gingival overgrowth.
- In case, the patient is on dialysis, treatment is done 24 hours after dialysis, when heparin is no longer a factor in hemostasis.
- In patients receiving steroid therapy supplementation is done before major dental procedures.
- Precaution against hepatitis should be either avoided or their dosage modified.
- In case of severe CRF, patient should be treated in a hospital environment.

Hepatic Disorder

Hepatitis A (Infectious hepatitis): It occurs more frequently in overpopulated poor sanitation conditions. The incubation period ranges from 15 to 40 days. Most common mode of transmission is oro fecal route. Initially, it is usually asymptomatic or with abnormal pain, low grade fever, anorexia and increased serum urea. Severe cases are manifested by fever, hepatomegally, jaundice, vomiting and diarrhea. Most patients recover without relapse or development of chronic hepatitis. No specific therapy is required. An appropriate diet, isolation and complete bed rest is necessary.

Hepatitis B (Serum hepatitis): Incubation period of hepatitis B ranges from 40 to 180 days. Clinical symptoms are similar to hepatitis A. Mode of transmission is through parenteral route by contaminated blood products or instruments, tears, saliva, urine, feces, or semen. No specific treatment is available, however, bed rest and adequate nutrition is recommended. This disease showed 100 percent mortality rate. Children with hepatic disorders may manifest clinical signs of jaundice, enamel hypoplasia or hypo calcification and discoloration of tooth.

Hepatitis infection control in dental operatory

Protocol:

1. Provide treatment in isolated and sterilized area
2. Staff involved in hepatitis control should wear sterilized disposable gown
3. Cover dental chair and all other equipment with disposable sterilized sheet
4. Dental staff should follow strict aseptic technique
5. Dental staff should use protective eyewear
6. Minimize the handpiece aerosol with the help of suction
7. All contaminated instrument should be placed in labeled color coded-plastic bag for sterilization and waste disposal
8. All gowns and covers must be sterilized or properly discarded
9. Dental operatory must be appropriately cleaned after use.

Precautions During Dental Management

- If patient is suffering from hepatitis, he should not receive any elective dental treatment. Only emergency care is delivered.
- Strict hepatitis precautions must be advised.
- When surgical procedure is required, PT and bleeding time must be assessed.
- Drug therapy should exclude medications that are metabolized by liver.
- Dentist and dental professional are at a very high risk and should receive Hepatitis B vaccine.
- Patients with advance a liver disease should be treated in a hospital. In candidates for liver transplantation all foci of infection such as advanced dental caries and oral infections should be first eliminated.

Endocrine Disorders

i. **Diabetes Mellitus;**

Diabetes mellitus is a generalized disturbance caused by deficiency of insulin. It is characterized by derangement of carbohydrate, protein and fat metabolism. Three major forms of diabetes have been identified.

1. Juvenile Onset (Type I): Insulin dependent, mostly occurs in children.
2. Maturity Onset (Type II): Non-insulin dependent occurs after 40 years of age.
3. Secondary Diabetes: Occurs secondarily to certain disease such as cystic fibrosis.

Clinical Manifestation

- Polyphasia
 - Polydypsia
 - Polyurea
 - Failure to gain weight
 - Fatigue, dizziness, confusion and hyperventilation.
- Uncontrolled diabetes is more prone to infections.

Precautions During Dental Management

- Well controlled diabetics can be treated normally in a dental office.
 - In case of juvenile diabetics, it is advised that patient should receive their insulin and breakfast as usual before initiation of treatment. Appointments should be kept in morning hours and either a glucose solution or juice is kept available to treat hypoglycemia.
 - Use of prophylactic antibiotic is always advised.
 - Reduction of stress during treatment is important.
 - L.A. is not contraindicated.
 - Acute infections should be treated aggressively by high antibiotic doses.
- ii. **Hyperthyroidism:** It usually occurs between the age of 12 and 16 years. It is characterized by following sign:
- Restlessness
 - Palpitations
 - Tachycardia
 - Systolic hypertension
 - Exophthalmos goiter
 - Large sized jaws
 - Accelerated growth and development including dentitions and precocious puberty.

Note: Patient receiving regular therapy require no special precautions. Patient poorly treated are susceptible to thyrotoxicosis crisis.

- iii. **Hypothyroidism:** In children hypothyroidism is known as cretinism and it can be either congenital or acquired. Insufficiency of thyroid hormone is associated with physical and mental sluggishness, poor muscle tone, macroglossia, hypothermia, bradycardia and large fontanelles.

No specific precaution is necessary. It is important to treat infection promptly. Use of Epinephrine is avoided in poorly controlled case.

iv. **Hypoparathyroidism:** It may result because of surgery, a general autoimmune disorder associated with Candidiasis, Addison's, pernicious anemia, diabetes mellitus, thyroiditis and alopecia.

Signs and symptoms are:

- Tetany and prolonged hypocalcemia.
- Bizarre behavior, irritability and even mental retardation.
- Hypoplasia of dentition.
- Weaker molar roots.
- Twitching of facial and Perioral muscles.

Treatment: Elective dental care should be delayed until systemic manifestations are under control. Emergency care is directed towards control of infection and pain.

v. **Hyperparathyroidism:** It is characterized by excessive secretion of parathyroid hormone. Primary hyperparathyroidism may be due to adenoma or hyperplasia while secondary disease can be caused by chronic renal disease, anomalies of GIT, vitamin D refractory rickets.

Oral sign and symptoms are:

- Absence of lamina dura
- Ground glass appearance of bone, cyst like bony lesions
- Loose and malpositioned teeth
- Hypoplasia or hypo calcification of dentition.

Treatment: Patients with milder form of disease can undergo dental treatment without complication. Elective dental treatment is provided only after symptoms are controlled in patients with complications.

Adrenal Insufficiency

There are two types of adrenal insufficiency, primary and secondary. Primary insufficiency (Addison's disease) is caused by disease affecting the pituitary or adrenal glands. Secondary insufficiencies can be caused by prolonged administration of steroids.

Clinical Manifestation

- Fatigue, anorexia, weight loss
- Abnormal pigmentation of skin and mucous membrane
- Stress may precipitate addisonian adrenal crisis.

Precautions During Dental Treatment

Doubling or tripling of dosage of steroid is advised before dental appointments. Patients on topical steroid ointments are candidates for steroid supplementation. In emergency, if physician is not available an IM dose of hydrocortisone 1 hour before appointments is acceptable.

Convulsive Disorder

Seizures are sign of abnormal brain function. It is caused by excessive and disorderly discharge of neurons of the brain which results either in stimulation or inhibition of certain body functions. The causes can be:

- Genetic
- Infection, fever, tumor, hypoxia
- Hypocalcemia, brain malformation
- Degenerative diseases or

Unknown seizures have been classified as febrile, partial or generalized.

Febrile Seizures: Occurs in preschool children who develop sudden high fever above 104°F. Most patients do not have subsequent seizures.

Partial Seizures: They are caused by localized abnormalities as determined by EEG. There are two types of partial seizures with elementary symptomatology and with complex symptomatology.

Generalized Convulsions

They can be divided into:

- Petitmal
- Generalized tonic-clonic (Grand mal)

Grandmal seizures are preceded by an aura. The attack begins with a violent tonic contraction of all muscle with upward rolling of eyes. The tongue is frequently bitten; the child may salivate excessively and have uncontrolled bladder and bowels. This is followed by clonic phase where limbs and trunk jerk violently. Seizures may be followed by headache, confusion, or deep sleep.

The general goal, medical as well as dental are prevention of seizures. It is essential to take complete medical and drug history and toxicity and precaution required for each drug.

Preventive Measures

- Reduces stress with psychological behavior management and sedation. Diazepam is a drug of choice.

- Use appropriate lighting and do not position directly over patient's face, it may precipitate seizures.
- Avoid seizures promoting drug such as phenothiazine.
- Appropriate drug intake as advised by the physician is carried out, if the child develops a seizure:
- Place patient on the floor on his side
- Maintain patent airway
- Administer oxygen for prolonged convulsions.
- Protect the patient from biting the tongue.
- Administer diazepam slowly in increments of 3 mg. IV for a total dose of 10 mg in 20 ml saline (to lower the concentration).
- Transfer the patient to the hospital if patient does not respond within 5 min.

Immune Disorder

Immuno deficient patient can be classified as follows:

1. Patient with congenital immune defects of cellular or humoral immunity or both.
2. Patient with malignant lesions.
3. Patient receiving immunosuppressant therapy for treatment of malignancies or with various types of transplants.
4. Patient with low WBC count.
5. Patient with AIDS.

Management of such patients is based on the following:

1. Underlying condition must be thoroughly assessed through different investigation reports.
2. It must be assessed, whether oral manifestations are likely to complicate or endanger patient medical status.
3. Antimicrobial therapy must be based on sensitivity report and should be lethal and specific for the infectious agents.
4. Biopsy specimens can enhance the diagnostic process.

Leukemia

It is the most common form of malignant disease in children below the age of 15. Acute lymphoblastic leukemia (ALL) is the dominating form accounting for 75 to 80 percent of the cases. Acute myelogenous leukemia (AML) is also seen in children. Leukemia is characterized by uncontrolled proliferation of leukocytes

and their precursors in the bone marrow, blood and reticuloendothelial tissues that are invaded by immature blood cells.

The signs and symptoms of disease include anemia, weakness, fever and fatigue. Petechiae, ecchymoses and bruises even after minor trauma can be seen due to thrombocytopenia. Pain in leg occurs due to leukemic infections. If no treatment is instituted death occurs within 4 months due to bleeding or infections.

Therapy – It is treated with cytotoxic drugs in various combinations with steroids and sometime with radiation. The goal is to eliminate leukemic cells from the body. The treatment causes thrombocytopenia and granulocytopenia

Precautions During Dental Management

- Leukemic child whose first remission has not been obtained or one who is in a relapse, all elective procedures are deferred. It is essential that potential source of infection should be controlled, for example, immediate extraction of carious teeth with pulpal involvement.
- Routine dental procedure can be provided in a patient with complete remission. Before the appointment preferably the same day- a blood picture should be taken.
 1. Pulp therapy on primary teeth is contraindicated in any patient with history of leukemia. Endodontic treatment for permanent teeth is not recommended in patients with granulocyte suppression. An area of chronic inflammatory tissue may remain in the periapical region and may act as foci of infection.
 2. If patient have less than 20,000 platelets/cumm³. Any surgical treatment are contraindicated Prophylactic platelet transfusion should be given under physician's guidance.
 3. It may be necessary to discontinue the use of tooth brush due to spontaneous bleeding and substitute with moist gauze wipes and saline rinses.
 4. Patient with classical leukemic gingivitis experience varying degree of discomfort, the use of warm saline rinses several times may bring relief.
 5. Erosive or ulcerative lesions are commonly associated with chemotherapeutic agents. Treatment is directed towards relief of discomfort.

6. Candidiasis is common in children who are susceptible because of debilitation, prolonged antibiotic therapy, poor oral hygiene and immunosuppression. Nystatin oral suspension (100,000 units/ml) 5 ml chewed for 5 minutes and then swallowed) is advised every 6 hrs, continued after lesions disappear for the period of 2 week.
7. Prescription of salicylate is avoided.

Malabsorptions and Chronic Inflammatory Intestinal Diseases vs Dental Caries

- Patients with Cron's disease have high consumption of sugar. An individualized preventive programmed is essential to reduce risk of dental caries. Recurrent apthous ulcerations are associated with the disease.
- Coeliac disease has shown to induce mineralization disturbances of permanent teeth due to malabsorptions.
- In patients with lactose intolerance, if milk is substituted with soft drinks, dietary advice should be given to avoid dental caries.

DEVELOPMENTALLY COMPROMISED PATIENTS

Down's Syndrome (Mongolism, also see chapter *Genetic Counseling*)

It is also known as Trisomy 21 syndrome. Down's syndromic patient are characterized by following clinical feature such as reduced height, small head, short neck, round flat face, short hand etc. There is hypotonic muscle and hypermobility of joints. Death at an early age is common often caused by congenital cardiac failure or respiratory tract infections. Patients also have low resistance to infections and a high incidence of leukemia. It is also associated with mild to severe mental retardation.

Children with Down's syndrome showed following oral manifestation:

- Rapid destructive periodontal diseases related to tooth morphology,
- Bruxism,
- Malocclusion and poor oral hygiene,
- Systemic factors that complicate the conditions are poor circulation, decreased humoral response, general physical deterioration and genetic influence.

- Low prevalence of dental caries attributed in part of delayed eruption.
- Abnormal sequence of eruption.

Management

- Many children are affectionate and cooperative.
- Light sedations and restrains may be used in patients who are apprehensive.
- Severely resistive patients may require GA.
- Delayed tooth eruption frequently occurs in such children.

NEUROPSYCHOLOGICAL DISABILITIES

Mental Retardation

It has been defined as "significantly sub average person's ability to think in a logical way and understands things and functioning existing concurrently with deficits in adaptive behavior and manifested during developmental period. Children with IQs below 70 are classified as mentally retarded. IQs have been further subdivided to reflect various levels of retardation. Several pathologic conditions such as chromosomal disorders, maternal infections (rubella), hypoxia, trauma and metabolic disorders may be etiologic factors.

Oral Manifestation of Mentally Retarded Patient

- Prevalence of dental caries and periodontal disease in mentally retarded individual is predicted by multiple intrinsic and extrinsic factors like age, degree of mental retardation and oral hygiene status.
- Bruxism, self injurious behavior and caprophagia compromised oral health.
- High incidence of delayed eruption and over retained primary teeth.

Level of mental retardation		
<i>IQ level</i>	<i>Level of mental impairment</i>	<i>Individual's ability</i>
<24	Profound	Totally dependent
39 to 25	Severe	Dependent
54 to 40	Moderate	Trainable
69 to 55	Mild	Educatable
85 to 70	Borderline	Slow learner

Management

- Children with mild retardation can manage with simple, preventive and short, predictable operative procedures and are very cooperative.
- Children with moderate mental retardation respond well in dental sitting. Sometime they may require heavy sedation and restraint method of behavior modification.
- Children with profound mental retardation are candidates for GA.
- Mentally retarded patients usually present with anomalies of facial structure, morphology of teeth, malocclusion, and open bite, hypoplasia or hypocalcification. Most common dental disease is caries.

Following procedure have proved beneficial in treatment of patients with mental retardation.

- Familiarize patient with dental personnel and facility available in dental office.
- Give one instruction at a time. Reward with compliments.
- Listen carefully to the patient.
- Keep appointments short.
- Schedule patient in the morning.

Childhood Autism

Childhood autism is an early onset developmental disturbance of behavior and communication. Koppel listed 12 behavioral characteristics:

- Extreme loneness,
- Language disturbance,
- Mutism,
- Parrot like repetitions
- Speech difficulty with concept of 'yet',
- Confusion, obsessive desire for maintenance of sameness,
- Eating disturbance,
- Mobility such as intrigue with spinning objects,
- Hyperactivity,
- Self stimulatory behavior,
- Nystagmus,
- Mental retardation and seizure disorder.

Behavior modification techniques using positive reinforcement, special education programs, psychotherapy, and family counseling to pharmacologic therapy have been employed. Gingival hypertrophy may be seen due to Phenytoin administration.

Oral Manifestation

- Poor tongue coordination with food pouching.
- Increased rate of oral trauma due to accident proness and self inflicted injuries.

Management

- Dentist should use patience with slow approach.
- Behavioral management techniques such as Tell-show Do, modeling technique and positive reinforcement may be useful.
- Preoperative sedation with muscle relaxant and use of N₂O-O₂ analgesic may be required.

Hyperactivity

It is a childhood disorder also termed as minimal brain dysfunction or hyperkinetic syndrome. It is characterized by following sign and symptoms:

- Increased motor activity and restlessness
- Short attention span and inability to concentrate
- Lack of motor coordination
- Difficulty in performing structured task and lack of social integration
- Although, children may be of normal intelligence but demonstrate learning disabilities and fail to achieve expected level of intellect.

Factors such as brain damage in uterus or during birth, hypocalcaemia, and nutritional deficiencies may be etiological.

Treatment consists of medications in addition to psychological and behavior therapy. Amphetamines are most effective.

Management

- Patient delay in reception area should be kept minimum.
- Because of short attention span, dental appointments should be kept short.
- Routine behavioral modification techniques are of little use.

Cerebral palsy: Cerebral palsy is a chronic condition in the neuromuscular system resulting from early damage during prenatal, perinatal, and postnatal stage before the CNS has reached maturity. It is characterized by following signs and symptom:

1. Increased muscle tone
2. Decreased muscular strength

3. Involuntary movement
4. Trembling or stiffness
5. Patient may present with history of seizures disorder, mental retardation, behavioral or emotional problems, visual or hearing impairments.

There are three types of cerebral palsy:

1. Spasticity
2. Athetosis
3. Ataxia.

Spasticity type of cerebral palsy is characterized by:

- Increased muscle tension and excessive involuntary contraction when the muscle is stretched.
- Counted control of neck muscle.
- Lack of control of muscle that support the trunk.
- Lack of coordination of intraoral, perioral and masticatory musculature.
- There is impaired chewing and swallowing, excessive drooling and persistent spastic tongue thrusts.

Athetosis types of cerebral palsy is characterized by:

- Constant and uncontrolled motion of involved muscles
- A succession of slow, twisting involuntary movements
- Excessive head movements
- Uncontrolled jaw movements
- Hypotonic perioral musculature with mouth breathing
- Tongue protrusion and excessive drooling and chewing and swallowing difficulties.

Ataxia types of cerebral palsy is characterized by:

- Muscles are unable to contract completely
- There is poor sense of balance and uncoordinated voluntary movements.

Oro dental symptom:

- Mineralization defect and delayed eruption of permanent teeth
- Bruxism, drooling of saliva
- Lip biting
- Increased incidence of fractured anterior teeth due to trauma resulting from fall/accident.
- Mouth breathing contributes to orthodontic problem of anterior open bite and increased overjet.

Precautions During Dental Management

- Patient must be preferably treated on the wheel chair
- Make all effort to stabilize the patients head during treatment.

- Maintain patient in midline of dental chair with arms and legs as close to body.
- Keep patient's back elevated to minimize difficulties in swallowing.
- Use physical restraints for controlling failing movements of the extremities.
- For control of jaw movements choose from variety of mouth props and finger splints and bite blocks.
- Avoid abrupt noises, movements and light to minimize startle reflex reactions.
- Consider use of rubber dam if possible.
- Work efficiently and minimize chair time.

Sensory Disabilities

Deafness: Deafness in children may be due to genetic disorder, infections, prematurities; trauma etc. most deaf children have delayed speech development.

Oral symptom: Dental hypoplasia and demineralization related to etiology of sensory impairment.

Treatment consideration in dental operatory:

- Prepare the patient for the appointment.
- Let the patient decide the method of communication, for example-interpreter, lip reading, sign language etc. face the patient and speak at a normal pace.
- Enhance visibility for communication.
- Reassure patient with methods of physical and other methods of behavior management.
- Display confidence.
- Avoid blocking of patient eye's with rubber dam.
- Adjust hearing device before airtor handpiece is in operation.
- Make sure that patient understands explanation of diagnosis with treatment.

Blindness

Blindness in children can be caused by prenatal infection (rubella). Blindness can also be seen in various syndromes, post natal causes may be tumor, trauma or certain medical condition.

Oral symptom: Same as deaf patient.

Treatment Consideration

- Determine the degree of visual impairment
- Ask patient's desires and assistance in moving to dental clinic.

- Describe dental clinic setting with adequate description.
- Assure the patient by method of physical contact
- Avoid sight references.
- Invite patient to touch, taste or smell.
- Use audiocassettes and Braillo dental pamphlets to supplement information or advice.

Physical Disabilities

Various hereditary or progressive conditions may leads to physical disabilities.

1. Muscular dystrophy constitutes a group of primary myopathies that reset in progressive degeneration of striated muscle.
2. Myasthenia gravis is a neuromuscular junction disease of unknown cause. Symptom include ptosis of eye lids, deglutition and speech problem along with muscular weakness of arms and legs.
3. Spina bifida is a congenital defect of spinal column characterized by a localized absence of vertebral arches with a protrusion of spinal membrane into the area of defect.
4. Patients have difficulty in locomotion.

Treatment consideration in dental operatory:

- Preventive oral hygiene program
- Dentist should optimize comfort
- Pharmacologic agents that depress respiration are avoided.

Cleft Lip and Palate

Cleft lip and palate are structural defects of facial oral complex that may vary from a slight notching of the lip or small cleft of uvula to a complete separation of lip and absence of partition of oral and nasal cavities. Majorities of patients develop associated defects such as malformed teeth malocclusion, impairment of speech, middle year infections and high susceptibility to upper respiratory tract infections.

Precautions During Dental Treatment

- The extent of dental care needed may vary considerably according to severity of original malformations.
- Rehabilitation starts immediately after birth, a feeding appliance is constructed that facilitate feeding and prevents collapse of maxilla.

- Initial dental visit should be made when patient is 2 to 3 year old, at that time primary dentition is developing and surgical closure of cleft is completed.
- It is essential that radiographs are obtained at 4 year of age, for detection of caries, supernumerary, congenitally missing or malformed teeth.
- Most of cleft lip and palate patient have deviated nasal septum. Interference with this causes high degree of anxiety in these patients.
- Patients usually have supernumerary teeth in deciduous and permanent teeth. In deciduous dentition such teeth are allowed to exfoliate naturally, as extraction may causes loss of adjacent teeth. Supernumerary' teeth in permanent dentition are extracted at earliest as possible.
- The space occupied by congenitally missing or prematurely lost teeth should be maintained.
- Dental hypoplasia is usually seen on central and lateral incisors, adjacent to cleft site, whenever possible these teeth should be restored with composite and fluoride solution applied.
- Special prosthetic appliance is needed to improve patient's speech and esthetic. Speech appliance is fabricated, consisting of partial denture frame work with an extension of metal frame into cleft area.
- Cleft patient with retruded maxilla, an overlay denture is required for improved occlusion and appearance.
- Since, retention of prosthetic appliance is a major problem, preservation of teeth for eventual retention of appliance is of utmost important.

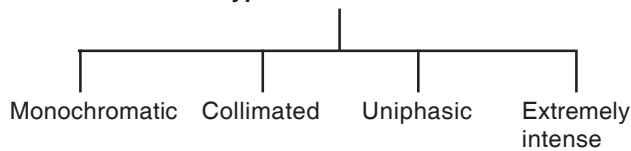
BIBLIOGRAPHY

1. Cottone JA, et al. Hepatitis B virus infection in the dental profession, JADA 1985;110:617-21.
2. Curtis AB. Childhood leukemias: Initial and manifestations, JADA 1971;83:159-64.
3. Hsia PC, et al. Non A, Non B hepatitis: Impact of the emergence of the hepatitis C virus, Adv Intern Med 1991;31:223.
4. Mc Kown CG. Oral Management of patient with bleeding disorders. Part II: Dental considerations, JIDA 1991;70:16-21.
5. Sonis AL, et al. Oral bleeding in classic hemophilia, Oral Surg 1982;53:363-6.
6. Stafford R, et al. Oral pathoses is diagnostic indicators in leukemia, Oral Surg 1980;50:134-9.
7. The treatment of hemophilia. New York, 1975-1982, the National Hemophilia Foundation, Medical and Scientific Advisory Council.

Laser in Dentistry

Term Laser stands for light amplification by stimulated emission of radiation. Laser is a high technology device that generates a beam of concentrated light. This beam of light brings energy into the mouth and removes areas of infections or tooth decay with great precision and accuracy. Dental child patients treated with lasers are much more comfortable both during and after treatment, because in many instances the need for anesthetic injections is eliminated, as well as associated side effects, and also less time spent on the dental chair.

Types of laser beam



- An ideal laser beam is monochromatic i.e. composed of a single wavelength of light. In collimated laser, the light waves are parallel to each other instead of diverging, while in case of uniphasic laser, the peaks and valleys of the waves are synchronous.
- Laser beam can reflect off, transmit through, scatter within or can be absorbed by organic target tissue. The 1st three conditions elicit no response within the tissues but when absorbed, a laser beam may produce several different results. The photo thermal effect of laser generates tremendous heat within the tissues. In soft tissues, it causes the intracellular water to boil or vaporize and literally explodes and disintegrates the cells. In hard tissues, similar effects are seen in hydroxyapatite because of its water content.

- Laser, wavelengths that are absorbed by water e.g. CO₂, Er: YAG lasers are appropriate for soft tissues surgery.
- Laser wavelength well absorbed by hemoglobin is better suited for vascular tissues such as argon, copper vapor lasers.
- Er: YAG is absorbed by both hydroxyapatite and water and allows for hard tissue usage.

Principle modes of laser use: there are basically two principle modes of uses of laser

1. Focused mode/incision mode: the tip target distance in this mode is about **0.5 mm** for hollow wave guide type of laser to more than **1 cm** for articulated arm laser. This mode is used for incision of target tissue.
2. Defocused mode or ablation mode: In this mode the target tissue distance is increased leading to vaporization or removal of the superficial tissues and not deeper tissues.

Laser for Hard Tissues (Teeth)

In 1997, the Er: YAG laser (Fig. 37.1) with a wavelength of 2.94 micron was cleared for marketing by the US food and drug administration (FDA), for hard tissues, after extensive scientific and clinical use.

- In 1999, Er: YAG laser were cleared for all ages (can be safely used in children). Precise ablation of sound, carious enamel and dentine with a shallow thermal penetration (5 micron) depth is a quality of this laser wavelength. It was observed that with the use of this laser, pulpal temperature was increased above the threshold limit for irreversible pulpitis; otherwise it was less irritating than use of conventional drill.



Fig. 37.1: Dental laser machine with focusing hand piece (water laser)

Wigdor et al reported that dental cavity preparation with laser is leaving uniform, smooth dentinal tubules without debris as compared to the conventional cavity preparation.

Advantages

1. Normal architecture of odontoblastic layer was retained with no irreversible inflammatory cell infiltration.
2. Reparative dentine formation has been reported immediately adjacent to the pulpal floor of the laser treated area occurred in four days.
3. No morphologic changes in dentinal tubules beneath the laser preparation zone.

Hard tissue laser biophysics: Er: YAG laser is highly energetic and produces wavelength of 2.9 micron (infrared light), and its short pulse causes fast healing of dental tissues in a small area. A fast shock wave is created when energy dissipates explosively as volumetric expansion of water in hard tissue occurs. This phenomenon is called cavitations. Water molecules are superheated, explode and in turn ablate tooth structure and caries.

Capabilities and Limitations of Laser

The Er: YAG laser are cleared by the FDA for class I to VI cavity preparation. During laser cavity preparation 1 mm dentine should be present between laser beam and the pulp in children and adult both. The laser

modification (Etching) is characterized by typical chalky appearance at cavosurface margin and internally within the dentine.

Dental use of laser: dental laser can be used to do the following

1. To remove caries
2. To remove enamel, dentine and cementum
3. To remove composite and glassionomer cement
4. Ablate soft tissue with no hemorrhage.
5. For all cavity preparation from class I to class VI
6. Ideal for pit and fissure caries.

Note: Laser is contraindicated for removal of following restorative material from the dental cavity.

1. Amalgam
2. Gold
3. Porcelain
4. For crown preparation

Laser cavity preparation technique: different laser parameters or settings are required for ablation of enamel, dentine and caries because of greater water contents in increasing order for enamel, dentine and caries.

Water composition (wt %)

Enamel 1%

Dentine 20%

Recommended setting for the Er: YAG (2940 nm, lambda) sapphire laser tip as follows:

Teeth surface	Energy in MJ (mili Joules)	Pulse/second (Hz)
1. Caries	100 to 200	10
2. Enamel	200 to 250	15
3. Dentine	150 to 200	10
4. Etching of enamel surface	30 to 50	15

- Since, Er: YAG laser wavelength has an affinity for the water contents of hard tissues; less energy is required to ablate caries than enamel or dentine due to its increased hydration. The laser has dual feedback to the operator- tactile and auditory. Tactile due to gentle touch of the contact tip against the tooth surface.

1. Cutting radiation moves out only from distal end of the tip
2. Water air stream is directed on to the cutting tip and on to the target tissues.

3. No anesthetic is required, but if during procedure patient becomes uncomfortable then the frequency (Hz) should be decreased.

Instructions for fiber tip laser handpiece application:

1. Always gentle touch target dental tissue with laser tip end.
2. Water stream should be directed to the targeted dental tissue.
3. Always keep operation area wet during laser procedure.
4. Always keep tip moving to provide effective ablation and better cooling.
5. For wider cavity preparation, constantly move laser tip over the surface.
6. For deep cavity preparation, constantly move laser tip up and down
 - Focused mode of laser: Focused mode of laser is used for faster cutting of dental surface and ablation of dental caries. It is used as close as possible to the targeted dental tissues.
 - Defocused mode of laser: this mode of laser causes slower cutting of dental surface and ablation of caries. **It should be used 1mm above the targeted dental surface.**

Laser treatment sequence during cavity preparation:

1. Enamel ablation- laser contact tip is positioned in contact with tooth surface, continuous 1mm lateral and up and down movement for faster ablation.
2. Dentine ablation and caries- laser contact tip is positioned in contact with tooth surface with 1mm lateral erasing movement.
3. Enamel modification (Etching) - Laser contact tip is positioned 1mm from surface at enamel surface margin.
4. Total lasing time – three minute.
5. Composite placement and curing.

Er: YAG cavity preparation Vs conventional cavity preparation

Investigation report showed that the Er: YAG laser were equal to or better than drill. While working with lasers it was found that the pulpal temperature rise was less than 2°C at 120 mJ, 10 Hz, 2 second exposure time with water cooling. Temperature rise greater than 5.8°C is required to cause irreversible pulpal damage. No cracks and fissure were formed with Er: YAG laser in tooth structure.

Lasers on soft tissues: Laser can be used for soft tissues procedures like excision of excess tissues, either normal or pathologic and re-contouring of soft tissues. Incision is accomplished by placing the laser at its focal lengths (i.e. the smallest possible spot size) near the tissues, or touching the tissues if a contact tip laser is used. Ablation is also known as vaporization, allows the removal of large area of very superficial tissues (e.g. removal of surface mucosal epithelium) without affecting deeper structures. Most lasers are intrinsically haemostatic to a degree, depending on the laser's depth of penetration.

The CO₂ laser generally seals vessels 500 micron or less in diameter, where as the more Hb specific KTP: YAG, Nd: YAG and organ lasers may provide deeper homeostasis.

Indications for use of lasers in cosmetic dentistry are:

1. Frenectomy
2. Gingivectomy
3. Tissues and papilla re contouring
4. Pathological lesion removal
5. Pigment and tattoo removal

Advantages of Laser

- Laser surgical healing of wounds is faster than conventional surgery because of minimal tissues trauma and précised accuracy.
- Since, laser uses very quick and short pulses of energy therefore the reaction thresholds of nerves is usually not reached to the level of pain or minimal pain, because of this anesthetics are not often required for many procedures.
- Laser sterilizes the surgical area along with germ destroying effect.
- Lesser bleeding occurs at the time of surgical procedure and less post operative edema and pain than conventional surgery.
- It is a minimal invasive and precise technique.
- Reduced dental procedure time, hence less chair time.
- Makes less noise than traditional drill.
- Post operative wound contracture is less because less number of myofibroblasts is formed.

Laser Safety

1. The primary safety measure required during laser treatment is proper protective eye wear. Each

particular wavelength requires different sets of safety glasses to absorb that particular wavelength.

2. Rubber dam should be used for isolation. A matrix band can be used to protect the adjacent tooth in case of class II cavity preparation.
3. A wet gauge should be placed to protect adjacent tooth, especially while working on soft tissues.
4. It is mandatory for the laser working team to wear special laser masks that filter out smaller than usual

particulate matter. At the same time high power evacuator is fitted with laser filters to remove “laser plume” (a common byproduct of photo thermal laser effect; a smoke like material comprised of cellular and tissues debris).

BIBLIOGRAPHY

1. DCNA; Laser, vol. 44, oct. 2000.
2. Esthetic dentistry; ascheim, Dale; II edition 2001.

Dentistry for Sport Players

INTRODUCTION

As young sport players become involved in organized sports or recreational activities, it is important in our practice as a *Pedodontist* to play an active role and encourage guardians of these kids to wear proper protective appliances to prevent oral injuries. Pedodontist must educate themselves and their young patients about the prevention of such injuries during sport. Prevention is an obligation of dentistry as well as a responsibility. Safe sports participation should be the goal of any sports program and the dental profession should enthusiastically work to achieve this goal in every community of the world.

Definition: Sports dentistry is the treatment, prevention and interception of maxillofacial athletic injuries and related oral diseases and manifestations.

ADA Recommendations for Mouth Guard

- A properly fitted mouth guard reduces the chances of sustaining a concussion from a blow to the jaw (ADA).
- Mouth guards should be worn during competition; in practice as well as in games.
- Contact your local dental society or association for information regarding manufacturer and mouth guard programs in local area.

The American Dental Association recommends wearing custom made mouth guards for the following sports:

- Skydiving, volleyball, water polo, weightlifting, wrestling, football, gymnastics, handball, ice hockey, martial arts, racquetball, acrobats, basketball, soccer, boxing, field Hockey, roller hockey, rugby, shot putting, skydiving,

Careful screenings and examinations are essential in preventing and intercepting dental injuries.

Examination

Includes health histories, at risk dentitions, diagnosis of caries, maxilla/mandibular relationships, orthodontics, loose teeth, dental habits, crown and bridge work, missing teeth, artificial teeth, and the possible need for extractions for orthodontic concerns or wisdom teeth. These extractions should be done at least 1 month prior to playing competitive sports as to not interfere with their competition or weaken their jaws during competition.

- Sports Dentistry also includes the need for recognition and referral guidelines to proper medical personnel for non dental related injuries which may occur during a maxillofacial injury. These injuries may include:

- Cerebral concussion,
- Head and neck injuries

Dental surgeons need not to treat above injuries but as health professionals dentists should be able to recognize their sign and symptom and refer these patients to the proper medical personnel.

- Smokeless tobacco: It has been frequently seen that most of the player are drug addicted. Smokeless tobacco is one of them. So it should also be included and addressed under sports dentistry. The public should be educated on the dangerous properties and consequences of using smokeless tobacco.
- It is not uncommon for dentists to recognize the symptoms of anorexia and bulimia through dental examination. Eating disorders are not as infrequent as one may think in female athletics.

- **Woman's gymnastics**, volleyball, and basketball are just a few sports where eating disorders have been documented in the medical/dental literature. Erosion patterns in the teeth, caused by gastric acids, often help dentists in the differential diagnosis of eating disorders. These patients need to be referred to the proper medical and psychological health professional.

Mouth guard (Fig. 38.1): The first recorded use of mouth guards was by boxers in 1920s to professional boxing game.

- In some sports, injury prevention, through properly fitted mouth guards are considered essential. These are the contact sports like football, boxing, martial arts and hockey. Other sports, traditionally classified as non contact sports, basketball, baseball, bicycle riding, roller, soccer, racquetball, also require properly fitted mouth guards, as dental injuries unfortunately, are a negative aspect of participation in these sports.
- Treatment of maxillofacial injuries (simple or complex) is to include not only treatment of injuries at the dental clinic, but also initial treatment at the site of injury, such as a basketball court or football or rugby field, where the dentist may not have the convenience of all the diagnostic tools available as at their dental clinic. A thorough Knowledge and clinical ability is required to do initial treatment" on injury site". A proper differential diagnosis is essential, without the use of radiographs and dental operator, to determine the future treatment and prognosis of the injury.

Advantage of mouth guards: Mouth guards provide protection for a player in three different ways:

1. Mouth guards protect the teeth by distributing the force of a blow over all the surrounding teeth and gums.



Fig. 38.1: Custom made mouth guard for player. See the extension of acrylic flanges

2. Mouth guard protects against neck injuries.
3. Mouth guard serves as a shock absorber for concussive forces affecting the lower jaw.
 - Properly diagnosed, designed, and custom made mouth guards are essential in the prevention of athletic maxillofacial injuries.
 - Mouth guard design and construction is extremely important. There are following types of mouth guards:
 1. Stock
 2. Boil and Bite
 3. Vacuum custom made.
 4. Pressure laminated custom made.

Factors affecting constructions of mouth guards

1. Dentition
2. Age and sex
3. Size of mouth
4. Number and shape of teeth
 - Mouth guards bought at sporting good stores, without the recommendation of a qualified dentist, should not be worn.
 - Prefabricated mouth guard should not be recommended, only custom made mouth guard is properly fit and prevents dental injuries.
 - The mouth guard should be designed to facilitate the eruption of succedaneous teeth in young player.
 - For patients with braces, special designs for the mouth guards are required to facilitate the orthodontic movement without compromising on injury prevention and proper fit.

TYPES OF MOUTH GUARDS

1. Stock Mouth guard: This is a prefabricated mouth guard. The stock mouth guards are available in as small, medium, and large size and are the least expensive and least protective.

Drawbacks

- They are bulky
 - Less retentive, player tries to hold in place by constantly biting down.
 - This interferes with speech and breathing, making the stock mouth guard the least acceptable and least protective.
2. Boil and Bite Mouth guard (Fig. 38.2): Presently, this is the most commonly used mouth guard, made from



Fig. 38.2: Boil and bite mouth guard after improper distorted fabrication (Note excessively thin material after forming)

thermoplastic material. They are immersed in boiling water and placed in the mouth as well adapt within the mouth by using finger, tongue, and biting pressure.

Drawbacks

- Available in limited sizes.
- Most of boil and bite mouth guards do not cover all posterior teeth
- Most of the athletes try to adjust these bulky and ill fitting boil and bite mouth guards by cutting. It further enhances ill fitness, poor retention, and gagging effects of mouth guard.

3. Custom-made Mouth guards:

Custom made mouth guards fulfill all the criteria for adaptation, retention, comfort, and stability of material. It has virtually no effect on breathing and speech. There are two categories of custom mouth guards:

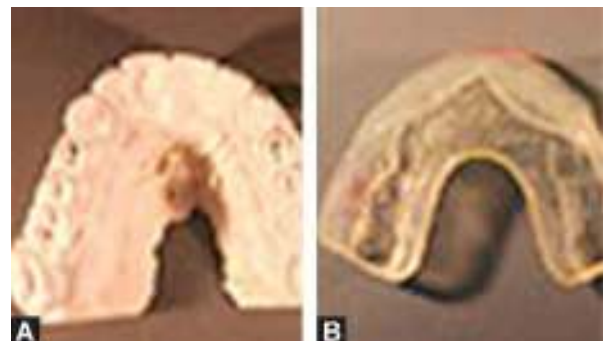
- a. The Vacuum custom made (Fig. 38.3)
- b. The Pressure Laminated custom made.

The Vacuum Custom Made Mouth Guard (Figs 38.5A and B)

- It is made on a stone dental model of the mouth; a thermoplastic mouth guard material is adapted over the dental model with a special vacuum machine.
- The most common material used for vacuum custom made mouth guard is poly ethylene vinyl acetate. The vacuum mouth guard is then trimmed and



Fig. 38.3: The vacuum colored custom made mandibular mouth guard



Figs 38.4A and B: Pressure laminated mouth guard fabricated on the dental cast with the help of pressure molding machine

polished to allow for proper tooth and gum adaptation.

- All posterior teeth should be covered by mouth guard and should not impinge the soft tissues.
- Custom made mouth guards can be fabricated through the dental clinic or commercial laboratory with nominal fee.

Drawbacks

- Efficient and complete lamination cannot be achieved under low heat and vacuum.
- The layers will not properly fuse together with the vacuum machine.

Pressure Laminated Mouth Guard (Figs 38.4A and B)

- Lamination: is defined as the layering of mouth guard material to achieve an appropriate thickness and strength under a high heat and pressure environment. This type of mouth guard is used for full contact sport.



Fig. 38.5A: Vacuum machine used for the fabrication of mouth guard or night guard



Fig. 38.5B: Impression trays with mouth guard container

- Efficient and complete chemical fusion occurs under high heat and pressure with, pressure laminated machines such as the Bio-star.
- Most of the dental literature shows that multiple layer mouth guards (laboratory pressure laminated) are preferred over the single layer vacuum mouth guards.

The advantages of pressure laminated mouthguards are:

1. Precise adaptation.
2. Negligible deformation when worn for a period of time.
3. It is repairable and modifiable as required.

Drawbacks

- Increased protective thickness leads to decreased impact forces.
- The mouth guard does not fully adapt to the model with little pressure and vacuum.
- Mouth guards must maintain minimal and consistent thicknesses in critical areas. These thicknesses may have to vary according to the athlete's individual needs for optimal protection.
- The thicker materials (3-4 mm) are more effective in absorbing impact energy and the thinner materials show marked deformation at the site of impact. These mouth guards are bulky and uncomfortable.

Properties of mouth guards: Mouth guard properties measured in various studies included shock-absorbing capability, hardness, stiffness (indicative of protective capability), tensile strength, tear strength (indicative of durability) and water absorption.

Materials used for fabrication of mouth guards are:

- i. Ethylene vinyl acetate (EVA) copolymer (most commonly used for mouth guard fabrication)
 - ii. Polyvinylchloride
 - iii. Latex rubber
 - iv. Acrylic resin
 - v. Polyurethane.
- Latex rubber was a popular material used in early mouth guards but it has lower shock absorbency, lower hardness and less tear and tensile strength than EVA or polyurethane.

Ideal Properties for Mouth Guard

1. Protective
2. Comfortable and Biocompatible
3. Resilient
4. Tear resistant
5. Odorless
6. Tasteless
7. Light in weight
8. Cause minimal interference to speaking and breathing
9. Proper fit and retentive
10. Sufficient thickness in critical areas.

Effects of mouth guards on dental injuries and concussions:

- The risk of a maxillofacial sports injury was 1.6-1.9 times higher when a mouth guard was not worn.



Fig. 38.6: Patient is showing socket of avulsed tooth, during sport activity

- Mouth guards should continue to be used in sport activities where there is significant risk of maxillofacial injury.

Purpose

Dental injuries may be permanent and may severely affect esthetics of the individuals. They are also universally expensive to treat. Many dentists, sports physicians, and athletic trainers recommend mouth guards for athletes participating in certain competitive sports, including hockey, boxing, rugby etc, because of a common perception that mouth guards afford protection from dental injuries, and even some concussions.

What to do when a tooth is avulsed during sport activity?

Treatment of avulsed tooth: Replantation (Fig. 38.6) (see the chapter dental injuries and their management).

Head Injury

- Concussion is an alteration of consciousness, disturbance in vision and equilibrium caused by a direct blow to the head or rapid acceleration and/or deceleration of the head, or direct blow to the base of the skull from a vertical impact to the chin during sport activity.
- There are several levels of concussion:

Asymptomatic

No headache, dizziness or impaired orientation, concentration or memory during rest or exertion.

- Grade 1 (mild): No loss of consciousness, and Post traumatic amnesia (PTA) for less than 30 minutes.
- Grade 2 (moderate): Loss of consciousness less than 5 minutes or PTA greater than 30 minutes.
- Grade 3 (severe): Loss of consciousness greater than 5 minutes or PTA greater than 24 hours.

During a blow to the chin, in most instances, the temporal bone is violated as it houses and ports cranial nerve trunks. As they exit the base of the brain blood supply to the brain and auditory and balance mechanisms is disturbed.

In football, when mouth guards are not worn, the mandible is placed in the most vulnerable position for injury and concussion, upwards and back into the fossa and base of the skull. Mouth guards can be properly made for speech and comfort and still fulfill the important job of concussion prevention.

Note: The importance of protection during various types of sports activities cannot be overemphasized. The use of mouth guards has been instrumental in preventing dental injuries. Being as a Pedodontist we must be knowledgeable in advantages and the drawbacks of these various types of protective mouth guard devices.

Forensic Science for Pedodontist

FORENSIC DENTISTRY OR ODONTOLOGY (FORENSIC ODONTOSTOMATOLOGY)

Definition

- “That branch of odontology which is in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings” (FDI).
OR
A branch of forensic medicine that deals with teeth and marks left by teeth (as in identifying criminal suspects or the remains of a dead person) (as per Merriam Webster, 1993).

IMPORTANCE OF FORENSIC DENTISTRY

Since, teeth are most resistance to destruction as compared to the other part of the body as well as they are not easily destroyed by the fire and helps in establishing identity of the living or dead individuals because:

- Each adult has 32 teeth with their own personal characteristics of shape, size, position and spacing, with the result that no two sets of teeth are exactly the same.
- Teeth extracted after death leave a completely different socket pattern from those removed during life.
- The tooth pattern and shape angulations are changed during and after dental treatment and its record will exist with the dentist.
- Being sheltered in the oral cavity, they are generally not damage easily by fire.
- Teeth as well as dentures made of acrylic resins are generally resistant to the action of corrosive acids.

ARMAMENTARIUM REQUIRED FOR EXAMINATIONS OF BODY

- Forensic Pedodontist should have their own kit containing necessary instruments for use in hospital, mortuaries and open sites.
- Materials such as disposable gowns, masks, and rubber gloves, clear eye protection glasses, scrubbing brush, detergent and towels are added for protection of the Pedodontist.
- Adequate light sources such as illuminated mouth mirror, cheek retractor and head light are necessary, especially when they are working outdoors. The light source should be battery operated as the power supply may not be available at the site of examinations.
- Instruments like scalpel blade, handles, stainless steel autopsy saw, rongeur, skull holding devices, wooden wedges, self retaining retractors, etc. are needed for gaining access in the oral cavity.
- Mouth mirror, probes, tweezers, tooth brushes, aspirating syringes, gauze pieces, etc. are required for head and neck examinations.
- Other useful material in the autopsy is portable radiographic equipment, camera and films, extraction forceps, impression materials and trays, glass tubes, and odontogram charts.

Methods of Mortem/ante Mortem Identifications: Irvin M Sopher, describes an outline of identification methods is as follows:

1. Visual recognition by relatives and friends. This is the least reliable method.

2. Scientific identifications by:
 - Fingerprints
 - Dental and skeletal characteristics
3. Identification by exclusion method: Identification process has three stages;
 1. Examination and recording of all details.
 2. Collection of information of a similar character from missing individuals.
 3. Crosschecking of data of body with that of missing individuals. (Antemortem data v/s established postmortem data).

Dental Identification Based on

- I. Basic dental anatomy
- II. Microscopic technique
 1. Ground section e.g. Longitudinal section done for Incremental Lines.
 2. Microscopy
 - a. Ultraviolet photomicrography (fluorescence)
 - b. Polarized light microscopy
 - c. Scanning electron microscope.

Types of Bodies Coming for Dental Identification

- a. Normal
- b. Decomposed
- c. Mutilated
- d. Burned
- e. Skeletonized

Technique of Human Identification (By Sasouni)

- a. Comparative group: Antemortem record crossed checked with postmortem records:
- b. Reconstructive group: If no previous records are present then reconstruct the face or body over skeleton and match with missing individual.
- c. Dental DNA evidence: Find out the pulp cells from tooth and make a DNA finger print and match with relatives of missing person.

Role of Pedodontist in Forensic Science

The forensic pedodontist acts as a consultant medical examiner in the determination of identity of the individuals in collaboration with medical forensic examiner. They may apply the knowledge of Forensic science in the following area as given below:

1. Child abuse
2. Accidental and non-accidental oral trauma
3. Mass disaster
4. Dental fraud
5. Age determination
6. Bite mark evidence
7. Lip print identification
8. DNA Printing.

Child Abuse and Neglect

Definition: It can be defined as, the non-accidental or iatrogenic physical injury, minimal or fatal inflicted upon children by person caring for them.

Or

Defined by Vale as 'any act of commission or omission that endangers or impairs a child's physical/emotional health and development' come under physical abuse or neglect. (Dental Clin North Am, 1977).

Types of child abuse		
	Types of child abuse	Percentage
1.	Physical abuse	31.7 percent
2.	Educational abuse	26.4 percent
3.	Emotional abuse	23.5 percent
4.	Sexual abuse	6.7 percent
5.	Munchausen's syndrome by proxy	Not specified
6.	Poisoning	Not specified

Physical abuse: These injuries are inflicted by caretaker or parent as a result of punishment that is inappropriate for the child's age, condition or level of development. Physical injury is usually recognized by the pattern of injury and/or its consistency with the history related; Bruises, belts, fractures, burns and lacerations are commonly inflicted physical injuries.

Battered Baby Syndrome (Caffey Syndrome)

Etiology

- In a recent paper Green et al who observed the parents patterns of family interaction encountered in 60 cases of child abuse, concluded that etiology is based upon an interaction between the personality traits of the parents, the child's characteristics with enhances scope goading and the environmental condition resulting in increased demand for child care.
- Numerous studies have indicated that the mother tends to be most frequent perpetrator of child abuse.

However the father, step parent, foster parent, babysitter, paramour distant relative or sibling may also be offenders, or siblings may also be offenders.

Recognition by the Forensic Pedodontist

The head and cheek is a common area for child's physical abuse injury. Furthermore in fatal cases, it represents the most frequent cause of death. It has been stated clearly and firmly that the head is frequently a target because it is the best example of the "self" of the attacked child. This fact has practical application for the dentist because injury to the oral and facial structures may result in a patient seeking dental care for related injuries. The dentist should be aware of the abused child syndrome when dealing with problems of unusual oral injuries, especially in cases with accompanying head or body injuries. Suspicion is further aroused if in the dentist's opinion, the nature of the injuries is inconsistent with the available historical and chronological "explanation" of their origin.

The presence of discolored, devitalized teeth or radiographic evidence of old fractures may represent past instances of oral trauma as a result of abuse. In the absence of oral injury the dentist may notice unusual bruising or other injury in the child presented for routine dental care, which should arouse the suspicion of possible child abuse.

Sexual Abuse

Sexual abuse or sexual misuse are frequently interchanged terms that denote any sexually stimulating activity that is inappropriate for child's age, level of cognitive development or role within the family. Sexually abusive acts may range from exhibitionism or kissing to fondling pornography or rape.

Emotional Abuse

Emotional abuse is usually seen as abnormal behaviors or mental health problems that are multifactorial in origin. Emotional and verbal abuse involves interaction or lack of interactions on the part of care taker that inflict damage on the child's personality, emotional well being or development. Continuous isolation, rejection, degradation, terrorization, corruption, exploitation or denials of affection are such behaviors that frequently have damaging effects on the child's emotional status.

Munchausen syndrome by proxy: This is a rare malignant disorder of parenting in which the perpetrator (usually the mother) relates a factitious history, produces false signs or symptoms and fabricates illness on the child that result in extensive medical evaluations, testing and often prolonged hospitalizations.

Probable Factors of Parents Responsible for Child Abuse

1. Youthful parenthood
2. Unwanted or unplanned parenthood
3. Low socioeconomic status and related variables such as crowded and inadequate housing
4. Social isolation
5. Long parenthood
6. Partner discord
7. Responsibilities and frustration of parenthood
8. Altered physical or physiological status
9. Child itself (for example infantile colic)

Ego Weaknesses

- Character disorders
- Impulsive aggressive
- Rigid – exacting
- Immaturity, passive dependency or inadequacy depressive disorder
- Psychic disorder
- Alcoholism.

Nonspecific Ego Defects

- Low self-esteem
- Inability to empathize
- Inability to trust.

Vectors

- Stresses created by child
- Specific individual psychodynamics
- Collusion or facilitation by partner
- Culture bound disciplinary practice and beliefs
- Relative absence of other need satisfaction, frustrating objects (Socioisolation)

Poisoning (Table 39.1): Different metallic poisons may have manifestation in oral cavity. They are most commonly associated with metallic taste and a non-specific ulcerative gingivitis, accompanied by varying

Table 39.1: Oral manifestation of metal poisoning

Metal	Poisonous Compounds	Fatal Dose	Oral Manifestation
1. Arsenic	(i) Arsenious oxide or Arsenic trioxide (ii) Copper arsenate (iii) Arsenic acid (iv) Sodium potassium arsenate (v) Arsenic sulfide	0.1 to 0.2 g	(i) Sweetish metallic taste (ii) Difficulty in swallowing
2. Mercury (Quick silver)	(i) Mercuric chloride (ii) Mercuric oxide (iii) Mercuric iodide (iv) Mercuric cyanide (v) Mercuric sulphide	1 to 4 gm	First phase 1. Acid metallic taste 2. Tongue, mouth becomes corroded, swollen and show grayish – white coating 3. Hot burning pain in the mouth Second phase (i) Glossitis (ii) Ulcerative gingivitis (iii) Loosening of teeth (iv) Necrosis of jaw
3. Lead	(i) Lead acetate (ii) Lead carbonate (iii) Lead chromate (iv) Lead monoxide (v) Lead trioxide	About 20 g lead acetate and 40 g lead carbonate	Acute poisoning On astringent metallic • A stripped blue line called Burtonian line seen on the gums in 50-70 percent of cases • It appear due to subepithelial deposit of granules at the junction teeth Foul breath
4. Copper	(i) Copper sulfate (ii) Copper subacetate	10-20 gm	(i) Metallic taste (ii) Increased salivation
5. Manganese	Potassium permanganate	10-20 gm	(i) Burning pain from mouth to stomach (ii) Swallowing

amount of mucosal and gingival pigmentation. Pedodontist may come across cases of chronic metal poisoning and should be able to diagnose it by clinical signs and symptoms, coupled with the history.

Treatment of Metal Poisoning

1. Arsenic Poisoning:

- Emetics can be given
- Stomach should be emptied and then thoroughly and repeatedly washed by the stomach tube with large amount of slightly warm water.
- Freshly prepared and precipitated hydrated ferric oxide (antidote) is given orally.
- Patient is advised to eat butter and greasy substance to prevent intestinal absorption.

2. Mercury Poisoning:

- Give egg white, milk or animal charcoal to precipitate mercury.

- Gastric lavage is done with 5 percent solution of formaldehyde sulfoxylate.
- 10 gm of sulfoxylate in 100 to 200 cc of distilled water is administered by slow IV injection and repeated after 4 to 6 hours acts as an antidote.

3. Lead Poisoning

a. Acute Poisoning

- Gastric lavage with 1 percent solution of sodium or magnesium sulfate
- Demulcents
- The combination of BAL and calcium disodium versenate is effective.

b. Chronic Poisoning

- Potassium or sodium iodide up to 2 g, 3 times a day may be given.
- Sodium bicarbonate 20 to 30 gm a day in lividea transforms the insoluble tribasic lead phosphate to the soluble dibasic phosphate through the liberated carbonic acid, and is excreted in the urine.

4. Copper Poisoning

- Wash out the stomach with 1 percent solution of Potassium Ferrocyanide which acts as an antidote by forming an insoluble ferrocynide, complex-compound.
- N- penicilamine is very effective.
- Demulcent drinks form insoluble albuminate of copper.

Accidental and Non-accidental Oral Trauma

- Another area where the knowledge of forensic Pedodontist can be applied is the examination of children, who have sustained accidental and non-accidental trauma, which may be due to accident, negligence and malpractice or child abuse. In such cases, a detailed analysis and examination supported with tests, radiographs and photographs is required by the inquiring agency as often these cases are challenged in the court.

Mass disaster: It means a chaotic event initiated by a destructive force which results in multiple facilities necessitating identification.

- 1st mass disaster where dentistry played a role in identifying victims was in the year 1897, “Bazaar de Lacerate five” accident in Paris. The first victim was identified by a dentist, Davenport IB.
- According to Clark, amongst 54 disasters occurred between 1951 to 1988 dental evidence helped to identify 43 percent of victims.
- General principles of dental identification apply to mass disaster identification, but mass disasters are associated with multiple fatalities scattered throughout. Broad areas may be associated with loss of ante mortem record, remains may be hidden, dismembered or mutilated, also proper facilities to carryout examination may not be available because most often temporary mortuary is set up in the scene of disaster causing difficulty in identification of victims. So properly trained individuals work as a team to deal with such disasters. This organized team is trained to face emergency situations.
- The best example of mass disaster is airplane crash with twin towers of USA, tsunami, etc.

Mass disaster genetics: It is a new accurate method used by Ballantyne in disaster victim identification by using “DNA typing”. 139 out of 141 victims (98.6%) were

positively identified by comparing DNA profiles obtained from human remains with those obtained from close biological relatives.

Advantages

- DNA profile gives highly accurate identification.
- DNA profile may be the only means for identification of victims when there are no ante mortem records available.

Disadvantages

- Cost and more time consuming process for the DNA profile.
- Even though this method provides biologic relationship it may not be unique to an individual

Dental fraud: With the introduction of consumer’s forum act, the dentist is required to examine patient thoroughly and examination findings should be noted on a dental record to defend him if required. Also, records are to determine whether a treatment paid for by a 3rd party has actually been performed or not.

Lip Prints (Cheiloscopy), (Fig. 39.1): The wrinkles and grooves visible on lips and the imprint produced by these grooves is termed lip print. The examination of which is referred to as cheiloscopy. (Forensic Sci, 1974). Lip print can be divided into simple and compound lip print.

S.No.	Simple lip wrinkles	Compound lip wrinkles
1.	Straight line	Bifurcated
2.	Curved Line	Trifurcated
3.	Angled Line	Anomalous
4.	Sine shaped curve	

Tsuchihashi: Later proposed a separate classification dividing the pattern of grooves into six types. (Forensic Sci, 1974)

- Type I : Clear-cut vertical grooves that run across the entire lip
- Type II : Similar to type I, but do not cover entire lip.
- Type III : Branched grooves
- Type IV : Intersected grooves
- Type V : Reticular grooves
- Type VI : Differentiated
- More characteristic groove patterns are vertical, branched, intersected, reticular and undermined.

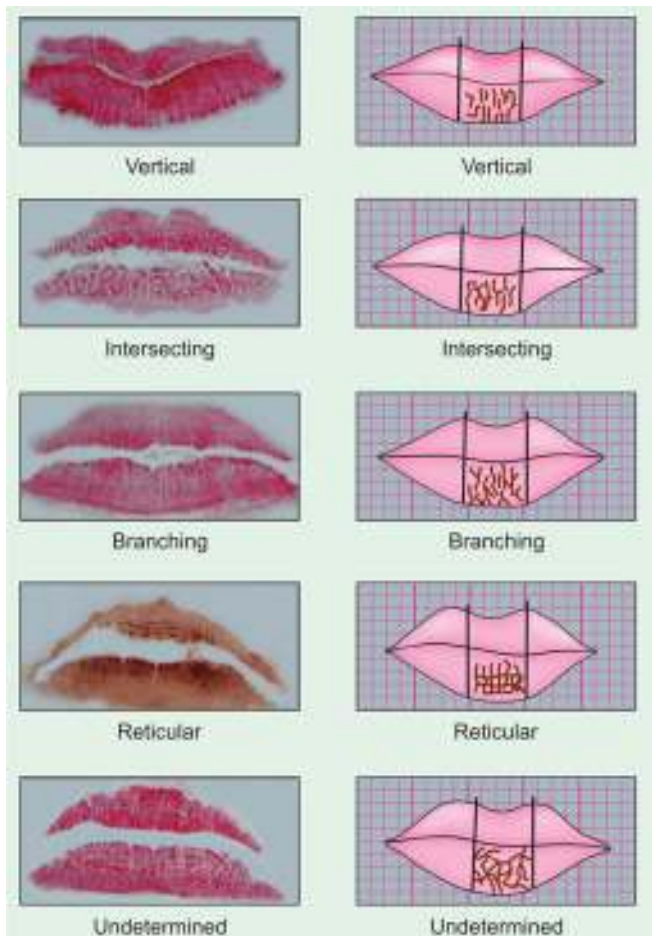


Fig. 39.1: Photograph and sketch diagram of lip print

Rugoscopy: Rugae patterns of the anterior palatal area are used in forensic science to identify the body by using the knowledge of:

1. Comparative anatomy
2. Anthropology
3. Odontology
4. Genetics
 - Rugae patterns do not change due to growth of an individual and reappears after trauma or surgical removal.
 - They are considered unique to an individual and hence provide a reliable source of identification
 - Males have better rugae than female. Palatal mucosa is protected by lips, cheeks and tongue. Thus, it is protected during fire and mass disasters.

Lysell measured rugae in straight line from their origin on medial side to terminus (Acta Odontologica Scandinavica, 1955).

- Primary rugae (> 5 mm)
- Secondary rugae (3-5 mm)
- Fragmentary rugae (2-3 mm)

S.No.	Shape	Rugal pattern (Thomas and Kotze)
1.	Curved	Branch
2.	Wavy	Unified
3.	Straight	Crosslinked
4.	Circular	Annular and papillary

Analysis of rugae pattern: Limson and Julian have developed a computer software **programmed RUGFP – ID**. On digitized images of the palate, characteristic points are plotted on the medial and lateral extremities of all the rugae (J Forensic Odontostomatol, 2004).

The plotted points are processed by the software and the information sequentially stored corresponding to pixel position. These researchers obtained 93 percent accuracy in identifying individuals in a mock ante and post mortem comparison of palatal rugae.

Bite Mark (Fig. 39.2): It is defined as “A mark made by the teeth either alone or in combination with other mouth parts” (McDonald). (J Forensic Sci Soc, 1974).

McDonald's Classification (J Forensic Sci Soc, 1974)

Classification of bite mark is based on etiology:

1. **Tooth pressure marks:** Marks produced on tissue by Incisal edges of anterior teeth. They are stable and subjected to minimal distortion.
2. **Tongue pressure marks:** Involves ‘suckling’, i.e. tongue presses against soft tissue, this causes the distortion of the marks.
3. **Tooth scrapes marks:** These are marks caused because of irregularities in the teeth due to fractures, restorations, etc.
4. **Complex marks:** Combination of above type of marks.

Characteristics of bite: Measurable features and shapes help to differentiate adult versus child bite, e.g. difference in arch size and shape of tooth.



Fig. 39.2: Measuring bite mark with scale and see the arch form

Individual Characteristics

<i>Teeth</i>	<i>Marks produced</i>
• Incisors	Rectangular
• Canines	Triangular/rectangular
• Premolars and molars	Spherical/pointed.
– These are deviations from standard class characteristics, e.g. are a rotated tooth or chipped tooth. Human bites may present as circular or elliptical pattern injury.	
• Impressions should be made only after initial photographs and any swabbing have been completed.	
• Two stone casts should be made, a virgin cast that will be preserved untouched and in pristine condition for presentation in court of law.	
• Working cast is to be used in the bite mark analysis.	

Legal Aspect for the Forensic Pedodontist

- A forensic Pedodontist should have thorough knowledge of current legal system for child protection acts. Dental professionals should know the definitions proposed of child abuse/neglect and existing related laws under the draft 'Model child protection Act' to protect himself and apply it correctly in child abuse/neglect cases. Dentist should strictly follow the do's and don't or always follow principles.
- There are certain principles that have to be followed by forensic Pedodontics. They are:
 - i. A pedodontist should always be fully aware of legal standards of care and legal responsibilities.

- ii. A Pedodontist should keep legibly written, accurate case records.
- iii. Various data required in the record book or more precisely case sheet should be made in the presence of patient.
- iv. No alterations or changes in the original records should be made. However, if the changes are inevitable they may be done and duly signed by the patient.
- v. A pedodontist should keep a thorough knowledge of his subjects, as well as forensic science and legal child protection Acts.
- vi. Diagnostic tools like radiographs should always be used pre operatively and post operatively.
- vii. Avoid diagnosis and recommending treatment on phone.
- viii. A pedodontist should always be in consultation with legal/medicolegal expert to review insurance policies or any financial legal matters.

Recent Advances for Collecting Forensic Evidences

Xeroradiography: In this type of radiography, there is an advantage of seeing through tissue damages, which may not be visible with photographic technique. It has a sharper image than conventional radiography.

Transillumination (Fig. 39.3): This method is successful in enhancing low light energy images produced by an intra-dental injection of chemically luminescent liquids.

Videotape analysis: It is an advanced computerized technique, which makes it easy to analyze a transparency, as the eye can focus on certain aspects of display as the levels of density are separated or broken down. This video and computer analysis, such as color discrimination, provides more definitive data.

Scanning microscopy: Helps in analyzing the 3-D characteristics in a bite mark, for example, depth of the bite mark.

DNA fingerprinting (Figs 39.4 and 39.5): Jeffrey's et al demonstrated DNA fingerprinting first time in 1985, by using a minisatellite probe chosen of a human myoglobin gene.

- DNA fingerprinting is immensely useful in criminal court decisions requiring identifications with a high precision.



Fig. 39.3: Transillumination test (arrow) with the help of low intensity light gun to find out cracks or minor malformations of enamel



Figs 39.4 and 39.5: DNA fingerprints

- DNA fingerprinting is based upon the occurrence of a family of DNA sequences that are randomly repeated and dispersed throughout the genome. These short repeated sequences are called minisatellites. Each person has a unique minisatellite composition and by using DNA finger printing technique this individual specific variation can be detected.
- This technique is commonly applied on a drop of blood, a hair follicle or a loose scrapping from the skin of a victim.

Age and sex determination: Teeth are among the most reliable source of information in the process of identification especially in 1st and 2nd decade of the life.

- The stages of development can be considered as one of the most dependable indicators in assessing age of the victims.
- Age of an individual is the sign of Maturity which may be divided into:
 - a. Chronological age (skeletal radiographic age)
 - b. Anatomical age
 - c. Dental age
 - d. Sexual age
 - e. Mental age

The following methods are used for determination of age from dentition:

- a. By visual or clinical examination
- b. By radiographic examination
- c. By histological and biochemical examination.

Visual examination and radiographic examination (Figs 39.6 and 39.7): The visual examination provides the information regarding the number of teeth that are present in the dental arches and the dentition to which they belong.

Histological examination (Fig. 39.8): Developmental incremental lines can be observed microscopically in undercalcified section of the enamel and dentin. In primary teeth, where hard tissue formation begins prenatally and is completed postnatally the neonate's accentuated incremental line can sometimes be seen.

This is believed to reflect disturbance in metabolism occurring during neonatal period. This usually represents about fifteen days of retarded development.

The presence of such lines confirms that infants had survived the 1st, 3 to 4 week of life. It is reported that deciduous dentin is produced at the rate of 4 microns per day (Shown 1946) and it was suggested (Miles 1963) that measuring the thickness of the dentin on the pulpal side of neonate line can provide an indication of age.

Methods of age estimation in forensic dentistry:

- i. Using dentition
- ii. Using craniofacial skeleton
- iii. By using hand-wrist X-ray
- iv. Photography

(i) By using Dentition (Fig. 39.9): Following factors are used for age determination using dentition.

1. Appearance of tooth germs
2. Earliest detectable trace of mineralization
3. Degree of completion of unerupted tooth



Fig. 39.6: Mandibular left post quadrant shows implant

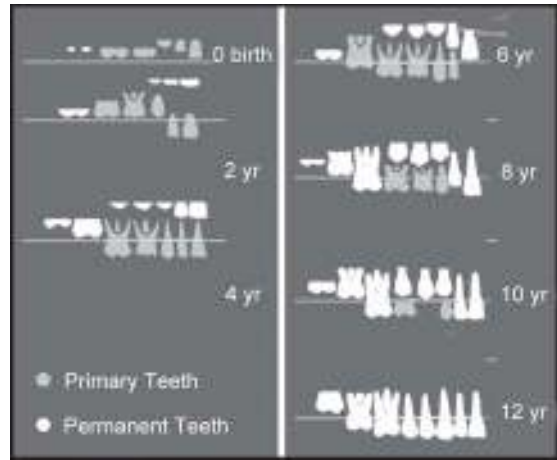


Fig. 39.9: Age determination dental chart



Fig. 39.7: Radiograph of head and neck region used for age assessment



Fig. 39.10: Attrition of teeth



Fig. 39.11: Lateral incisor shows gingival recession

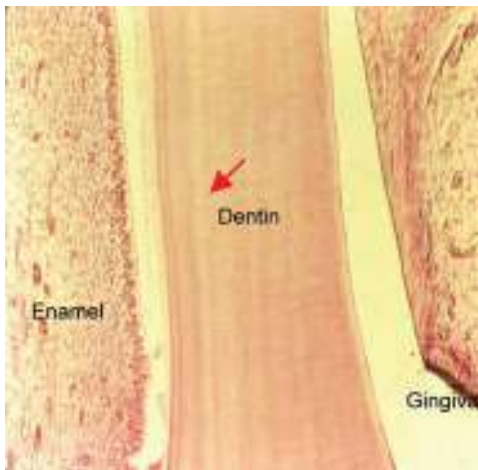


Fig. 39.8: Developmental incremental line on enamel and dentin part of tooth

4. Rate of formation of enamel and formation of neonatal line
5. Clinical line
6. Degree of completion of root of erupted tooth
7. Degree of completion of primary tooth
8. Attrition of crown (Fig. 39.10)
9. Formation of cementum
10. Transparency of root dentin
11. Gingival recession (Fig. 39.11)
12. Root surface resorption



Fig. 39.12: See the pattern of tetracycline staining



Fig. 39.13: Maxillofacial skeleton with toothbuds



Fig. 39.14: Mandibular bone, arrow indicate position of mental foramen

13. Pattern of discoloration and staining of teeth (Fig. 39.12)
14. Changes in chemical composition of the teeth
15. Influence of disease on maturation of tooth eruption
16. Influence of sex on tooth eruption.

(ii) By using Craniofacial Skeleton (Tables 39.2 to 39.4):

1. By using skull
2. By using hand-wrist X-ray
- By using skull (Figs 39.13 and 39.14)

Table 39.2: Age changes on craniofacial bone

S. No.	Age	Characters
1.	Neonatal skull	Edentulous jaws, size of the orbits are relatively large.
2.	1 year	Fusion of midline symphysis of the mandible fusion of metallic suture, lateral sphenoid synchondroses.
3.	3 years	Condylar portion of occipital bone fuses with squama
4.	5 years	Condylar portion of occipital bone fuses with basioccipat
5.	18-21 years	Sphenooccipital synchondroses

Table 39.3: Mandibular angle of different age group

Age	Angle
1. Infancy	160°-175°
2. 1-3 years	150°-160°
3. 6-12 years	125°-140°
4. 15-17 years	120°-130°
5. 18-21 years	90°-125°
6. 30-40 years	95°-115°
7. 40 years and above	Obtuse angle < infancy

Table 39.4: Age changes of mandible

Area	Infancy	Adult	Old age
Body	Shallow	Thick and long	Shallow
Ramus	Short and oblique form an obtuse angle with the body	Less obtuse angle	Obtuse angle (140°)
Mental foramen	Near the alveolus	Midway between upper and lower margin	Near the alveolus
Condyle	Lower level than Coronoid	Above the Coronoid	Neck behind backward

Due to putrefaction of soft tissue; the body remains become skeletonized leaving bone and teeth. Bone can be used to determine age, sex and race of the body

- Presence of long bone cartilages or ruminants of ligament would indicate that death occurred recently, erosion, pitting, chalkiness and staining of bone indicate that much of the protein content is lost and that bones are not of recent death.

- The time of appearance of ossification centers site, size, and degree of fusion with other parts of bone can be used for estimation up to 21 years with an error of plus or minus one year.

Methods of Sex Determination

- I. *Visual/clinical*: Mandibular canine shows greatest dimensional differences with larger teeth in males than in females. Mandibular canine index (MCI) was developed by Rao NG et al to determine sex between 15-21 years (J Indian Acad Forensic Med, 1986). $MCI = 7.1$, Sex is predicted as female when values derived are within this limit. Accuracy-89 percent
- II. *Microscopic methods*: Whittaker and coworkers determined sex from necrotic pulp tissue stained with quinacrine mustard and using fluorescent Y chromosome test for males
- III. *Advanced methods*.

Sex determination from enamel protein: AMEL is a major protein found in the human enamel. It has a different signature in male and female enamel.

In Males, amel gene on Y-chromosome.

In Females, amel gene on X-chromosome.

The female has two identical AMEL genes whereas male have two different AMEL genes. (Sivagami et al reported 100 percent accuracy).

Skull	Male	Female
Architecture	Rugged	Smooth
Frontal and parietal eminences	Small	Large
Forehead and, supraorbital ridges	Sloping well developed	Vertical, slightly developed
Mastoid process	Large	Small
Tympanic, plate of temporal bone	Well developed	Delicate

Mandibular feature	Male	Female
Condyle	Larger	Smaller
Body height	Greater depth at symphysis	Shallow at symphysis
Shape of chin	Squarish	Rounded
Gonial angle	Less obtuse	More obtuse
General features	Larger, thicker, broader ascending ramus	Smaller, thinner, narrower ascending ramus



Fig. 39.15: Hand-wrist X-ray used for age determination

(iii) *By using hand-wrist X-ray* (Fig. 39.15): The bone of the human skeleton develops from separate ossified centers from these centers; Ossification progresses till the bone is completely formed. These changes can be studied by means of X-ray. It is therefore possible to determine the approximate age of an individual by radiological examination of:

- Hand-wrist X-ray in children.
- Elbow, shoulder, pelvis, and knee in adult
- Skull, vertebrae and sternum in old people.

(iv) *Photography*: This is most reliable and useful tools in forensic dentistry. The composition of photographs must be clear to show precisely focused area of forensic concern.

Genetic Counseling in Dentistry

INTRODUCTION

Prenatal genetic counseling is provided for all prospective parents, ideally before conception, to assess risk factors for congenital disorders. Parents with risk factors are advised about possible outcomes and options for evaluation. If testing identifies a disorder, reproductive options are discussed; preconception options include contraception, artificial insemination if the man is a carrier, and oocyte donation if the woman is a carrier; post conception options include pregnancy termination and, in some cases, treatment (eg, Dexamethasone).

Risk factors: Some risk of genetic abnormality exists in all pregnancies. Among live births, incidence is 0.5 percent for numeric or structural chromosomal disorders, 1 percent for single-gene (Mendelian) disorders, and 1 percent for multiple-gene (polygenic) disorders.

- Chromosomal disorders are more likely to be present in fetuses that spontaneously abort during the 1st trimester (50 to 60%), in fetuses with a major malformation (30%), and in stillborns (5%).

Genetic counseling is the process of:

- Evaluating family history and medical records
- Ordering genetic tests
- Evaluating the results of this investigation
- Helping parents understand and reach decisions about what to do next

Genetic tests are done by analyzing small samples of blood or body tissues. They determine whether you, your partner, or your baby carry genes for certain inherited disorders, or not.

ROLE OF THE PEDIATRIC DENTIST IN GENETIC COUNSELING

Pediatric Dentists treat children with Dentofacial anomalies and therefore should have a working knowledge of syndromology and molecular Genetics. Often Pediatric Dentists are the first health care practitioners to document Dentofacial dysmorphic features in a child. It is thus important for them to have an understanding of molecular genetics because the sensitivity and specificity of molecular based diagnosis have revolutionized how disease and disorders are defined. These specific and technological advances translate into improved health, disease prevention, smarter diagnostics, and innovative therapeutic approaches to Dentofacial dysmorphogenesis. Dentist should work with the genetic counselor and radiologist to reach the conclusion of molecular based diagnosis of the child, and take a preventive and interceptive treatment plan for the abnormal dentofacial structure of a child (phenotype).

Prior to molecular based diagnosis, craniofacial disorders were established based on characteristic features (pattern recognition), e.g. a child with a molar hypoplasia, Mandibular retrognathia, down slanting palpebral fissures, coloboma of the lower eyelid had the clinical appearance of Treacher Collins Syndrome. Although the common disorders were identifiable, there was difficulty in establishing the diagnosis for all patients. Some had clinical characteristics that did not readily fit into a particular syndrome or the condition was uncommon and most clinicians were unaware of its existence.

- With molecular diagnosis, it is now possible to establish the correct diagnosis for most patients with craniofacial anomalies. Using this new tool it has become evident that classification of craniofacial malformations based on clinical features (phenotype) is sometimes quite different from categorization by genetic findings (genotype). Patients with craniofacial syndromes may have similar clinical phenotype that are caused by different mutations in a gene; identical mutations within a gene can cause widely different clinical phenotype. Additionally, mutations in different genes can cause similar clinical phenotypes. Molecular-based diagnosis for complex craniofacial anomalies has truly transformed how we define these disorders.
- The mother-to-be has had two or more miscarriages or babies that died in infancy
- The mother-to-be 35 or older when the baby is born. Chances of having a child with Down syndrome increase with the mother's age: a woman has a 1 in 350 chance of conceiving a child with Down syndrome at age 35, a 1 in 110 chance at age 40, and a 1 in 30 chance at age 45.
- You are concerned about genetic defects that occur frequently in certain ethnic or racial groups. For example, couples of African descent are more at risk for having a child with sickle cell anemia; couples of central or eastern European Jewish (Ashkenazi), Cajun, or Irish descent may be carriers of Tay-Sachs disease; and couples of Italian, Greek, or Middle Eastern descent may carry the gene for thalassemia, a red blood cell disorder.

The Genetic Counselor

The genetic counselor can help a person or family understand their risk for genetic conditions (such as cystic fibrosis, cancer, or Down syndrome), educate the person or family about that disease, and assess the risk of passing those diseases on to children.

A genetic counselor will often work with families to identify members who are at risk. If it is appropriate, they will be advised for genetic testing, coordinate any testing, interpret test results, and review all additional testing, surveillance, surgical, or research options that are available to members of the family.

Genetic counselors often work as part of a health care team in conjunction with specially trained doctors, social workers, nurses, medical geneticists, Pediatric dentist or other specialists to help families make informed decisions about their health. They also work as patient advocates, helping individuals receive additional support and services for their health care needs.

Experts recommend that all pregnant women, regardless of age or circumstances, be offered genetic counseling and testing to screen for Down syndrome. It's especially important to consider genetic counseling if any of the following risk factors apply to you:

- A standard prenatal screening test (such as the alpha fetoprotein test) yields an abnormal result
- An amniocentesis yields an unexpected result (such as a chromosomal defect in the unborn baby)
- Either parent or a close relative has an inherited disease or birth defect
- Either parent already has children with birth defects or genetic disorders

The Genetic Consultation

A genetic consultation involves evaluation of an individual or family for one or more of the following reasons:

- Confirming, diagnosing or ruling out a genetic condition
- Identifying medical management issues
- Calculating and communicating genetic risks
- Providing or arranging for psychosocial support.

At the Genetic Counseling Session

Genetics consultations usually involve one or more visits and phone calls with genetic counselors. Occasionally, consultations can take place in groups (e.g. cancer or prenatal consultations) or by phone (e.g. routine or uncomplicated matters).

1. Assessment: Gathering information

- Explore with the patient and family:
 - Reason for referral
 - Understanding of genetics
 - Diagnoses under consideration
 - Perception of disease status or risk
 - Beliefs about cause of disease
 - Perception of disease burden
- Document patient's birth history, past medical history and current status.
- Obtain directed family history in pedigree form using standing symbols, including:
 - The patient's first degree (children, siblings, parents) and second degree (grandparents,

Table 40.1: Genetic screening of ethnic groups

S. No.	Ethnic group	Disorder	Screening test	Prenatal diagnosis
1.	All	Cystic fibrosis	DNA Analysis of 25 CFTR Mutation, which are Present in >0.1% population	CVS or amniocentesis
2.	Blacks	Sickle cell anemia	Screening test for sickle cell, hemoglobin, confirmatory hemoglobin, electrophoresis.	CVS or amniocentesis for Genotype determination (direct DNA analysis)
3.	Mediterranean people	Beta-thalassemia	MCV < 80% followed by hemoglobin, electrophoresis.	CVS or amniocentesis for Genotype determination (direct DNA analysis or linkage analysis)
4.	South east asians	Alfa-thalassemia	MCV < 80% followed by hemoglobin, electrophoresis	CVS or amniocentesis for genotype determination (direct DNA analysis or linkage analysis)

grandchildren, aunts, uncles, nieces, nephews) relatives, and further removed as appropriate

- Status of current pregnancies
- Ethnic background
- Presence of consanguinity

2. Symbols for constructing a family pedigree.

3. Genetic screening for some ethnic groups (Table 40.1)

4. *Evaluation*: Interpreting medical and family history, results of physical examination and tests

- Consult relevant references.
- Compare patient's history and examine to know diagnosis.
- Discuss diagnostic impression.
 - Clear diagnosis - Share information about the condition
 - Differential diagnosis - Suggest further tests or evaluations
 - Unknown diagnosis - Discuss what known diagnoses are ruled out, follow over time

5. *Communication*: Sharing information about the condition (within the family's ability to understand the information)

- Review the details about the disorder in question including:
 - Expected course of the disease
 - Management issues, and possible treatments or interventions
 - Underlying genetic cause if known, including pattern of inheritance
- Describe risks to family members compared with general population risks.

• Discuss reproductive options, if and when appropriate, which may include:

- Pregnancy with prenatal testing
- Pregnancy without prenatal testing
- Remaining childless
- Parenting by adoption
- Pregnancy by egg or sperm donation
- Pregnancy following preimplantation genetic diagnosis

6. *Support*: Helping the family to cope

- Recognize and discuss the emotional responses of family members to information given (which may include shock, disbelief, relief, fear, guilt, sadness, shame, and acceptance).
- Review normal grief responses and signs that might indicate the need for further psychosocial support.
- Listen to the whole story, and hear what this situation has meant to the family.
- Explore strategies for communicating information to others, especially family members who may be at risk.

Provide written materials and referrals to support groups, other families with the same or similar condition, with the help of local and national service agencies.

7. *Follow-up*: Maintaining ongoing communication

- Arrange for follow-up diagnostic testing or management appointments, or communicate this need to the referring healthcare provider.
- Document the content of the consultation for the referring healthcare provider and for the patient when appropriate.

- Contact the patient to assess level of understanding and response to decisions made.
- Encourage family to re-contact the clinic when considering pregnancy or for updated information.
- Be available to answer future questions.

Genetic counseling sessions do not include:

- Any testing or procedures that you do not explicitly approve
- Prescriptions: In most cases, genetic counselors are not medical doctors and do not write prescriptions.
- Specific medical recommendations: A genetic counselor will try to make sure that you fully understand the risks, benefits, and possible consequences of every option that is available to you. However, the genetic counselor will not make medical decisions for you.
- Long-term psychological care: Although many genetic counseling sessions include follow-up sessions to be sure that you are able to handle new information about your health, most genetic counselors are not trained to provide long-term psychological care.

Conclusion of genetic counseling; if you've learned prior to conception that you and/or your partner are at high risk for having a child with a severe or fatal defect, your options might include:

- Pre-implantation diagnosis—When eggs that have been fertilized in vitro (in a laboratory, outside of the womb) are tested for defects at the 8-cell (blastocyst) stage, and only nonaffected blastocysts are implanted in the uterus to establish a pregnancy
- Using donor sperm or donor eggs
- Child adoption

If you've received a diagnosis of a severe or fatal defect after conception, your options might include:

- Preparing yourself for the challenges you'll face when you have your baby
- Fetal surgery to repair the defect before birth (surgery can only be used to treat some defects, such as spina bifida or congenital diaphragmatic hernia, a hole in the diaphragm that can cause severely underdeveloped lungs. Most defects cannot be surgically repaired.)
- Ending the pregnancy

Genetic Testing: A genetic test is the analysis of human DNA, RNA, chromosomes, proteins, or certain metabolites in order to detect alterations related to a inheritable disorder. This can be accomplished by directly examining the DNA or RNA that makes up a gene (direct testing), looking at markers co-inherited with a disease-causing gene (linkage testing), assaying certain metabolites (biochemical testing), or examining the chromosomes (cytogenetic testing).

Although, genetic testing shares some features in common with other kinds of laboratory testing, in many ways it is unique and requires special considerations.

- Genetic testing may be used for medical management and for personal decision-making.
- Genetic test results usually apply not only to the patient but also to other family members.
- Genetic testing may be performed in the context of a genetic consultation and should include informed consent, test interpretation, and follow-up medical and psychosocial services as indicated.
- Because most genetic disorders are rare, genetic testing is often done only by specialized laboratories.
- Intense research efforts in molecular genetics result in the rapid development and availability of new genetic tests; therefore, healthcare providers need to continuously update their knowledge.
- In order for genetic testing to yield meaningful results:
 - Multiple test methodologies may be required
 - Other family members may need to be tested
 - A genetic consultation may be appropriate

Genetic tests may be used for:

- Diagnostic testing
- Predictive testing
- Carrier testing
- Prenatal testing
- Preimplantation testing
- Newborn screening.

Research tests generally do not give clinically applicable results. Research testing is discussed further in the "Ordering Genetic Testing" section.

Diagnostic Testing: Diagnostic testing is used to confirm or rule out a known or suspected genetic disorder in a symptomatic individual.

Points to be Kept in Mind

- DNA testing may yield diagnostic information at a lower cost and with less risk than other procedures.
- Diagnostic testing is appropriate in symptomatic individuals of any age.
- Confirming a diagnosis may alter medical management for the individual.
- Diagnostic testing of an individual may have reproductive or psychosocial implications for other family members as well.
- Establishing a diagnosis may require more than one type of genetic test DNA testing may not always be the best way to establish a clinical diagnosis.

Predictive Testing: Predictive testing is offered to asymptomatic individuals with a family history of a genetic disorder. Predictive testing is of two types: presymptomatic (eventual development of symptoms is certain when the gene mutation is present, e.g. Huntington disease) and predisposition (eventual development of symptoms is likely but not certain when the gene mutation is present, e.g. breast cancer).

Points to be Kept in Mind

- Predictive testing is medically indicated if early diagnosis allows interventions which reduce morbidity or mortality).
- Even in the absence of medical indications, predictive testing can influence life planning decisions
- Because predictive testing can have psychological ramifications, careful patient assessment, counseling, and follow-up are important
- Many laboratories will not proceed with predictive testing without proof of informed consent and genetic counseling.
- Identification of the specific gene mutation in an affected relative or establishment of linkage within the family should precede predictive testing.

Carrier Testing: Carrier testing is performed to identify individuals who have a gene mutation for a disorder inherited in an autosomal recessive or X-linked recessive manner. Carriers usually do not themselves have symptoms related to the gene mutation. Carrier testing is offered to individuals who have family members with a genetic condition, family members of an identified carrier, and individuals in ethnic or racial groups known to have a higher carrier rate for a particular condition.

Points to be Kept in Mind

- Identifying carriers allows reproductive choices.
- Genetic counseling and education should accompany carrier testing because of the potential for personal and social concerns).
- Molecular genetic testing of an affected family member may be required to determine the disease-causing mutation(s) present in the family.
- In some situations, DNA testing may not be the primary way of determining carrier status.
- Carrier testing can improve risk assessment for members of racial and ethnic groups more likely to be carriers for certain genetic conditions.

Prenatal Testing (Table 40.2): Prenatal testing is performed during a pregnancy to assess the health status of a foetus. Prenatal diagnostic tests are offered when there is an increased risk of having a child with a genetic condition due to maternal age, family history, ethnicity, or suggestive multiple marker screen or foetal ultrasound examination. Routine prenatal diagnostic test procedures are amniocentesis and chorionic villus sampling (CVS). More specialized procedures include placental biopsy, periumbilical blood sampling (PUBS), and fetoscopy with foetal skin biopsy.

Points to be Kept in Mind

- A laboratory that performs the disease-specific test of interest must be identified before any prenatal diagnostic test procedure is offered
- All prenatal diagnostic test procedures have an associated risk to the fetus and the pregnancy; therefore, informed consent is required, most often in conjunction with genetic counseling.
- In most cases, before prenatal diagnosis using molecular genetic testing can be offered, specific gene mutation(s) must be identified in an affected relative or carrier parent(s)

Prenatal testing includes the following:

General Testing

- Blood Test
- Paternity Testing
- Urine Test
- Ultrasound
- Rh Factor Testing.

Table 40.2: Indications for fetal genetic diagnostic test

S. No.	Indications	Descriptions
1.	Maternal age > 35 yr at expected delivery	Chromosomal Analysis may be indicated for parents Chromosomal Analysis may be indicated for parents Need for genetic testing is controversial Balanced parental chromosomal aberrations may not require genetic testing.
2.	Recurrent previous spontaneous abortion	
3.	Chromosomal abnormality in a previous child.	
4.	Parental age > 50 yr.	
5.	Parental chromosomal Disorder	
6.	Levels of maternal serum marker suggesting trisomy 21 and 18th chromosomes during 1st or 2nd trimester	Chorionic villus sampling, sometimes with ultrasound during the 1st or 2nd trimester or amniocentesis during the 2nd Trimester is done.
7.	Elevated maternal alpha-fetoprotein and in determinant ultrasound results	Amniocentesis is done

First Trimester

- Chorionic Villus Sampling (CVS)
- First Trimester Screen

Second Trimester

- Amniocentesis
- Cordocentesis: Percutaneous Umbilical Blood Sampling (PUBS)
- Maternal Serum Alpha-Fetoprotein Screening (MSAFP)
- Quad Screen
- Triple Screen Test: Multiple Marker Screen

Third Trimester

- Biophysical Profile (BPP)
- Fetal Non-Stress Test (NST)
- Glucose Challenge Screening and Glucose Tolerance Test (NST)
- Group B Strep Infection

The ultrasound looks for:

Ultrasounds are diagnostic procedures that detect or aid in the detection of abnormalities and conditions related to pregnancy. Ultrasounds are usually combined with other tests, such as triple tests, amniocentesis, or chorionic villus sampling, to validate a diagnosis. An ultrasound exam is medically indicated throughout pregnancy for the following reasons:

First Trimester

- Confirm viable pregnancy
- Confirm heartbeat
- Measure the crown-rump length or gestational age
- Confirm molar or ectopic pregnancies
- Assess abnormal gestation

Second Trimester

Diagnose fetal malformation

- Weeks 13 to 14 for characteristics of potential Down syndrome
- Weeks 18 to 20 for congenital malformations
- Structural abnormalities
- Confirm multiple pregnancy
- Verify dates and growth
- Confirm intrauterine death
- Identify hydramnios or oligohydramnios – excessive or reduced levels of amniotic fluid
- Evaluation of fetal well-being

Third Trimester

- Identify placental location
- Confirm intrauterine death
- Observe fetal presentation
- Observe fetal movements
- Identify uterine and pelvic abnormalities of the mother.

The chorionic villus sampling (CVS) test looks for:

Chorionic villus sampling detects chromosome abnormalities (i.e. Down syndrome) and genetic disorders (i.e. cystic fibrosis). This test is different from amniocentesis in that it does not allow for testing for neural tube defects. Chorionic villus sampling also provides access to DNA for paternity testing prior to delivery. DNA is collected from the potential father and is compared to DNA obtained from the baby during chorionic villus sampling. The results are accurate (99%) for determining paternity.

The amniocentesis test looks for:

Amniocentesis detects chromosome abnormalities, neural tube defects and genetic disorders. Down

syndrome or Trisomy 21 is the most common chromosome abnormality. Genetic disorders include disorders like cystic fibrosis. The most common neural tube defect is spina bifida. Amniocentesis is occasionally used late in pregnancy to assess whether the baby's lungs are mature enough for the baby to breathe on his own. Amniocentesis also provides access to DNA for paternity testing prior to delivery. DNA is collected from the potential father and is compared to DNA obtained from the baby during amniocentesis. The results are accurate (99%) for determining paternity.

The cordocentesis test looks for:

The procedure is similar to amniocentesis except the objective is to retrieve *blood* from the fetus versus *amniotic fluid*. Cordocentesis detects chromosome abnormalities (i.e. Down syndrome) and blood disorders (i.e. fetal hemolytic disease). Cordocentesis may be performed to help diagnose any of the following concerns:

- Malformations of the fetus
- Fetal infection (i.e. toxoplasmosis or rubella)
- Fetal platelet count in the mother
- Fetal anemia
- Isoimmunization

This test is different from amniocentesis in that it does not allow testing for neural tube defects.

Prenatal Screening for Down Syndrome

Genetic screens are often performed on pregnant women older than 30 or 35. Common screening procedures for Down syndrome are (Table 40.3):

- Fetal nucleated red blood cells test for trisomy 13.

In a pilot study to establish fetal nucleated red blood cell (NRBC) detection in maternal blood, trisomy 13 was diagnosed by FISH analysis at 11 weeks' gestation.

Diagnostic Testing for Trisomy 18

Ultrasonographic evaluation of trisomy 18; The sonographic finding of increased nuchal translucency appears to be a prominent phenotypic manifestation of double trisomy in the first trimester.

Other abnormal findings, namely subcutaneous edema, omphalocele, and a large atrioventricular septal defect. These sonographic findings were initially considered highly suggestive of trisomy 18.

Diagnostic Testing for Trisomy 9

Detection of trisomy 9; trisomy 9 can be detected prenatally with chorionic villus sampling and cordocentesis, and can be suggested by obstetric ultrasonography

Diagnostic Testing for Turner's Syndrome

Ultrasonographic Analysis for Turner's Syndrome

The first time presented for uterine ultra sonography 15 weeks from the date of last menstrual period. The fetus has a posterior cervical mass, typical of the cystic hygroma of Turner's syndrome, as well as generalized edema and protruding abdomen with ascites and a single horseshoe kidney.

A mass in the posterior nuchal region detected by ultra sonography is likely an encephalocele or a meningocele.

Table 40.3: Common screening procedures for Down syndrome

Screen	Gestation periods in weeks	Detection rate	False positive rate	Description
Triple screen	15-20	75 percent	8.5 percent	AFP and abnormal levels of hCG (human chorionic gonadotropins) and estriol may indicate that the developing baby has Trisomy 21 (Down syndrome), Trisomy 18 (Edwards Syndrome) or another type of chromosome abnormality
Quad screen	15-20	79 percent	7.5 percent	Same as above
APF/	13-22	80 percent	2.8 percent	This test measures the alfa fetoprotein, produced by the fetus and free beta hcg, Produced by placenta.
Nuchal translucency	10-13.5	91 percent	5 percent	Uses ultra sound to measures nuchal translucency in addition to the free beta HCG and pregnancy associated plasma proteins.

Prenatal Trimester Screening for Turner's Syndrome

A 45, X karyotype is confirmed by fibroblast culture and, as is frequently observed, the α -fetoprotein level in amniotic fluid drawn at the time of termination was abnormally high.

BIBLIOGRAPHY

1. Bowles BB, et al. The future of genetic counseling: An international perspective. *Nat Genetics* 1999;22(2): 133-7.
2. Chen MD, et al. "Introduction to Trisomy 18." *E Medicine*. Retrieved on 2008-07-24.
3. Epstein CJ. "Down's syndrome; Critical genes in a critical region". *Nature* 2006;441(7093):582-3.
4. Lewis R. *Human Genetics: Concepts and Applications*, 6th Ed. McGraw Hill, New York 2005.
5. *Mayoclinic Complete book of Pregnancy and Baby's First Year*. Johnson, Robert V, MD et al "Chap. 11 (Ultrasound, Chorionic villus sampling), Chap. 6 (Triple Screen)".
6. Pediatric Dentist as a Amateur Geneticist; *Pediatric Dent* 2005;27:146-9.
7. Stipoljev F, et al. "Antenatal detection of mosaic - Trisomy I by ultrasound: A case report and literature review." *J. Maternal Fetal Neonatal - Medi* 2003;14(1);65-9.
8. *Williams Obstetrics Twenty-Second Ed*. Gnningham, Chap. 13 (Amniocentesis).

Advances in Dental Instruments

MACHINED RESTORATION: CAD/CAM

There are two principal machining approaches for dental restoration.

- i. Analogous system: Copy milling
- ii. Digital system: CAD/CAM technology.

CAD/CAM TECHNOLOGY: AN INTRODUCTION

1. This method uses digital information about the tooth preparation (Computer surface digitization: (SD) or a digital pattern of restoration to provide computer aided design (CAD).
2. The image is then seen on LCD monitor for inspection and modification and then designing a restoration on the video monitor.
3. Once the three dimensional image (3D image) for the restoration is accepted, the computer translates the image into set of instruction to guide a milling tool in cutting the restoration from a block of material.
4. The unit consists of three-dimensional video camera, an electronic image processor, memory unit and a processor (computer), which is connected to a milling machine.
5. Ceramic reconstruction system (CEREC) was the first commercially available CAD/CAM system.

STAGES OF MACHINED RESTORATION FABRICATION

This ideally involves five basic stages:

1. Computerized surface digitization: this includes digital information about the tooth preparation or tooth reduction.

2. Computer aided design: To view on the monitor for inspection and modification.
3. Computer assisted manufacturing: In this computer translates the image in to set of instructions to guide a milling tool.
4. Computer aided aesthetic.
5. Computer aided finishing.

Note: The last two stages are very difficult and have not yet being included in commercial system.

- Laser (Optical) technique and contact digitization are most promising approaches in terms of cost and accuracy.
- Elevation of the imaged surfaces is calculated by more fringe displacement.
- Cerec 2 is advancement to cerec 1, but it can't prepare occlusal anatomy of the restoration. The cerec 2 equipment is also equipped with cylindrical diamond stone, which is able to finish of undercuts at buccal extension, curved shoulders at cusp preparation and the proximal areas. This instrument has more improved camera system and image processing.

Cavity consideration for cad-cam inlay: Rapid improvement of technology with the use of several computerized devices; it makes possible to fabricate ceramic inlays and on-lays from high quality ceramics blocks within minutes.

- Generation of cerec restoration begins after the dentist prepares the tooth and uses a scanning device to collect information about the shape of preparation and its relationship with the surrounding structures (electronic impression or an optical impression). In

this, by Moiré fringe displacement, we measure the height and depth of the preparation.

- The operator must confirm some of the boundaries of the restoration, such as the position of the gingival margins.
- Once the restoration has been designed, the computer directs the micro-milling device (CAM position of the system), which mills the restoration out of a block of high quality ceramic or composite in a matter of minutes.
- Laboratory fabricated indirect system requires the preparation to have a path of draw that allows insertion and removal of restoration without interference from undercuts. However, the cerec system automatically removes any undercuts during the optical impression.
- Using cerec system an experienced dentist can prepare the tooth, fabricate an inlay and deliver it in approximately 1 hour.
- When delivering a CAD/CAM inlay (Cerec-1), more adjustments are usually necessary when trying in, finishing and polishing. The original cerec system used to mill the occlusal surface relatively flat without any significant surface details. However, the newer cerec 2 and 3 systems are able to mill the occlusal contour in variety of manners. It can build the surface up to the level of scanned wax bite, the neighbouring teeth (in particular marginal ridges and cusp height).

Disadvantages of CAD/CAM Systems

- High cost and need for extra training of the operator.

Stages of Machined Restoration with CAD-CAM (Figs 41.1A to H)



Fig. 41.1A: Cerec in Lab system (CAD/CAM)



Fig. 41.1B: Optical impression through electronic sensor



Fig. 41.1C: Prepared abutment secured in scanning plate form



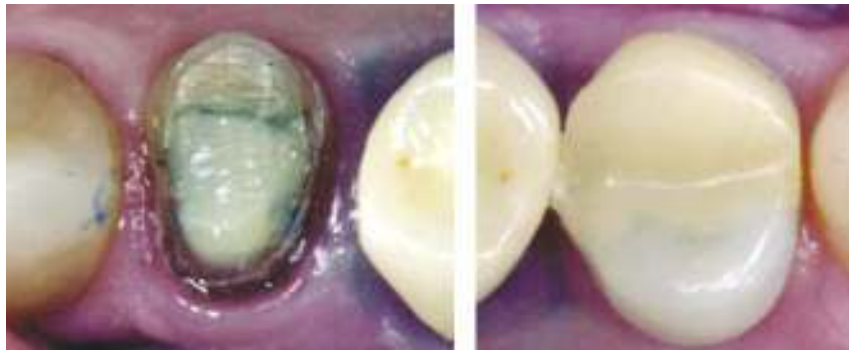
Fig. 41.1D: Two milling diamond forms precise specifications for restoration- Vita block



Fig. 41.1E: Milling of vita block with water ejection



Fig. 41.1F: Prepared restoration coping



Figs 41.1G and H: Prepared abutment and restored abutment respectively

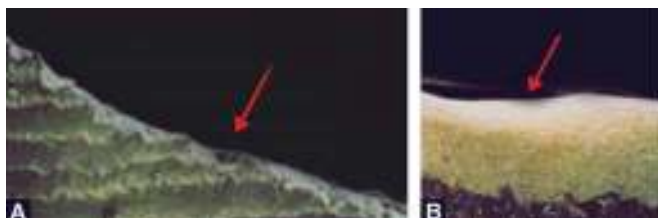
DENTAL AIR ABRASION (MICRODENTISTRY) (FIGS 41.2 AND 41.3A and B)

History: Dr Robert Black in 1940's first described a device which delivered an abrasive material under high pressure, and which would cut through enamel and dentine. But soon fell out of favor.

- In 1970, Dr Tim Rainey started working with Dr Black and in 1985, revived concept of Air abrasion. It can be expressed as, "It is a philosophy, not merely a mechanical system, technology or even technique. While cutting speed of micro abrasion is comparable to rotatory instrumentation; a traumatic access to cavity that can be provided' has obvious advantage over traditional rotary instruments - advantages which are compounded many times over when the need for L.A. is eliminated."



Fig. 41.2: Air abrasion machine (Prep Start) with hand piece



Figs 41.3A and B: (A) Shows cavity preparation by rotatory instrument, (B) shows cavity cutting by air abrasion machine (smooth surface)

Introduction: Air abrasion also called as micro-abrasion and kinetic cavity preparation; is a method of tooth structure removal considered to be an effective alternative to standard dental drill.

- Air abrasion is the use of finely graded 27.5 microns Al_2O_3 powder administered under compressed air through a very fine tip. The hand piece blows a powerful air stream of Al_2O_3 out of its tips onto tooth structure. It uses kinetic energy principle, in which particles bounce off tooth and blasts the carious decay away.
- It will only cut in direction it is pointing.
- The tip of instrument is about 2-4 mm away from material being cut. This is to allow particles to discharge their Kinetic energy. If you hold it closer; the particles bouncing back will impede the particles coming out of the hand piece thus reducing cutting efficiency.
- A rubber dam is applied around the selected tooth area being treated to serve as particle barrier.
- This procedure can leave an accumulation of harmless, dusty particle debris in patient's mouth, resulting a gritty feeling which can be eradicated by oral rinse.

Advantages: Air abrasion procedures are virtually painless, which in most cases, eliminates need of anesthetic solution.

- It produces no vibration and no heat from friction.
- The technology does not harm soft mouth tissues and operates very quietly.
- Because air abrasion cuts tooth surfaces with utmost precision, it removes less tooth than drill and thus it reduces risk of enamel micro-fracturing.
- The treatment is usually of shorter duration.

Indications: It is used to prepare various types of cavities; mostly restored with composite or "white fillings".

- It can be used to remove an old composite but not for amalgam removal.
- To repair cracks and discolorations of crown.
- Prepare tooth surfaces for bonding procedures and perform additional procedures.

Pediatric Dental Uses of Air Abrasion

- It is a good alternative for children afraid of needle, noise and vibration of a regular dental drill.
- In case of nervous patients.
- In case of handicapped patients.

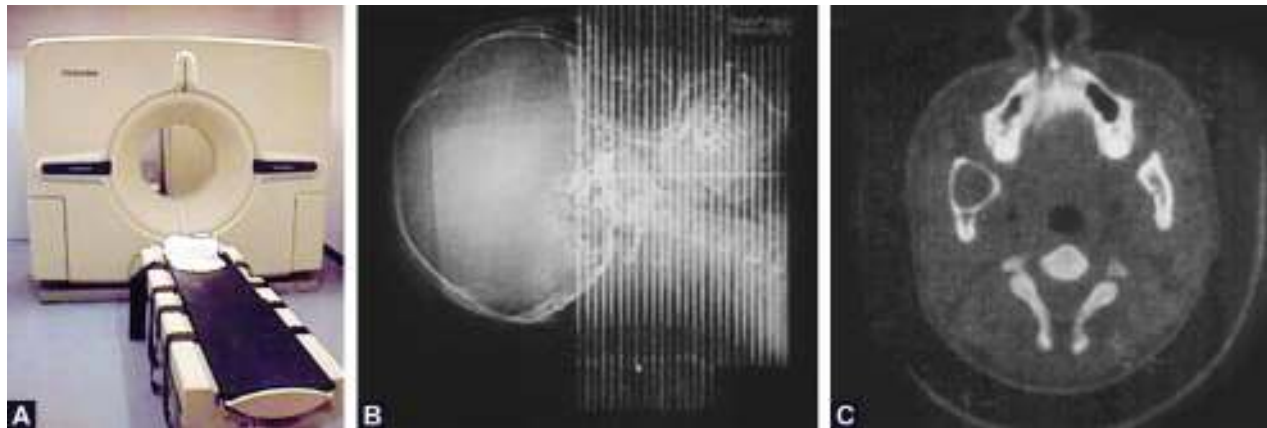
How to choose an air abrasion system: There are a number of systems in market and thus a number of things to look out for choosing abrasion system.

- **Manufacturer's warrant:** There is only one system which gives 3 year warranty that is "crystal mark".
- **Particle size:** Units for use in mouth should be 27.5 microns and should be graded carefully. As larger particles will clog the tips and do not have abrasion potential.
- **Controlling powder flow:** appropriate powder flow should be present.
- Ease of maintenance.
- It should be attached with airtor hand piece holder of dental chair and use the compressor.

Advances: The Prophyl Jet tops in the line of self-contained air abrasion systems.

- It is well-designed, easy to use, mobile air abrasion system with an onboard compressor and auxiliary intra and extra oral evacuation system.
- It is easy to learn and use
- Air abrasion allows for much smaller cavities to be restored hence term microdentistry is used.
- Air abrasion and microdentistry come together in diagnosis and treatment of early pit and fissure caries cases.

CT- Scan (Hounsfield unit): In 1972 Godfrey Hounsfield announced the invention of a revolutionary imaging technique, which is called as computerized axial transverse scanning (Figs 41.4A to C). With this technique he was able to produce an axial cross-sectional image of the head using a narrowly collimated, moving beam



Figs 41.4A to C: (A) CT scan machine (B) Lateral radiograph of head and neck. (C) Reconstructed axial image

of X-ray. This machine is most commonly known as Computed Tomography (CT scan).

Components of computed tomography system: There are many different system configurations for CT scanners, but they all have same basic components:

- The gantry
- The Computer
- The Operating console.

Gantry: The gantry consists of

1. Detector array
2. The X-ray source or tube.
3. Patient support couch.

Detector Array: It contains 2400 discrete detectors or cells (Crystal scintillation or gas filled).

- These detectors acquire unique information for the scan and send that information to the computer.
- Commonly used scintillation detectors are cesium iodide, bismuth germinate or cadmium tungstate.
- Gas filled detector contain either Xenon or Xenon-Krypton mixture.

X-ray source or tube: It contains X-ray generator and X-ray tube.

- X-ray generator is designed to produce a high-milli ampere, (400mA) beam at a nearly continuous rate.
- X-ray tubes have an anode heating capacity of between 1 and 4 MHO (Mega-hertz units).

Patient support couch: It provides a way to stabilize the position of a patient during a CT scan.

- Couch must be made of a low molecular-weight material such as carbon fiber, to ensure that the path of X-Ray beam is not altered before or after it transverses the patient.

Computer: The rapidity of image-capture and large matrix size (512 × 512) necessitate the use of high-speed computer.

- Today's CT scans require computers that can solve 30,000 equations simultaneously.
- The time it takes to generate a visible image after data acquisition is termed reconstruction time.
- Reconstruction time for a single slice is usually of the order of 1 second.

Control console: Control console allows the operator to dictate the parameters of the CT scan, to view the images as they are being generated and to determine the output format.

- Most consoles have at least two monitors so that the radiographer and the radiologist can manipulate the image as the data is acquired.
- CT scan is reconstructed by the computer which mathematically manipulates the transmission data obtained from multiple projections.
- The CT image is recorded and displayed as a matrix of individual blocks called VOXELS (Volume elements).
- Each square of the image matrix is a pixel; size of the pixel (about 0.1 mm) is determined partly by the computer program used to construct the image.

- The length of the voxel (about 1 to 20 mm) is determined by the width of the X-ray beam within through controlled pre-patient and post-patient collimators.
- Each pixel is assigned a CT number representing density.
- This CT number is proportional to the degree to which the voxel has attended the X-ray beam. It represents the:
 1. Absorption characteristic
 2. Linear alteration coefficient, of that particular volume of tissues in the patient.
- 3. For evaluation of intracranial tumor, benign and malignant lesion of the maxillofacial complex, cervical spine injuries, pelvic fracture and deformities of hand and face.
- 4. It allows the construction of life sized models that can be used for trial surgeries and construction accurate implanted prosthesis.

APEX LOCATOR (FIGS 41.5A TO C)

Introduction: It is an automatic Root Canal length measuring device and is referred to as an electronic apex locator.

History: The electronic apex locator is a relatively recent addition to clinician's armamentarium. The principle design and development of units was undertaken by Suzuki in 1942 and introduced in clinical practice by Sunada.

Advantages

1. Reduces radiation exposure by minimizing the number of radiographs.
2. Less time consuming
3. Gives extra insurance that measurements are accurate and reliable.
4. No resetting required for multiple measurement.
5. Facilitates working root length determination in difficult cases.
6. Decreases chair time.
7. Light weight and portable.
8. Automatic calibration which reduces setup time.

Disadvantages

1. File holder reduces the effective length of files.
2. Not accurate with surrounding metal restoration.
3. Not accurate with leaky restoration.

Types of Apex Locator

- Resistance
- Impedance
- Frequency

RESISTANCE APEX LOCATOR

Principle: It works on the principle that resistance between the periodontal membrane and the oral mucosa is a constant value.

Advantages of CT Scan

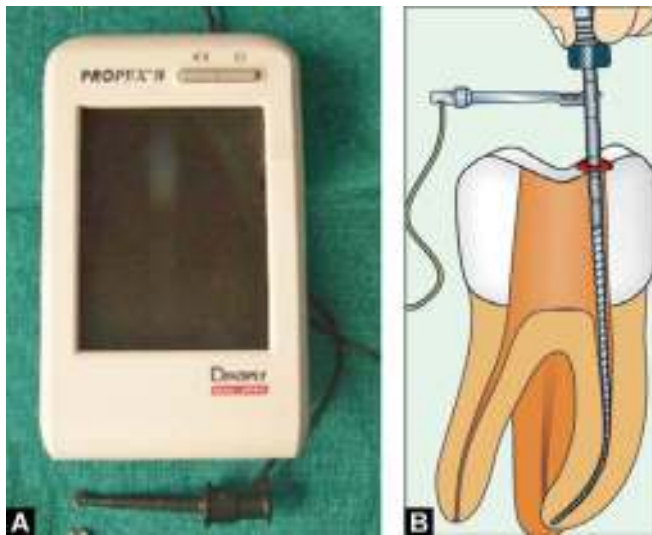
1. It completely eliminates the superimposition of images of structures superficial or deep to the area of interest.
2. Because of inherent high contrast resolution of CT, difference between tissues that differ in physical density by less than 1 percent can be distinguished.
3. Data from a single CT imaging procedure consisting of multiple contiguous scans can be viewed as images in the axial, coronal, or sagittal planes, depends on the diagnostic task.

Dental Uses

1. Useful for diagnosis of disease in the maxillofacial complex, including the salivary glands and TMJ.
2. Useful for evaluation of patients before placement of end-osseous oral implants.
3. It allows reconstruction of cross-sectional images of the entire maxilla or mandible or both from a single imaging procedure.
 - Multi-plane CT imaging are two dimensional images and require a certain degree of metal integration by the viewer for interpretation; this limitation led to the development of computer programs that reformat data acquired from axial CT scan into three dimensional image (3D CT).
 - 3D CT requires voxel, shaped as a rectangular parallelepiped or rectangular solid, dimensionally altered into multiple cubical voxels. This process is called Interpolation.

3D CT is applied to:

1. Craniofacial reconstructive surgery.
2. Treatment of both congenital and acquired deformities.



Figs 41.5A and B: (A) Apex locator (Densply co.) (B) Cross-sectional sketch diagram of canal inserted file along with attached apex locator file-holder



Fig. 41.5C: Apex locator leads; dental file holder cheek or soft tissues holder

1. One side of this unit is connected to oral mucosa through a lip clip and other side to a file.
2. File is placed into root canal and advanced apical until its tip touches the periodontal tissue at the apex.
3. For measurement of the canal it should be dry otherwise it will give a false reading.
4. Cannot estimate beyond 2.0 mm.
5. Causes patient's sensitivity.

Working of Resistance Type Apex Locator

1. Turn on the device and attach the lip clip near the arch being treated. Place a number 15 file into the scanner / file holder. Use a file with a plastic handle that is 25mm long, unless the tooth is very short.

2. Insert the tip of the file approximately 0.5 mm into the sulcus of the tooth. Adjust the control knob until the reference needle is centered on the meter scale and produces audible beeps.
3. Using a preoperative radiograph, estimate the working length and canal width. Using the instrument calculated for width, set the stop at the estimated length. The canal should be slightly wet with irrigant (hydrogen peroxide or sterile water).
4. Insert the file slowly into the canal until the reference needle moves from extreme left to the center of the scale and the alarm beep sounds. This should happen near the site where you have placed the stop, if your estimate has been accurate. Reset the stop at the reference point, remove the file, and record the length.
5. Take a radiograph with file in place at the length indicated by the locator and examine the resulting film.
6. If the suggested length is considerably longer or shorter than your estimate, it is possible that preoperative films are elongated or foreshortened.

Impedance Apex Locator

Principle: Tooth exhibits increasing electrical impedance across the walls of the root canals, which is greater apical than coronal.

1. At Dentino-Cementum Junction, there is constriction in the canal as well as abrupt decrease in the impedance.
2. This abrupt decrease in impedance can be detected and displayed on analogue meter scale.
3. It can detect bifurcated canals, lateral canals, and perforation.
4. The use of insulated canal probes eliminates the need of having reasonably dry canal.

Frequency Apex Locator

Principle: There is maximum difference of impedance between electrodes depending upon the frequencies used.

1. Unit comprises of a lip clip and is calibrated by the insertion of a file into the coronal portion of the canal.
2. As the file is advanced apical, the difference in the impedance value begins to differ greatly and is maximum at the apical portion.

3. Operates in an electro conductive (moist) environment, using K-files, which is a major advantage. It can work in the presence of sodium hypochlorite, local anesthetic, blood or pulp.
 4. Unit can also operate in the presence of pus and pulpal tissue.
- The sensor plug is directly attached into the computer and can be positioned intraorally.
 - When using standard position, the sensor is placed within a plastic holder that is attached to a metal ring that helps align the tube head.
 - Nowadays, these are available for intraoral, panoramic and cephalometric radiography.

Advance Technology

Endo-Analyzer: It is more convenient. It is 2 machines in one: In the Apex locator mode, you get the time saving and accuracy of our apex locator and with a flip of switch unit can be set to vitality scanning mode where you get safest and most reproducible pulp testing. Thus the endodontic diagnostic needs are made as simple as a flip of switch.

Apex Locator vs Radiographs

Apex locator helps the dentist to determine canal width, canal curvature or number of canals; it does not mean elimination of the radiographic importance.

RVG: is a film less, direct, intra oral radiographic imaging system that uses a charge coupled device (CCD) sensor instead of conventional dental radiographic film (Figs 41.6A to C).

- A standard X-ray unit is used to produce ionizing radiation that falls on the sensor.
- The sensor then responds to the radiation and transmits the digital signal to a computer monitor.
- The sensor measures 24 mm × 40 mm length, width and 6mm thick.
- Disposable sheath -barrier provide proper infection control during intra oral use and the sensor can be surface disinfected if contaminated.

Features

- Images can be enhanced for contrast and density.
- Images can be enlarged several times.
- Images can be reversed from black to white.
- Multiple images can be viewed and compared simultaneously.
- May focus on specific position of image such as apices.
- Images can be saved for longer period of time.
- It provides a hard copy of the image within 10 seconds for the patient record.
- It also has the facility to record the radiographic image in the computer database.
- Interface between dental office computer and RVG allows image to be instantly transmitted across the country (Teleconference).
- It also has a facility to record the radiographic image in the computer database.
- RVG can immediately show the presence and location of root tips during extraction.

Uses

- Measurements are automatically calibrated.
- Identify difference in bone density.
- Diagnosis of dental caries.
- Calculation of working length or fitting or trial cover.



Figs 41.6A to C: (A) RVG's screen monitor (B) Remote module (C) APS sensor respectively

Advantages

- Dark room is not required, instant image is viewed.
- Radiographic images are produced in seconds on the screen.
- Elimination of the hazard of film development.
- Printer is conveniently located on card and provide immediate hard copy image.
- Radiation dose is decreased.
- Approximately 88 percent less radiation is required for each exposure compared with conventional radiography.

Disadvantages

- Diagnostic image quality was less than that of conventional film.
- Bulky cart system lacked portability.
- Sensor holder was difficult to place intra orally.
- Poor design of sensor holder made it difficult to align the tube head.
- Sensor thickness impeded proper placement.
- High cost of system.

Conclusion

The practitioner enjoyed the evolution and benefits of direct digital radiography (RVG) with included fast image speed, elimination of processing chemicals, ability to print images at chair side and extremely easy and friendly software.

- One important shortcoming was that the diagnostic quality of the image was less than that of conventional film.
- The unit also lacked portability in the dental treatment room because the cart was bulky.
- Finally, the sensor was difficult to place properly because it is thick and its holder is cumbersome.

Dental Microscope (Fig. 41.7)

Some of the newer devices and materials have enhanced and in some cases improved dental surgical procedures. These include the light and magnification devices such as surgical microscope (Dental Microscope) and fiber optics devices.

Introduction

- Surgical operating microscope offer superior flexibility in magnification and optics compared with



Fig. 41.7: Seiler precision dental microscope

magnifying coupes (most common system of optical magnification used in dentistry)

- They have binocular eyepieces joined by two offset prisms with parallel optical axes. This permits ;
 1. Stereoscopic viewing of the operative field without eye convergence.
 2. Relaxed viewing of the operation field with eyes positioned as if focused on infinity without convergence.
- This reduces eye strain and fatigue.
- Operating microscopes also incorporate fully coated optics with achromatic lenses to provide the highest resolution and most efficient illumination.
- Surgical microscopes are available with objective lenses for various working distances ranging in dentistry from 200 to 400 mm.

Uses

1. For surgery.
2. Diagnosis
3. Treatment procedures in endodontic.

Advantages

1. Magnification
2. In-line illumination
3. They are also adapted for videotaping and to transmit the image to a television monitor for direct viewing or recording.
4. Enhance the view of surgical field.
5. Help in identification of undetected structures.
6. Facilitates surgical procedure.



Fig. 41.8: Intraoral camera with USB cord which is attached with computer during function

Disadvantages

1. Expensive
2. Long period of adjustment before clinical proficiency is reached.

Conclusion

- They reveal fine details and structures that remain invisible to the naked eye.
- They offers more precise diagnosis, new approaches to treatment and also help in good prognosis.
- Help in patient communication, demonstrates various stages of treatment on the monitor.

INTRAORAL CAMERA (FIG. 41.8)

It is a digital intra oral camera that provides digital images which can be viewed on a computer monitor or directly on TV screen. The camera lens is located at the end of an ergonomically designed handpiece that is protected by disposable barrier; transparent sheaths. The focus control is located at the base of the handpiece which enables the user to switch from extra oral to intra oral views and to zoom. Auto focusing intraoral camera is also available. Clinician can integrate the camera into an office system with analog network that attach to television, monitor, VCR tapes. When images from intra oral camera are transmitted to clinical chair side work station, they can be stored along with radiographic images in the patient's database for easy retrieval. This type of camera can be valuable adjunct to the microscope camera because of its lower cost.

Advantages

- Excellent image quality.
- Camera is easy to focus.

- Can be used as a communication tool with patient when discussing the treatment plan.

Disadvantage

- Length of cord.

Conclusion

- It produces excellent image quality, easy to focus and aids in patient communication.
- Sensor produces sharp and clear images that appear instantly on computer screen.
- CCD consists of a chip of pull silicone with an active area that has been divided into two dimensions array of elements called pixels (picture elements).

OXIMETRY

Pulse oximetry is the simple, non-invasive method of monitoring the percentage of hemoglobin, which is saturated with oxygen. This method determines pulpal vascular health by evaluating oxygen saturation.

Method

Pulse oxymetry is based on placing arterial blood vessel between light sources and detector. A source of light originates from probe at two wavelengths (650 nm + 805 nm). The light is partly absorbed by the hemoglobin by amount, which differs depending on whether saturated or de-saturated with oxygen.

- By calculating absorption at two waves-lengths the processor can compute the proportion of Hemoglobin, which is oxygenated.
- The oxymetry is depending on pulsatile flow and if flow is sluggish it does not work.

Indications

1. It is used in between vital and non-vital teeth by consistently providing saturated oxygen values that were lower than the value recorded on patient finger.
2. It detect hypoxia before patient detects it clinically, mostly in the pediatric patient.

Other Uses

- i. To monitor oxygenation and pulse rate through out anesthesia.
- ii. Used during recovery phase.
- iii. In patient with respiratory or cardiac diseases in order to reflect severity of diseases.

Research Methodology and Biostatistics

Research methodology: It can be defined as scientific and systemic search for pertinent information on a specific topic.

- A hypothesis must perform the function of a guide for collection of facts (Claude Bernard, 1965) the second stage is the examination of the hypothesis.
- There should be a value of study protocol in any research. The value is based on the following facts.
 1. Clinical epidemiology
 2. Evidence based
 3. Clinical knowledge
 4. Critical appraisal.

Aim and Objective of Research

Ultimate aim and objective of research study is to add to the existing knowledge and to better individuals life's. The understanding of the casual association of disease like etiological agent, and risk factors: To improve the method of diagnosis, to help the sick people and prolong the longevity of the healthy individuals in the population. The following factor may be considered in mind during setting of aims and objective of a research.

1. To discover answers to questions through application of scientific methods.
2. To accurately describe the characteristics of a particular disease in individual, situation or a group (discriptive research).
3. Exploratory or formulative research studies.
4. To determine the disease frequency and associated factor (diagnostic research).
5. A hypothesis testing research.

Types of Research Study

Classification of research, (Bailar and Mosteller, 1986)

1. Longitudinal studies
 - A. Prospective studies
 - I. Randomized (to use a method in an experiment, a piece of research that gives every item an equal chance of being considered; to put things in random order)
 - II. Non-randomized
 - B. Retrospective studies
 - I. Deliberate (planned) intervention
 - II. Observational studies
2. Cross-sectional studies includes
 - Disease description
 - Diagnosis and staging
 - Disease process.

Longitudinal studies: When a descriptive study is conducted over a long period of time it is called longitudinal study or done on samples drawn from the population and the observation are made at a periodic interval or Cross-sectional studies done for a longer duration by repeating periodically.

- The same individuals are examined upon repeated occasions and changes within the group recorded in terms of elapsed time.
- The longitudinal studies are extremely useful
 1. For studying natural history
 2. For identifying the risk factors associated with the disease.
 3. For calculating the incidence rate of the disease.

Prospective Study

A study also called a 'Cohort study or Follow up study' that follows its subject forward in time from initial exposure (or non exposure) to some expected risk factor, to the eventual disease outcome. (disease is expected to occur in future).

- development of disease in exposed and non exposed compared
- suitable for common disease with common exposure.
- bias is generally lower.

Retrospective Study

- This study is also called as case control study) that looks backward in time from final disease outcome to potential cause. (in this case, disease has already occurred)
- In it groups of affected individuals (cases) and unaffected individuals (controls) are compared to the extent of their exposure to the same suspected risk factor.

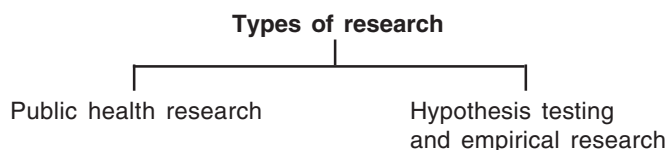
Advantages

1. Relatively easier to carry out.
2. Useful for rare case with smaller numbers, substantial bias can occur

Cross Sectional Study

This study is simplest in concept and execution. It measures the prevalence of the disease hence also called 'prevalence study'. In this, a set of individuals are chosen who may be the representative sample of the general population or of people in a particular community, or a sample of members of some special subgroup-school children, and the measurement of exposure as well as effect are made at the same time.

We are able to get information on the relationship between a disease and other variables of interest as they exist at one point of time. For example in cross-sectional study of oral malignancies, we can also collect data during their survey on history related, occupation, tobacco habit and age, sex.



1. Types of public health research (documentation-descriptive research)
 - A. Epidemiology research
 - B. Descriptive epidemiology (description of the distribution of the disease, the comparison of its frequency in different populations and in different segments of the same population).
 - C. Risk assessment: Correlation studies to identify risk factors for disease.
 - D. Identifying trends in a population
 - E. Product testing: Report on product quality and use.
 - F. Financial and manpower documentation.
2. Hypothesis testing and empirical research
 - A. Randomized controlled trials.
 - B. Field experiment (fluoride study, Area related disease).
 - C. Laboratory study.

Research Design

- Any work or research should start from the library; there should be some crystallization of present objectives of the study.
- Young researchers should develop index cards of possible topics of research.
- Finally the research project should be adapted to the available material and method within individual's limitation.
- The subject of research should be capable of being tested as alternative hypothesis. It should therefore test propositions in which there is real difference in opinion.
- The research project should be circumscribed, specific, and definite in its objectives.

Research Planning

- It is the protocol by which research guide and researcher decide, in advance, how the investigation will proceed, in what order, and what observations shall be made.
- It proposes the objective which should be limited in extent and eminent obtainable. Policy of the course of action, procedure adopted and the step by step program needed to accomplish the mission in a specific time and budget.

Pilot Research Study

- It proposes the objective which should be limited in extent and eminent obtainable policy of the course

of action, procedure adopted and the step by step program needed to accomplish the mission in a specific time, and budget.

- Before embarking on any research (*vivo* or *ex vivo*) an attempt of the scheme in miniature is essential.
- To find out the approximate forecast of the study results.
- Many parameters should be scrutinized. If difficulties are discovered in the pilot study then, it may not be lost. Study can still be modified.

PROGRAM EVALUATION

Criteria for Research Empirical Studies

1. It is based on work of others.
2. It is replicable.
3. It is based on theory, or at least on established facts.
4. It is heuristic. (education encourages you to learn by discovering things for yourself)
5. It is generalizable.

REVIEW OF A RESEARCH STUDY

Research reports are issued by university scientist, drug companies, government agencies and professional organization. Researcher must go through the topic (selected) related published research paper in different journal.

A Research Study Format

- Title of study
- Abstract
- Introduction and review of literature
- Materials and method
- Observations and results
- Discussion
- Summary and conclusion
- Bibliography or references

Title of the study: The title of the study briefly indicates the topic and aims and objective of the study.

Abstract: An abstract of the study is usually provided at beginning of the paper. (By scanning this abstract, busy researcher can quickly determine whether the study is relevant to their interest or not.

It includes a brief summary of the research focus and importance of the topic, identification of the population

sampled or object of study, and a brief statement of the experiment strategy. This is followed by a summary of the method and findings and a concluding statement.

INTRODUCTION AND REVIEW OF LITERATURE

Researcher attempts to provide a back ground to the problem or question arises at the beginning of the study.

- Past controversies will be summarized, key studies will be mentioned, and the question clarified.
- Goal of the study should be clear.
- **Review of literature:** Make researcher aware of the relevant past research.

Materials and Method

- Materials used in the study and their properties as well as their draw back, manufacture's name, year of manufacturing, expiry date, batch no., etc. should be mentioned clearly.
- Subject and recruitment strategy.
- Measurement strategies and instruments
- Research design.
- Method for statistical analysis.
- Materials and Method section is the key of any research. This section provides us the specific and operational information about how the study was conducted.
- Method section should include 4 sub sections.
 1. Sampling strategy: this is a description of the population being sampled, the sampling method, and the method of assigning subjects to conditions)
 2. A description study design; the researcher should describe operationally the experimental study design in a step by step sequence. The description must be detailed enough so that the reader could replicate the study.
 3. The proposed statistical analysis strategy should be presented.
 4. The researcher should describe the proposed strategy for evaluating, quantifying, and analyzing results.

Observations and Result

This section includes a descriptive and inferential statistical review of the researcher's findings and summarizes findings in charts, graphs, and tables where it is necessary.

- All descriptive analysis should include the number of subjects and observations made, as well as summary statistics (measures of central tendency, range, frequency, and correlation)

Discussion and Interpretation of Results

- After having clearly represented the out come of research in objective terms. The experimenter will attempt will then interpret and explain these results.
- Although statistical analysis of observation is a consideration, questions regarding methods involving in gathering data and interpreting observation are far more critical.
- Research never actually proves the correctness or falseness of a theory or hypothesis.
- Researchers instead discuss the level of statistical support for the theory/hypothesis and compare the findings with those discussed in the introduction.
- Second step of discussion involves explaining negative and positive findings.

SUMMARY AND CONCLUSION

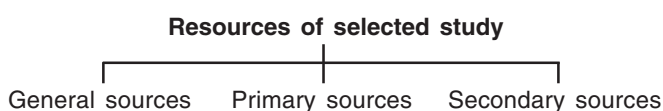
1. It is the investigator's obligation to critically evaluate the conclusion. Researcher states clearly the importance and interpretations of the study results.

BIBLIOGRAPHY AND REFERENCES

The researcher should provide accurate primary references for the introduction and assertions.

- These references can be valuable for the study reviewer who wishes to pursue the problems further and to learn more.
- The references also allow the study reviewer to go back and review the actual studies in cases where the study reviewer feels that the researcher may have misinterpreted or misread prior studies.

KEEP FEW THINGS IN MIND DURING SELECTION OF A STUDY



- A. *General sources*: often provide the first indication to the private clinician or researchers that some new

information is available regarding their relevant topics of concerns. These sources include:

1. Material intended for general public.
 2. Newspaper article
 3. Popular magazines (like health magazine)
 4. Television or radio report or surveys
 5. Popular science books or journals
- B. *Primary sources*: It includes journal articles, conference reports, and published abstracts. (including reports that appear on the internet and in web sites) example:
 - Scientific report of specific laboratory experiments.
 - Journals from professional publishers (example-free journals for advertising, publication for pharmaceutical co.)
 - Journals sponsored and published by professional organizations such as Indian Society of Preventive and Pediatric Dentistry, (American association of public health dentistry, the American dental association), learned or scientific societies (example international association for dental research, American association for public health, Indian dental association, etc.)
 - C. *Secondary sources*:
 1. Review articles published in professional and scientific journals.
 2. Dedicated journal issues, audio-visual reports
 3. Scientific reviews and educational texts.
 4. Textbook intended for specialists.

STATISTICS: AN INTRODUCTION

- No journal offers a guarantee as to the validity of its papers.
- In a survey Emerson and Colditz (1983) found 70 percent used some form of statistical analysis similar proportions in British Medical Journal.
- Statistics is not only a discipline but also a fundamental tool for investigation in all biological, medical and dental science.
- The modern computer facilities required for familiarity with the technical details of statistical calculations.

Two statistical techniques are generally accepted:

1. *Descriptive statistical technique*: To make an individual (statistician) to describe and summarize a set of data numerically.

2. Inferential statistical technique: Provides a basis for making a generalization about the probable results of a large group when only a selected portion of a group has been observed.

Terms to be Clearly Understood before Beginning of the Research

- Population: Is an entire group of items (objects materials, people community, etc.) that possess at least one basic defined characteristics in common (examples of population: All Indian citizens, all dentists, all periodontally involved teeth, etc.)
- Representative portion of the population called a sample by observing and measuring a sample, it is possible to obtain information and make statement about total population.
- When we collect a specific piece of information-data from each member of the population, we obtain a characteristic of the population called a parameter.
- When we collect a piece of information from each member of a sample, we obtain a characteristic of the sample called statistics.

Sampling: A sample truly representative of the population can be obtained by above described sampling method and taking sufficiently large samples.

Random sampling: is one in which every element in the population has an equal and independent chance of being selected. By using a specific random numbers to the collected samples, and selection would begin by

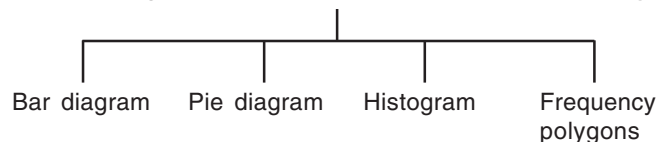
blindly identifying a number on the collected sample that corresponds to a member of the total population. The selection continues by taking numbers horizontally and vertically until desired sample size is reached. Repeated numbers are omitted.

Random sampling is the procedure of choice as it prevents possibility of bias on the part of the researcher.

Applied Steps in Data Analysis

1. Organizing data from lowest to highest.
2. Grouping and regrouping data, based on relevant information.
3. Tabulating scores.
4. Constructing a frequency distribution.
5. Constructing tables and graphs for efficient communication of obtained results.

Common graphic techniques used in research study



Bar diagram: Is used to represent qualitative data. It represents only one variable.

Multiple Bar (Fig. 42.1): Used to compare qualitative data with respect to a baseline data.

Proportional Bar Diagram: Used when desired to compare only the proportions of sub group between different major groups of observation.

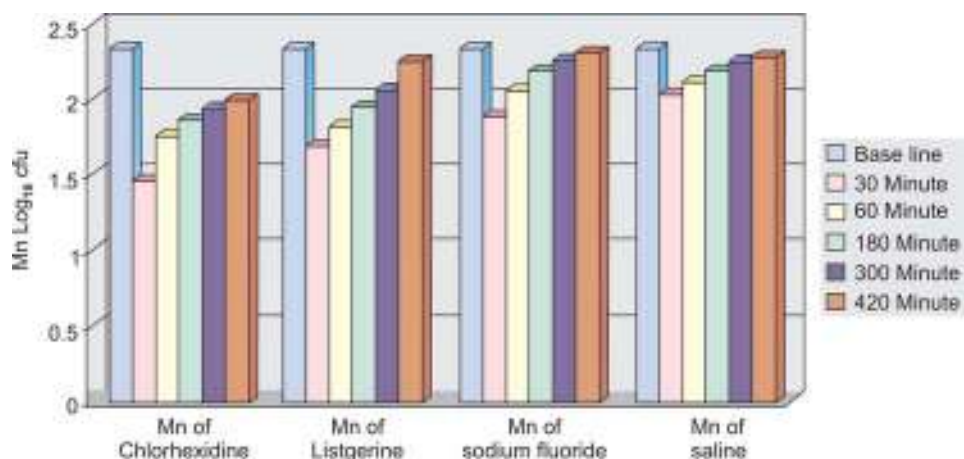


Fig. 42.1: Multiple bar diagram shows comparative evaluations and efficacy of different mouthwash at different time interval. (CFU = colony forming unit)

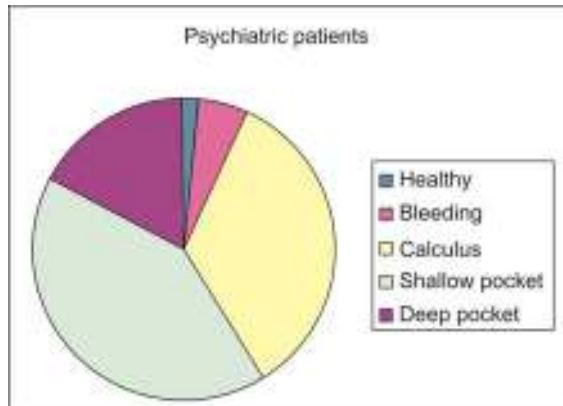


Fig. 42.2: Pie diagram shows periodontal status of hospitalized psychiatric patient (By CPITN)

Pie Diagram (Fig. 42.2): These are popularly used to show percentage break downs for qualitative data.

- A circle is divided into different sectors corresponding to the frequencies of the variable in the distribution.

Histogram: Is a graphic representation formed directly from a frequency distribution?

- It is a display in which horizontal and vertical axes of a graph are formed according to the scale values and the frequency of the distribution, respectively.

Frequency polygons: Is used to represent frequency distribution of quantitative data and is useful to compare two or more frequency distributions.

- To draw a frequency polygon, a point is marked over the mid point of the class interval, corresponding the frequency.

Example: Human pulse rate

60	64	65	67	70	71	71	72	72
73	74	74	75	76	77	77	77	78
78	78	79	79	80	80	80	80	81
81	81	81	82	82	83	83	85	85
86	87	87	88	89	90	92	94	96

When the observed values of a quantity variable are arranged in order it is known as an array or distribution.

- In statistics, the “range” is the difference between maximum and minimum values you observe in the variable. For example in above case 96 minus 60 gives a range of 36 pulse per minute.

Arithmetic mean: If data contains ‘n’ numbers $Y_1 Y_2 \dots \dots N_y$ then arithmetic mean is = sum of Y/N

Central tendency: The three measures of such tendency are the mean, median, mode.

BIBLIOGRAPHY

1. Danniel WW. Biostatistics: Foundations for analysis in health science, 2nd editions New York: John Wisley & Sons, 1987.
2. Lawanga SK, Cho-Yook Tye editors. Teaching health statistics, Geneva, WHO, 1999.
3. Rekha, et al. Oral health status and treatment requirements of hospitalized psychiatric patient in Bangalore city, JISPPD. 2002;20.

Fundamentals of Private Practice in Pediatric Dentistry

INTRODUCTION

The practice of modern pediatric dentistry requires thorough knowledge of the subject, latest instruments, and good quality of work with excellent business principle. Pedodontist must be knowledgeable about consumer needs, demands, and ethics of dental practice. The aim of the Pedodontist is to provide high quality patient care with sufficient profit to survive. Every young Pedodontist begins practice expecting to be successful.

Philosophy of Dental Practice

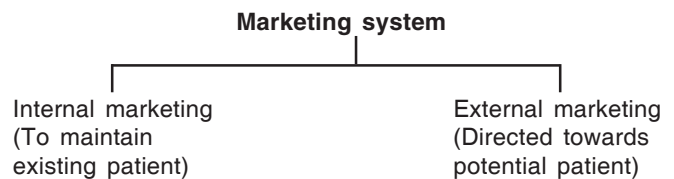
The 1st step of private practitioner should be writing his mission statement in the waiting area. This philosophy statement (Good oral health can makes good general health) acts as a blue prints for the office and that links the dentist to the staff and patient.

Patient Assessment

The Pedodontist should describes the target population by chief characteristics, such as age, location, parent's education level, income level, religious ethnicity, lifestyle and society status.

Aim and Objective

The aims and objectives of private practice are determined by dental personnel (Pedodontist and dental staff). Dental personnel are important part of internal marketing system. Goals and objective of private practice can be achieved by measuring new patient, recall visit, production and collections. Goals assessment can be done by monthly or quaternary or yearly basis. There are two types of marketing system



What is Marketing?

The marketing can be defined as properly directed all activities towards discovering and analyzing consumer needs and wants delivery services that satisfies those needs. As a Pedodontist, the purpose of marketing program is to maintain one's share of market. It is important to remember that key concept to successful marketing is fulfilling the needs of your current and potential

Patient assumes that doctor is willing to adopt his or her practice to better meet these needs.

Selection of a Target Market

- Priority strategy focuses on the one segment of community, which we think, has most potential for being as a dental patient, whether it will be particularly social group, age, sex or religion.
- One study showed that 84 percent of all dental appointments are made by women and that mother usually decides which dentist will care for the family. This segment deserves priority strategy in your pediatric dental practice.
- In the developing dental market, it is advantageous to the Pedodontist to bring back into the market as many of the 72 percent of our population that are poor users of dental care. Dental insurance is the newer concept in the marketing system to bring the

many people who previously did not utilize dental services.

Fundamentals of Marketing Plan

The Pedodontist must incorporate the following qualities into the marketing plan.

- Reality- Pediatric dental surgeon should plan for realistic goals.
- Commitment – A truthful commitment with dental staff and pediatric patient.
- Flexibility – Capable of being changed, according to condition and new information regarding patient history, cooperation ability, patient's socioeconomic status etc.
- Patience – Pedodontist must have patience because result do not happen overnight.
- Variety – Variety of methods and strategies should be used and changed according to needs of the marketing system.
- Measurability – The marketing plans effectiveness should be measured from time to time by evaluation of the dental practice.
- Fundamental – Make a plan to the patient dental visit first to the dental office and then sure them for good return on investment.
- Exemplariness – The pediatric practice should be made on true value and explained the advantage or disadvantage of dental treatment provided.
- Funding – A minimum budget of 2 – 5 percent of gross production is crucial for marketing plan.
- Worthiness – The marketing plan must be considered as investment.
- Consistency – Any marketing plan must be consistent over time.
- Confidence – Pedodontist should be confident and make patient confidence in his work.

Component of Developing Dental Marketing (4P-system)

The following components are playing an important role in the promotion of any marketing system.

- Product
- Price
- Place
- Promotion/advertisement

Product

It involves actual services we offers and what type of services perceived by the pediatric patient. Most of the patients have no idea to judge the competency of the general dentist. They usually judge by his or her packaging, such as appearance of the dentist, way of talking, cleanness of clinic and dental personnel appearance and their attitude towards patients and how much equipment present in the dental clinic. Pedodontist should be image conscious and careful about quality of work, communication skills of dental personnel to the patient and other dental personnel working in the dental office. These factors reflect the images of the dental office and help in gaining the patient confidence.

- Today, we offer a variety of advance technical services. People who feel secure with particular dentist, specially those dentists who handle their children well. They always prefer to that dental surgeon who fulfils all their dental needs rather than go to an unfamiliar dentist.
- Explain the use of lead apron to the patient and its protective efficiency during x ray radiation. This shows the carefulness of the dentist to the patient.
- Developed a program for adding dental services. Lists all the procedure that we now perform and rate them according to technical proficiency, time efficiency and targeted profit that needs within our target market. Also lists the procedures to refer out and for services that we neither perform nor refer.
- Surgical instrument should be as new and attractive as possible because patient can judge the quality of product by its package.
- To overcome marketing challenges, pedodontist must communicate with concern and care towards the apprehension of patients. in this way, the develops a sense of care in child in a much shorter period of communication.
- Pedodontist must convey message to the public that we are the most caring and most trustworthy and the best skilled dentist available in the market. Call your patient by their given name. Touch therapy should be provided only when Pedodontist is giving reassurance, support, or encouragement, by placing right hand lightly on their shoulder when patient feels anxiety. Touch therapy is providing a powerful and honest message about patients care.

- Make sure that parents are completely satisfied with the treatment done and do everything to gain their satisfaction and enthusiasm. This is the time to tell them how much we appreciate them as patient and to ask them for referral.
- Give reason for recall visit.

Note: Now a days, the chief marketing idea is the appearance of dental clinic, facility available in the clinic; internal dental environment, dentist personality and statement at the time of treatment provide a warm attractive and promote the feeling of high trust and low fear to the patient and parents. The chief marketing rule of the pediatric dentistry is to be people oriented, not time oriented, production oriented and definitely not dentist oriented. Pedodontist must provide a little more facility to the patient than they could receive in another dental practice.

Place

Term place in the marketing system denotes that how the product or services are distributed and how do we make our services available to our targeted population or communities. These goals can be achieved by establishing the dental clinic at an appropriate location. It is easy to do business where a need exist rather than an already overcrowded market, usually near the neighborhood school. Dental clinic location must be highly visible and in the way of high traffic road.

- Distribution refers not only location but also to the hours that our services are available. Try to work in the odd hours and open your clinic an hour earlier and eat lunch later so that you will be available before working hours of the individual and during lunch hours when working individual can get free. Pedodontist always offer people hours not doctor's hours.

Price

We always keep in mind that if patient ask about fee, is not correlated with lowest price but want to know about value and quality of work. Pedodontist must be ensuring the patients regarding comparative advantages and disadvantages of all the available services, and showed the worthiness of fee. Supply and demand must be considered in mind, when we are dealing with pricing strategies. Today, those dentists whose fees are modest have a marketing advantage.

- Pedodontist should provide the treatment option with fee and explain the advantage/disadvantage; so that patient can choose the option of higher fees or lower fees related with their socioeconomic status.
- Most important component of pricing is the spectrum of financial services offered. Usually, a cash policy severely limit the sizes of our patient load, where as time payment, discounts for cash, acceptance of third party payments, medical assistance and other alternative will significantly increase our share of the market.
- Most of the patient can't handle large dental bills in one payment and borrowing many at high interest rate is also impractical, so multimonth (EMI) payment arrangement seems to be necessary in virtually every practice. In many instances people will purchase our services based more on the level of monthly payments than on the total cost.

Note: Remember that aim of our practice is to serve our patient needs and extension of adequate , flexible credit term and acceptance of assignment of insurance benefits will enables us to meet the needs of a larger segments of our population.

Promotion: Promotion is not advertising of dental clinic but it includes all of the tools available to inform existing and potential patient about who we are and what our services consist of.

Internal Marketing (Internal Promotion)

- All those extra things do for maintenance of existing patient to say that we care about them. Patient who will tell all their friends about the special care, they receive from the particular dental clinic, called as Dental missionaries. Internal marketing must involve all dental personnel utilizing every contact with patient as an opportunity to promote our practice. Birthday card sent to the pediatric patient and small toy or balloon is given to every child, coming to the pediatric dental clinic to promote our practices.
- Dental missionaries or references might grant with special gift after 3rd or 4th referrals.
- The dental personnel should be well dressed and dental clinic can be decorated on every festivals. It will also help us to keep these patients in our practice.
- Emergency care should be available at our clinic 24 hours a day. Make emergency patient a marketing

opportunity; not a nuisance. Place a sign in your waiting area informing your patient that you provide 24 hours emergency care and give your entire patient a telephone sticker with your name and telephone number mentioned on it.

- We also use the letter or e-mail for internal marketing. A semiannual news letter sent to all of your patients is a great way to tell them, we care about them, to expand their dental IQ, to remind them of our services and availability and to keep our name in their mind.
- This letter should be informative regarding the dental education, tasty nutritional sugar free recipes, preventive program, X-ray safety trauma, address of your clinic, etc. The intension is not to impress treatment necessary, the total cost and payment scheduled agreed upon with emphasis placed on how the treatment will help the patient.
- Computer will prove to be an excellent investment in long run of dental clinic. It can store unlimited number of data, letters or file of the patient for this purpose and reduce the time of composing and typing correspondence.

External marketing: External promotion involves all of the various avenues we can pursue to inform the public about who we are and what our services consist of. The primary aim of external marketing are getting new patient in our clinic. The most deciding factor in purchasing dental services is the degree of trust and confidence in the dentist. Communities activity of the Pedodontist is an excellent way to create the recognition that builds a new practice like rotary club, lions club, local school board etc, provide school dental screening and dental office tour for nursery school.

- The utilization of audiovisual or multimedia for external marketing; can include both commercial and non commercial presentation. Local news usually will appear in the local news, columns of news paper and many activities in which you and your practice figure will attract the general reading public especially in small community. Commercial media presentation or advertising can be defined as any form of non personal presentation and promotion of ideas, goods and services that are paid for buy and identified with a sponsor.
- When most dental surgeon thinks of marketing, they think of advertising but advertising is a small part of

marketing and it will only be productive under very controlled conditions. Dental surgeons who think that advertising can be an appropriate part of his or her external marketing should follow following rules.

1. Choose your target market to determine both the content of advertising and effective audiovisual media according to what your target population watches, reads and listen to.
2. Use a professional help while advertising campaign.
3. Be absolutely honest and accurate in what you say: advertising must be positive communication.
4. Advertising is the long term investment. You should budget regular appropriation for at least 6th month before expecting any results.

Dental Staff, Policies and Systems

Pediatric dental practice can not be successful without team work. Dental staff is the most important quality that the dental surgeon has. Dental personnel should be skilled, trained, and offered opportunity for carrier development by rewarding exceptional performance.

Selection Criteria for Dental Personnel

Pedodontist have patient during hiring the dental personnel. True dental personnel are more concerned about making a contribution than making the demands. The following essential criteria should be considered to hire the best dental personnel

1. Dentist always interview one by one and interview should be recorded for future reviews.
2. The dental surgeon should select for intellectual skill not mechanical skill.
3. The Pedodontist should ask open ended questions that allow applicant to share their opinions and views
4. Dentist should ask the same questions to create the consistency and to hear the differences in how applicant responds.
5. Dental staff should have a 'WOW' word in front of the patient after the end of the dental work.
6. After selecting best dental staff; selected individual asked to spend a half day in the dental office to do a working interview.

Staff delegation: Delegation means transferring responsibility and authority to some other person. It is important steps in the evolution of the productivity. The

dental staff has to know what is expected and how the results will be evaluated. There are three components of delegation

1. Responsibility
2. Authority
3. Accountability

Motivation: Dental surgeons motivates the dental staff by getting them involved and committed to dental office task that needs to be accomplished. The real motivation comes from within, it is encouraged in an environment that cultivates personal growth, self improve and personal reward for persons and all dental team.

- To enhance the dental team's effectiveness and motivation in the pediatric dental office, the dental surgeons should be sensitive to level of each team member's performance, get his feed back and have to plan to extend member's effectiveness.

BIBLIOGRAPHY

1. DCNA. Symposium on Pedodontics: Professional Marketing for Pedodontic Practice Jan 1984;28(1):121-36.
2. Griffin AP, et al. Dental practice considerations, DCNA 1995;4:861-75.
3. Milone CL, et al. Marketing for dental practice, Philadelphia. WB Saunders Co. 1982.

Index

A

Absorption of fluoride 170
 Access opening for RCT in primary teeth 213
 Accidental and non-accidental oral trauma 323
 Acid etched composite crown 195
 Acidogenic theory 142
 Acidulated phosphate fluoride solution 178
 Acquired heart disease 298
 Acrylic
 jacket crown 197
 partial denture 96
 Acute
 dental caries 144
 necrotizing ulcerative gingivitis 292
 ADA recommendations for mouth guard 314
 Adrenal insufficiency 304
 Adsorption and ion exchange method 181
 Advances in dental instruments 338
 Advantages of
 CT scan 343
 electrosurgery 112
 fixed space maintainer 97
 incineration 13
 LA vs GA 223
 laser 312
 surgery 112
 myofunctional appliances 136
 water fluoridation 175
 Age specific plaque control 123
 Alveolar
 cyst 283
 lymphangiomas 283
 Anesthesia for maxillary primary molars and premolars 237
 Ankyloglossia 283
 Anodontia 75
 Anomalies of tooth
 form 73
 number 74
 structure 75
 Anterior teeth 205
 Anteroposterior TMJ articulation 46
 Antibiotic
 prophylaxis 299
 vaginitis 132

Antihistamines 248
 Antimicrobial action of fluoride 173
 Apex locator 343, 345
 Apexification pulpless in immature apex 216
 Apical barrier technique 216
 Arrested
 caries 144
 lesion 145
 Arsenic poisoning 322
 Articulatory speech 26
 Atraumatic restorative technique 198
 Autoclave 5
 Autoimmunity theory 143

B

Baby bottle tooth decay 132
 Bacterial
 growth and proliferation within dental plaque 118
 infections 292
 Balanced diet 66
 Band and
 bar type space maintainer 101
 loop space maintainer 98
 Battered baby syndrome 320
 Behavioral theory 104
 Benzodiazepines
 antagonist 247
 group 247
 Bisecting angle technique 41
 Bite wing technique 42
 Blindness 308
 Breastfeeding 130
 Brudevold technique 178
 Bruxism 288
 Buccal
 and lingual surfaces 192
 object rule 44
 Buckley's formacresol 212

C

Caffey syndrome 320
 Calcium hydroxide 212
 Canal irrigating agent 214
 Candidiasis 293
 Canines 72
 Capabilities and limitations of laser 311

Carbohydrate 66
 Cardiac diseases 298
 Careful handling of biopsy specimen 7
 Caries
 activity tests 151
 detection 32
 management 166
 protective component of food 149
 risk assessment 151
 vaccine 168
 Cariogram 155
 Cariology 142
 Cartridges 220
 Castable glass ceramic veneer 197
 Causes of mouth breathing 104
 Cavity
 in primary tooth 184
 preparation in primary teeth 184
 Cell inductive agents 213
 Cementation 197
 Cemented pins 265
 Cerebral palsy head support 298
 Chair side
 method 153
 veneered 194
 Chalky Whitespot lesion 144
 Challenges for pediatric dentistry in 21st century 3
 Characteristics of *Streptococcus mutans* 168
 Cheek and lip chewing 288
 Chelation theory 142
 Child abuse and neglect 320
 Child's
 first dental visit 163
 position during dental treatment 22
 Childhood
 autism 307
 development 55
 Child-language development 26
 Childs orofacial examination 20
 Chronic
 dental caries 144
 inflammatory intestinal diseases 306
 renal failure 302
 Clark's rule 255
 Classification of
 fluoride administration 174
 foods 64

- fracture 277
 - matrix band 185
 - resin fissure sealant 165
 - tongue thrust 105
 - waste 8
 - Cleft lip and palate 309
 - Clinical
 - classification of caries 43
 - examination of child 25
 - feature of digit sucking 104
 - significance of developmental theories 49
 - Coagulation disorders 299
 - Collecting forensic evidences 325
 - Collection of
 - important information 37
 - waste 9
 - Color of teeth 32
 - Combination of methods and sedative agents 245
 - Combustion chamber 12
 - Commissural lip pit 285
 - Common
 - infectious lesion of oral cavity in child and adolescent 290
 - pediatric oral pathology 283
 - Commonly used drugs in pediatric dentistry 254
 - Community
 - activities of pediatric dental surgeon 164
 - water fluoridation 175
 - Complete denture 97
 - Complexity of plaque bacteriology 116
 - Complications of
 - local anesthesia 224
 - traumatic injuries 276
 - Component of developing dental marketing 355
 - Composition of
 - dentifrices 121
 - local anesthetic 219
 - Computerized delivery systems 222
 - Concentration of Buckley's formacresol 212
 - Concepts of
 - bacterial specificity 118
 - preventive orthodontics 89
 - Congenital
 - heart disease 298
 - lesions 283
 - Conscious sedation in children and adolescents 241
 - Consequences of faulty wedging 186
 - Considerations of maxillofacial injuries in growing patient 277
 - Contents of counseling 130
 - Contraindication for
 - primary root canals 213
 - pulpotomy in primary tooth 212
 - Contraindications of removable space maintainer 96
 - Conventional
 - cartridge syringes 220
 - local anesthesia technique 235
 - method 156
 - Convulsive disorder 304
 - Copper poisoning 323
 - Cross sectional study 349
 - Crown
 - adaptation 196
 - and loop space maintainer 97
 - fracture 275
 - selection 196
 - Cystic fibrosis 301
- D**
- Defluoridation 181
 - Delayed
 - eruption of permanent teeth 72
 - speech 26
 - Demineralization process 146
 - Dental
 - air abrasion 340
 - caries 306
 - history 262
 - injuries 262
 - microscope 346
 - office access 19
 - plaque 116
 - radiology for child and adolescent 40
 - staff, policies and systems 357
 - uses 343
 - of EDA 233
 - Dentifrices 121, 128
 - Dentinogenesis imperfecta 77
 - Dentistry for sport players 314
 - Detergent food 149
 - Determination of working length 214
 - Development of
 - dentition 80
 - supernumerary tooth 74
 - supragingival plaque 117
 - Developmental
 - lesion 285
 - stages of nursing caries 159
 - Diagnodent 157
 - Diagnosis of
 - dental caries 155
 - ectopic eruption 71
 - Diagnostic testing for
 - trisomy 18 336
 - trisomy 9 336
 - Turner's syndrome 336
 - Dietary
 - fiber 66
 - fluoride supplements 175
 - Digit sucking 103
 - Digital imaging fiberoptic
 - transillumination 157
 - Disadvantages of
 - CAD/CAM systems 339
 - fixed space maintainer 97
 - laser surgery 113
 - myofunctional appliances 136
 - Discussion and interpretation of results 351
 - Disinfection of operatory surface and dental appliances 6
 - Displacement injuries 275
 - Distal shoe space maintainer 100
 - DNA probe 35
 - Down syndrome 306
 - Drawback of formacresol 212
 - Dual defluoridation technique 181
 - Duration of expected anesthesia 230
- E**
- EDA
 - advantages 234
 - contraindications 234
 - disadvantages 234
 - indications 234
 - Electric pulp testing 33
 - Electrical conductance measurements 156
 - Electronic dental anesthesia 232
 - Ellis and Davey classification of tooth
 - fracture 263
 - Ellis class
 - I fracture 263
 - II fracture 264
 - III fracture 265
 - IV fracture 267
 - V fracture 268
 - VI fracture 268
 - VII fracture 269
 - VIII fracture 272
 - Embryonic development 80
 - Emergency
 - equipment 243
 - treatment 278, 302
 - Emotional abuse 321
 - Enamel hypoplasia 75
 - Endocrine disorders 303
 - Endodontic therapy in primary and young
 - permanent teeth 209
 - Eruption cyst 70, 287

- Eruption of
 permanent teeth 82
 primary teeth 81
 teeth 69
- Special tooth vitality test 263
- Esthetic
 anterior space maintainer 101
 composite 187
 restoration of primary anterior teeth 194
- Etching 196
- Etiology of hypoplasia of enamel 75
- Examination of
 dentition 31
 head and neck 27
 maxillofacial injuries 263
 palate 31
 tongue and sublingual space 31
- Excretion of fluoride 172
- Fabrication 100
- ## F
- Facility option 12
- Factors
 affecting fluoride absorption 170
 influencing design of crown 189
 responsible for dental caries 146
- Failure of anesthesia 230
- Fatty acids 65
- Federation dentaire internationale 33
- Fentanyl 248
- Ferric sulfate 213
- Fiber optic transillumination 34, 156
- Finger nails biting habit 107
- Finn's modification of Black's classification
 for primary teeth 184
- Fissured tongue 285
- Fixed space maintainer 97
- Fluoridated
 dental materials 179
 sugar 176
- Fluoride
 and dental health 170
 containing oral prophylaxis paste 179
 exposure 296
 in beverages 176
 in blood plasma 171
 in calculus 172
 in dental tissues 172
 in plaque 172
 in saliva 172
 probe 35
 sustained release device 176
 toxicity 180
 varnishes 178
- Fordyce granules 286
- Forensic
 dentistry 319
 odontostomatology 319
 pedodontist 321, 325
 science for pedodontist 319
- Formalin gas chamber 5
- Fosdick calcium dissolution test 155
- Foster-Miller probe 35
- Fracture of
 mandible 279
 maxilla 281
 zygomatic arch 282
- Frank cavitation 145
- Free smooth surfaces 167
- Frequency apex locator 344
- Friction lock pins 266
- Function regulator appliance 141
- Functions of proteins in body 65
- Fundamentals of
 marketing plan 355
 private practice in pediatric dentistry 354
- ## G
- General
 anesthesia in pediatric dentistry 250
 principles of pediatric drug therapy 254
 refuse waste 8
 survey of child 25
- Genetic
 counseling 306
 in dentistry 330
 session 331
- Geographic tongue 285
- Gerber space maintainer 101
- Gingiva 31
- Gingival health considerations in child and adolescents 109
- Gluteraldehyde 212
- Greater palatine nerve block 238
- Growth and development of nasomaxillary complex and mandible 85
- Growth of maxilla 85
- Gum pad 81
- ## H
- Hand, foot and mouth disease 291
- Harvold activator 140
- Hazardous waste 8
- Hazards of radiation 46
- Head
 injury 318
 positioners 298
- Health education room 18
- Heat exchangers 13
- Hemangiomas 284
- Hematoma 287
- Hepatic disorder 302
- Herbst appliance 141
- Hereditary factor 151
- Herpangina 291
- Herpes labialis 290
- Hidden caries 145
- Home dental care regime 296
- Human immunodeficiency virus 291
- Hyperactivity 307
- Hypomineralization of enamel 76
- Hypomineralized incisors 77
- Hypoplasia 76
- Hypoplastic canine and premolars 77
- ## I
- Ideal pits and fissure sealant 165
- Immune disorder 305
- Immunologic response in gingivitis and periodontitis 119
- Impaction and delayed eruption of maxillary permanent canines 72
- Impedance apex locator 344
- Impetigo 292
- Importance of
 forensic dentistry 319
 pediatric dentistry 1
 pedodontics 3
- Incineration 9
- Incisors 72
- Inclined plane 137
- Indication for
 full coronal coverage of incisors 195
 GA in treatment of children 250
 local anesthesia 223
 pulpotomy in primary teeth 212
 radiograph in children and adolescence 33
- Indication of topical fluoride application 176
- Infection
 control
 in diabetic dental patient 6
 in pediatric dental clinic 4
 through hospital waste disposal 8
 to dental staff 6
- Infectious
 parotitis 292
 waste 8
- Infraorbital nerve block 240
- Inhalation sedation equipment 246
- Internal
 marketing 356
 promotion 356
- Intraosseous technique 227
- Intraligamentary injection 225
- Intramuscular sedation 245

Intraoral

- camera 347
- lesion 291
- radiography 41

Intrapapillary techniques 228

Intrapulpal anesthesia 229

Intraseptal injection 226

Intrinsic staining 78

Introduction to pediatric dentistry 20

Iontophoresis 179

J

Jaw fracture in children 278

Jaws rotation during growth 87

Jet injectors 223

Juvenile periodontitis 114

K

Knutson technique 177

L

Lacking in cooperative ability 57

Lap to lap position 22

Laser

- beam sterilization 6
- Doppler flowmetry 34
- for hard tissues 310
- in dentistry 310

Late fetal development 80

Lateral

- displacement 269
- skull projections 44

Lead poisoning 322

Leukemia 305

Lighting of operative field 39

Limitations of functional appliances 140

Lingual

- holding arch space maintainers 99
- nerve block 235
- thyroid 286

Listerfluor fluoride dental rinse 179

Local

- anesthesia for maxillary permanent molars 238
- anesthetics 223

Long buccal nerve block 236

Low temperature carbonization 12

Lymphangiomas 284

M

McDonald's classification 324

Machined restoration 338

Macroglossia 286

Malformation of teeth 32

Management of

acute toxicity of fluoride 180

dens in dente 73

dental problems of handicapped and systemically compromised children 294

double teeth 73

nursing caries 161

soft tissues 271

staining 78

teething 69

tongue thrust 106

Mandible 86

Mandibular rotation 88

Manipulation of polycarbonate crown 196

Maternal diet and nutrition 129

Matrix bands 185

Mayne space maintainer 101

Measurement of

- buffering capacity of saliva 154
- mutans streptococci in saliva 153
- salivary flow rate 154

Mechanical devices to hold mouth in open condition 297

Mechanism of

- action of fluoride 173
- fluoride absorption 170
- Streptococcus mutans* adherence to tooth surface 169
- submergence 70

Median alveolar notch 284

Melanotic neuroectodermal tumor of infancy 285

Menopause and oral health 133

Mental

- nerve block 240
- retardation 306

Meperidine 248

Mercury poisoning 322

Methods of

- cross bite correction 92
- sex determination 329

Microbial test 153

Microbiota of

- enamel caries 147
- root surface caries 147

Microwaves sterilization 9

Midazolam 247

Milk fluoridation 176

Minimal intervention for proximal caries in primary teeth 185

Modification of clinic for disabled child 19

Motor aphasia 26

Mottled enamel 78

Mouth

- breathing 104
- guard 317

Mouthwashes 290

MTA

- barrier technique 216
- for root perforation 268

Mucocele 286

Muhler technique 177

Mumps 292

Mycotic infection 293

Myofunctional appliance therapy 135

N

Nalgonda

- calcined magnesite technique 181
- technique 181

Naloxone 248

Nance holding arch 99

Narcotic 248

- antagonist 248

Nasal fractures 282

Nasoethmoidal fracture 282

Nasopalatine nerve block 238

Natal teeth 285

Neonatal candidiasis 293

Nerve anesthetized 226

Neuropsychological disabilities 306

Non spaced primary dentition 84

Normal

- child development 49
- periodontium 109

Number of teeth 31

Nursing bottle caries 132, 158

Nutrition during pregnancy and lactation 132

Nutritional

- considerations for children and adolescents 64
- strategies for adolescent girl 131

O

Obturator materials for primary root canals 214

Obturation technique 214

Occlusal

- radiographic technique 42
- reduction 192
- surface 167

Occlusion of teeth 32

Odontogenic cyst 286

Odontology 319

Open face steel crown 194

Operating room protocol 250

Oral

- flora 118
- health of child 130
- leukoedema 284
- manifestation of mentally retarded

patient 306
 mucosa 30
 symptoms of menopause 133
 Orbital fracture 282
 Origin of dental caries 145
 Oximetry 347

P

Palatal cyst 283
 Panoramic radiography 43
 Paralleling technique 41
 Parent counseling 161
 Parental of caretaker history 23
 Parulis 286
 Pediatric
 dental
 clinic 162
 uses of air abrasion 341
 oral habits 103
 restorative dentistry 183
 Pedodontics in India 1
 Peg shaped lateral incisors 73
 Periapical radiographic technique 43
 Periodontal
 pathogenicity of oral bacteria 116
 probe 37
 Periodontitis and loss of tooth in young children 113
 Periotemperature probe 35
 Permanent
 teeth 76
 tooth pulpotomy 215
 Pharynx and tonsil's examination 31
 Philosophy of dental practice 354
 Phosphorylating theory 143
 Physiological changes in body of pregnant women 129
 Pilot research study 349
 Pit and fissure caries 143
 Plaque maturation 117
 Polycarbonate crown 196
 Position of dental
 assistant 22
 and patient around dental chair 38
 Postanesthesia trauma 288
 Posterior teeth 202
 Postnatal
 and infancy history 23
 counseling 163
 Potentially cooperative behavior 58
 Powered injectors 223
 Practical implication of temperamental development 51
 Prasanti technology for defluoridation 181
 Preruptive caries 144

Prefabricated
 crown in pediatric dentistry 189
 metal crowns 190
 Preformed plastic crowns 197
 Prenatal
 and natal history 23
 dental counseling 130
 effect on facial development 80
 fluoride 129
 oral health and oral health in pregnancy 129
 screening for Down syndrome 336
 trimester screening for Turner's syndrome 337
 Preparation of
 child for general anesthesia 252
 socket 270
 tooth 196
 Prepubertal periodontitis 113
 Pressure laminated mouth guard 316
 Pre-veneered stainless steel crowns 194
 Primary
 anterior tooth preparations 192
 dentition 206
 posterior tooth preparation 192
 root canal anatomy 209
 teeth 76
 tooth
 fracture 275
 injuries 275
 preparation 192
 Principles of
 cavity preparation 183
 dental surgery for adult women 131
 preventive dentistry 161
 Probable factors of parents responsible for child abuse 321
 Properties of
 inhalation general anesthesia 251
 MTA 267
 X-rays 40
 Proteolysis theory 142
 Proximal
 slices 192
 slot preparation 185
 Psychoanalytic theory 103
 Psychological changes in pregnancy 129
 Psychology of hospitalized children 250
 Puberty and adolescence 131
 Pulp
 diseases in primary teeth 210
 therapy agent 215
 treatment for young permanent teeth 215
 vitality test 33

Pulpectomy in primary teeth 213
 Pulse oximetry in evaluation of pulp vitality 34

Q

Quantitative light induced fluorescence 157

R

Radiation caries 144
 Radioactive waste 8
 Radiographic techniques in dentistry 41
 Radiovisiography 156
 Rampant caries 158
 Recent
 concept of caries development 146
 development in dentifrices 121
 Recommended daily allowance 66
 Recurrent
 aphthous ulcers 291
 caries 144
 Regular professional supervision 296
 Reheating chamber 13
 Removable
 distal shoe space maintainer 97
 space maintainer 96
 Removal of
 dental fluorosis strains 78
 fluoride 181
 Renal disorders 302
 Repetitive speech or stuttering 26
 Research
 design 349
 empirical studies 350
 methodology and biostatistics 348
 planning 349
 study format 350
 Resistance
 apex locator 343
 form 274
 Respiratory disorders 301
 Restorative treatment 265
 Restraints for extremities 297
 Retainers 185
 Retrocuspid papilla 285
 Reverse osmosis 181
 Role of
 hygienist 162
 oral microbiota 147
 pediatric dentist 161
 in genetic counseling 330
 pedodontist in forensic science 320
 substrate 148
 Root canals cleaning and shaping 214
 Root canals of
 mandibular

- 1st primary molars 210
 - 2nd primary molars 210
 - maxillary
 - 1st primary molars 210
 - 2nd molars 210
 - primary molars 210
 - Root fracture 275
 - Rotation of maxilla 86
 - Rubeola 291
- S**
- Saliva 30, 154
 - Salt fluoridation 175
 - School water fluoridation 175
 - Scope of pedodontics 1
 - Secondary factor of caries development 150
 - Sedative hypnotics 248
 - Selection of
 - crowns 191
 - target market 354
 - teeth for sealant application 166
 - Self applicable topical fluoride 179
 - Self-threaded pins 266
 - Set-up of pediatric dental clinic 15
 - Sexual abuse 321
 - Showroom of preventive dentistry 164
 - Single
 - in house facility 12
 - use syringes 221
 - Size of teeth 32
 - Slavkin squares model for environmental
 - caries risk factor 148
 - Smokeless tobacco 289
 - Smooth surface caries 143
 - Snyder test 155
 - Sodium fluoride solution 177
 - Soft tissue injuries 279
 - Sources of
 - fluoride intake 170
 - proteins 65
 - Space
 - maintainers 95
 - relationship in replacement of
 - deciduous
 - canine and molars 83
 - incisors 83
 - Spot-welded matrix band 185
 - Stages of machined restoration
 - fabrication 338
 - with CAD-CAM 339
 - Staining of teeth 77
 - Stainless
 - crown trimming 192
 - orthodontic bands 197
 - steel crown 190, 194
 - Stannous fluoride solutions 177
 - Sterilization of
 - endodontic instrument 4
 - glass slab 5
 - gutta-percha 5
 - silver cone 5
 - Storage of fluoride in bone 171
 - Strip crown preparation 195
 - Sub-mentovertex projections 45
 - Submerged tooth 70
 - Submucosal sedation 245
 - Success of post and core restoration 272
 - Sulfatase theory 143
 - Supragingival plaque 117
 - Supraperiosteal technique for maxillary
 - primary, permanent incisors and
 - canine 236
 - Swab test 155
 - Systemic administration of fluoride 174
- T**
- Tactile examination 156
 - Talon cusp 74
 - Technique for
 - fabrication of post and core 274
 - maxillary and mandibular nerve block
 - 235
 - Technique of
 - fissure sealant application 166
 - human identification 320
 - inhalation 251
 - Teething
 - and associated problems 69
 - process 69
 - Temperature of body 27
 - Temporomandibular disorders in
 - pregnancy 132
 - Tetracycline staining 78
 - Tetralogy of dental caries 146
 - Thermal testing 34
 - TMJ projection 46
 - Tongue thrust habit 105
 - Tooth vitality test 263
 - Topical
 - anesthesia 224
 - fluoride 176
 - administration 174
 - agents 178
 - application 176
 - Toronto automated probe 35
 - Transcranial TMJ articulation 46
 - Traumatic ulcers 288
 - Treatment
 - during pregnancy 131
 - of metal poisoning 322
 - planning 37
 - Tunnel shaped cavity preparation 185
 - Turner's syndrome 336
 - Twin bloc 141
 - Types of
 - fissures 165
 - apex locator 343
 - appliances 137
 - bionators 140
 - bodies coming for dental identification
 - 320
 - caries 143
 - dentifrices 122
 - gait 25
 - mouth guards 315
 - periodontal probe 37
 - research study 348
 - wedges 186
- U**
- Unconventional local anesthetic techniques
 - 224
 - Uniform dental recording 32
 - Unintentional ingestion of fluoride 176
 - Use of
 - iontophoresis 179
 - natural or head lamp operating light 201
 - pit and fissure sealant 165
 - preventive
 - and interceptive orthodontics in
 - pediatric dentistry 89
 - orthodontics 89
 - wedge 186
 - weight for determination of dosage 255
- V**
- Vacuum custom made mouth guard 316
 - Vastness of pedodontics 2
 - Veneer restoration in primary teeth 187
 - Vincent infection 292
 - Viral infection of mouth 290
- W**
- Waste
 - disposal 9
 - from medical/dental environment 8
 - management 8
 - minimization options 13
 - Weight-watchers phenomenon 149
 - Wheel chair head rest 298
- X**
- Xeroradiography 156
- Y**
- Young's rule 255