

PART 1

# ILLUSTRATED PEDIATRIC DENTISTRY



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# **Illustrated Pediatric Dentistry**

**(Part I)**

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## **Illustrated Pediatric Dentistry (Part I)**

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## CONTENTS

<b>FOREWORD 1</b> .....	i
<b>FOREWORD 2</b> .....	ii
<b>PREFACE</b> .....	iii
<b>ACKNOWLEDGEMENTS</b> .....	v
<b>LIST OF CONTRIBUTORS</b> .....	vii
<b>CHAPTER 1 INTRODUCTION TO PEDIATRIC DENTISTRY</b> .....	1
<i>Satyawan Damle</i>	
<b>INTRODUCTION</b> .....	1
Definition .....	2
<b>DENTISTRY ENCOMPASSES DIFFERENT ASPECTS</b> .....	3
An Important Aspect of Children Being Treated in a Separate Speciality. ....	3
The Key Role of a Pediatric Dentist is .....	4
Responsibilities of a Pediatric Dentist Include .....	5
Aims and Objectives of Pediatric Dentistry .....	6
<b>HISTORY OF PEDIATRIC DENTISTRY</b> .....	8
<b>PEDIATRIC DENTISTRY PROCEDURES</b> .....	9
Why Is Pediatric Dentistry Important? .....	10
Pediatric Dentistry takes into Consideration .....	10
The First Dental Visit .....	11
Outcomes of a First Dental Visit .....	12
Anticipatory Guidance .....	12
Considerations of Child Management in Dentistry .....	13
Concept of Dental Home .....	15
Dental Conditions .....	16
Why Pediatric Dentistry is Better for Children? .....	17
<b>CONCLUSION</b> .....	17
<b>CONSENT FOR PUBLICATION</b> .....	17
<b>CONFLICT OF INTEREST</b> .....	17
<b>ACKNOWLEDGEMENT</b> .....	17
<b>REFERENCES</b> .....	18
<b>CHAPTER 2 EMOTIONAL DEVELOPMENT OF A CHILD</b> .....	19
<i>Raghavendra M. Shetty, Trisha Gadekar and Aditi Pashine</i>	
<b>INTRODUCTION</b> .....	19
<b>EMOTION</b> .....	20
Types of Emotions in Children .....	20
Emotional Development in Children .....	20
Commonly Seen Emotions in Children .....	25
<i>Crying</i> .....	25
<i>Obstinate Cry</i> .....	25
<i>Frightened Cry</i> .....	25
<i>Hurt Cry</i> .....	26
<i>Compensatory Cry</i> .....	26
Anger .....	26
Fear .....	26
<i>Objective Fear/real Fear</i> .....	28
<i>Subjective Fear/anticipated Fear</i> .....	28
Anxiety .....	30

Types of Anxiety .....	30
Phobia .....	31
Fear and Anxiety Assessment Scale .....	31
Corah's Dental Anxiety Scale (CDAS) .....	32
The Modified Child Dental Anxiety Scale (MCDAS) .....	33
Dental Fear Survey Scale .....	34
Children's Dental Fear Picture (CDFP) Test .....	34
Venham's Picture Scale (VPS)/Venham's Picture Test (VPT) .....	35
DA5 Scale .....	36
Smiley Faces Program (SFP) .....	37
Abeer Children Dental Anxiety Scale (ACDAS) .....	37
Anxiety Thermometer .....	37
RMS-Pictorial Scale (RMS-PS) .....	37
Chhota Bheem Chutki (CBC) Scale .....	38
RMS-Tactile Scale (RMS-TS) .....	39
Animated Emoji Scale (AES) .....	39
Animated Visual Facial Pain/Anxiety Rating Scale .....	39
<b>CONCLUSION</b> .....	39
<b>CONSENT FOR PUBLICATION</b> .....	40
<b>CONFLICT OF INTEREST</b> .....	40
<b>ACKNOWLEDGEMENT</b> .....	40
<b>REFERENCES</b> .....	40
<b>CHAPTER 3 PSYCHOLOGICAL DEVELOPMENT OF A CHILD</b> .....	41
<i>H. Sharath Chandra, M.H. Raghunath Reddy and Vidya Iyer</i>	
<b>INTRODUCTION</b> .....	41
Definition .....	42
Importance of Child Psychology .....	42
Theories of Child Psychology .....	42
<b>PSYCHODYNAMIC THEORIES</b> .....	43
Psychosexual/ Psychoanalytic Theory .....	43
<i>Psychosexual Development</i> .....	45
Psychosocial Theory .....	50
Stages of Erik Erikson's Psychosocial Theory .....	52
Stage 1: Seen in Infant (0- 18 months) .....	52
<i>Dental Implications</i> .....	52
<i>Dental Implications</i> .....	53
<i>Dental Implications</i> .....	54
<i>Dental Implications</i> .....	55
<i>Dental Implications</i> .....	56
<i>Dental Implication</i> .....	56
Cognitive Theory .....	58
Stages of Cognitive Development .....	59
<i>Volume: Classical Beaker Experiment</i> .....	62
<i>Number: Coin Experiment</i> .....	62
<i>Features of the stage</i> .....	66
<i>Clinical Implications</i> .....	67
<i>Formal Operational Stage (12 Yrs and Above)</i> .....	67
<b>BEHAVIOUR LEARNING THEORIES</b> .....	68
Classical Conditioning Theory .....	68
Clinical Implications .....	69

<i>Operant Conditioning Theory</i> .....	70
<i>Skinner Described 4 types of Operant Conditioning</i> .....	70
Social Learning Theory .....	71
<b>HIERARCHY OF NEEDS</b> .....	72
<b>CONCLUSION</b> .....	75
<b>CONSENT FOR PUBLICATION</b> .....	75
<b>CONFLICT OF INTEREST</b> .....	75
<b>ACKNOWLEDGEMENT</b> .....	75
<b>REFERENCES</b> .....	75
<b>CHAPTER 4 NON-PHARMACOLOGICAL BEHAVIOUR MANAGEMENT</b> .....	77
<i>Raghavendra M. Shetty, Aditi Pashne and Trisha Gadekar</i>	
<b>INTRODUCTION</b> .....	77
Behavioural Classification .....	78
<i>Wright's Classification (1975)</i> .....	78
Behaviour Rating Scales .....	79
Effect of Dental Office Environment and Parental Presence .....	80
Non-Pharmacological Behaviour Guidance Techniques .....	82
Communication and Communicative Guidance .....	83
<i>Prerequisites for Effective Communication</i> .....	83
Desensitization .....	84
Tell Show Do (TSD) Technique .....	84
Modification of TSD .....	85
Role Play and Drawings .....	86
Flooding Technique or Implosion Therapy .....	87
Contingency Management .....	88
Modelling .....	89
Types of Modelling .....	89
Distraction .....	90
Audio-Visual Distraction .....	92
Protective Stabilisation .....	92
Types of Restraints .....	93
Audio Analgesia .....	94
Hypnosis/ Psychosomatics/ Suggestion Therapy .....	95
Cognitive Restructuring - Reframing .....	96
Newer Methods of Behaviour Guidance .....	96
<i>ATP Technique</i> .....	96
<i>Applied Behaviour Analysis (ABA)</i> .....	96
<i>Essential Oil Therapy – Aromatherapy</i> .....	96
<i>Mobile Dental Application</i> .....	97
<i>Virtual Reality-Based Distraction</i> .....	97
<i>WITAUL [Writing in the Air Using Leg] Technique</i> .....	98
<i>Thaumaturgy</i> .....	98
<i>Animal Assisted Therapy (AAT)</i> .....	98
<i>Robotic Approach</i> .....	99
<i>Acupuncture and Acupressure</i> .....	99
<b>CONCLUSION</b> .....	100
<b>CONSENT FOR PUBLICATION</b> .....	100
<b>CONFLICT OF INTEREST</b> .....	100
<b>ACKNOWLEDGEMENT</b> .....	100
<b>REFERENCES</b> .....	100



<b>CHAPTER 5 DENTAL CARIES: ETIOLOGY, PATHOGENESIS, AND CARIES ACTIVITY TESTS</b> .....	102
<i>Armelia Sari Widyarman, Enrita Dian R. and Eko Fibryanto</i>	
<b>INTRODUCTION</b> .....	102
Etiology .....	103
Pathogenesis .....	104
<i>Dental Plaque and Biofilm</i> .....	104
Demineralization Process .....	106
Caries Activity Tests .....	107
Definitions .....	108
A Caries Activity Test Helps to: .....	108
Objectives .....	109
Uses .....	109
<i>For a Clinician</i> .....	109
<i>For the Research Worker</i> .....	109
Ideal Requirements for Caries Activity Tests .....	109
<b>CONCLUSION</b> .....	116
<b>CONSENT FOR PUBLICATION</b> .....	116
<b>CONFLICT OF INTEREST</b> .....	116
<b>ACKNOWLEDGEMENT</b> .....	116
<b>REFERENCES</b> .....	116
<b>CHAPTER 6 DIAGNOSIS OF DENTAL CARIES</b> .....	118
<i>Armelia Sari Widyarman, Eko Fibryanto and Tri Erri Astoeti</i>	
<b>INTRODUCTION</b> .....	118
Definitions .....	119
Dental Caries Classification .....	123
Dental Caries Classification .....	123
<i>A). Location</i> .....	126
<i>B). Size</i> .....	126
Transmission of Microorganisms from Mother to Child .....	129
Intrafamily Transmission of Microorganisms to Children .....	129
Diagnosis .....	129
<b>CONCLUSION</b> .....	131
<b>CONSENT FOR PUBLICATION</b> .....	131
<b>CONFLICT OF INTEREST</b> .....	131
<b>ACKNOWLEDGEMENT</b> .....	131
<b>REFERENCE</b> .....	131
<b>CHAPTER 7 ROLE OF DIET IN DENTAL CARIES</b> .....	133
<i>Satyawan Damle, Prachi Goyal and Dhanashree Sakhare</i>	
<b>INTRODUCTION</b> .....	133
Definition .....	135
Cariogenicity of Diet .....	135
Nature of the Diet .....	138
Retention and Oral Clearance Time of Dietary Components .....	139
Intake Frequency .....	139
Chemical Composition .....	139
Protective Component in the Diet .....	140
Sugar Studies .....	142

Sucrose – The Arch Criminal .....	143
Studies Assessing Relationship Between Sugar and Caries, Observational Human Studies .....	146
Modern Diet Versus Primitive Diet .....	147
Human Observational Studies .....	148
Results .....	148
<b>CONCLUSION</b> .....	149
Low Sugar Diet Has Low Levels of Dental Caries .....	149
High Sugar Diet Has High Levels of Dental Caries .....	149
Nikiforuk and Fraser in 1981 .....	149
Worldwide Epidemiological Observational Studies, Sreebny Lm 1982 .....	150
Tristan Da Cunha, (Fisher 1986) .....	150
Hereditary Fructose Intolerance (Hfi) (Newbrun 1909) .....	151
World War II Rationing .....	151
Interventional Studies .....	151
<i>Vipeholm Study (Gustaffson et al. 1954)</i> .....	151
<b>CONCLUSION</b> .....	153
<b>RESULTS</b> .....	154
Sugar Clock .....	158
Diet Counseling .....	160
<b>FOOD PYRAMID</b> .....	161
Dietary Advice for Different Age Groups .....	162
<b>CONCLUSION</b> .....	163
<b>CONSENT FOR PUBLICATION</b> .....	163
<b>CONFLICT OF INTEREST</b> .....	163
<b>ACKNOWLEDGEMENT</b> .....	163
<b>REFERENCES</b> .....	163
<b>CHAPTER 8 EARLY CHILDHOOD CARIES</b> .....	165
<i>Neerja Singh and Monika Rathore</i>	
<b>INTRODUCTION</b> .....	165
Definitions .....	166
Rampant Caries .....	166
Classification .....	167
Epidemiology .....	169
Etiological Factors .....	170
A. Dietary Factors .....	171
B. Microbiological Factors .....	171
C. Other Modifying Factors .....	171
<b>DIETARY FACTORS</b> .....	171
Breastfeeding .....	171
Bottle Feeding .....	172
The Diet and ECC .....	172
Microbiological Factors .....	172
Host Factors .....	173
Saliva .....	174
Enamel Defects .....	175
<b>GENETIC FACTORS</b> .....	176
<b>OTHER MODIFYING FACTORS</b> .....	177
The Maternal-Child Link to ECC .....	177
Socio Economic Status .....	177

Parental Education and Awareness .....	177
Oral Hygiene Practices .....	177
Low Birth Weight and Preterm Babies .....	178
<b>CLINICAL FEATURES</b> .....	178
<b>CONSEQUENCES OF UNTREATED EARLY CHILDHOOD CARIES</b> .....	180
<b>EFFECTS OF UNTREATED CARIOUS LESIONS ON QUALITY OF LIFE OF THE CHILD</b> .....	181
<b>EFFECTS OF UNTREATED CARIOUS LESIONS ON PARENTS' QUALITY OF LIFE</b> .....	181
<b>EFFECTS OF UNTREATED CARIOUS LESIONS ON SUCCEDANEOUS TEETH</b> .....	181
<b>MANAGEMENT OF EARLY CHILDHOOD CARIES</b> .....	181
<b>PREVENTION</b> .....	182
<b>SALIVA DIAGNOSTICS</b> .....	182
<b>CARIES RISK ASSESSMENT</b> .....	183
<b>PRIMARY PREVENTION</b> .....	184
<b>NON-FLUORIDE AGENTS</b> .....	186
<b>REPLACEMENT THERAPY AND PROBIOTICS</b> .....	187
Secondary Prevention .....	187
Tertiary Prevention .....	188
<b>CONCLUSION</b> .....	189
<b>CONSENT FOR PUBLICATION</b> .....	189
<b>CONFLICT OF INTEREST</b> .....	189
<b>ACKNOWLEDGEMENT</b> .....	189
<b>REFERENCES</b> .....	189
<b>CHAPTER 9 CRANIOFACIAL GROWTH AND DEVELOPMENT IN CHILDREN</b> .....	192
<i>Arun M. Xavier, H. Sharath Chandra and M. Vijay</i>	
<b>INTRODUCTION</b> .....	192
Terminologies .....	193
<i>Growth</i> .....	193
<i>Development</i> .....	193
Factors Affecting Growth .....	193
Genes and Heredity .....	194
Family Size and Birth Order .....	194
Secular Trends .....	195
Socioeconomic Factors .....	195
Climate and Seasonal Variations .....	195
Nutrition .....	195
Hormones .....	195
Growth Factors .....	196
Muscular Functions .....	196
Exercise and Adult Physique .....	196
Illness .....	197
Psychological Disturbances .....	197
<b>GENERAL PRINCIPLES OF GROWTH AND DEVELOPMENT</b> .....	197
Continuity .....	197
Sequentiality .....	197
Generality to Specificity .....	198
Differentiality .....	198
Variability .....	199
Growth Spurts .....	199
<i>Importance of Growth Spurts</i> .....	200

Orthodontic Correction Considerations .....	200
Differential Growth .....	200
Cranial Base Synchronoses .....	202
Fontanelles .....	203
Theories of Craniofacial Growth .....	204
Other Theories Related to Craniofacial Growth are: .....	205
Bone Remodelling Theory .....	205
Genetic Theory / Genetic Blueprint .....	205
Cartilaginous Theory / Scott's Hypothesis, Nasal Septum Theory, Nasocapsular Theory .....	205
Limitations .....	206
Sutural Growth Theory / Sicher's Hypothesis, Sicher's Sutural Dominance Theory .....	207
Limitations .....	207
Functional Matrix Hypothesis (FMH) .....	208
Neurotropism .....	210
Neurotropism is of Three Types .....	210
Van Limborgh Multifactorial Hypothesis / Van Limborgh's Composite Hypothesis .....	211
Servo System Theory / Cybernetics Theory .....	212
Application of Servo System .....	212
Enlow's Expanding 'V' Principle .....	212
Enlow's Counterpart Principle / Growth Equivalents Concepts .....	213
Functional Matrix Hypothesis Revisited (1997) .....	214
Methods of Studying Physical Growth .....	215
Growth Assessment Parameters .....	215
Chronological Age .....	215
Somatotypic Age .....	215
Sexual Age .....	216
Facial Age .....	216
Skeletal Age .....	217
Hand and Wrist Radiographs .....	217
Determination of Skeletal Age .....	217
Indications of Hand and Wrist Radiographs .....	218
Dental Age .....	218
Computerized Growth Forecasting .....	219
<b>CONCLUSION</b> .....	219
<b>CONSENT FOR PUBLICATION</b> .....	220
<b>CONFLICT OF INTEREST</b> .....	220
<b>ACKNOWLEDGEMENT</b> .....	220
<b>REFERENCES</b> .....	220
<b>CHAPTER 10 GROWTH AND DEVELOPMENT OF MAXILLA AND MANDIBLE</b> .....	222
<i>Bhavna Gupta Saraf, Dhanashree Sakhare and Parag Kasar</i>	
<b>INTRODUCTION</b> .....	222
Scope .....	222
Prenatal Growth and Development of Maxilla and Mandible-Maxilla .....	223
Maxilla Proper .....	223
The Ossified Tissue Appears as a Thin Strip of Bone. It Spreads in Different Directions as:	223
Premaxilla .....	224
<b>ACCESSORY CARTILAGES</b> .....	224
<b>DIVISIONS OF DEVELOPMENTAL SCIENCE</b> .....	228
Molecular Biology .....	228
Developmental Biology .....	228

<b>PRINCIPLES AND THEMES OF DEVELOPMENT</b> .....	229
Principles .....	229
<b>SHIFTS FROM COMPETENT TO FIXATION</b> .....	229
<b>SHIFTS FROM DEPENDENT TO INDEPENDENT</b> .....	229
The Ubiquity of Genetic Control Modulates by Environment .....	229
<b>MANDIBLE</b> .....	229
Meckel's Cartilage .....	229
Meckel's Cartilage Ossification .....	230
<b>OSSIFICATION OF THE MANDIBLE</b> .....	231
<b>ENDOCHONDRAL BONE FORMATION</b> .....	231
A. Condylar Cartilage .....	232
B. Coronoid Cartilage .....	232
C. Symphyseal Cartilage .....	233
Postnatal Growth of Maxilla and Mandible Maxilla .....	233
<i>Growth Centers</i> .....	234
Growth Sites .....	234
.....	234
Mandible .....	237
<i>Mandibular Growth after 1st Year of Life</i> .....	237
<i>Mandibular Remodeling</i> .....	237
<i>Growth At Ramus</i> .....	238
Lingual Tuberosity .....	238
Body of the Mandible .....	239
Condylar Neck .....	239
Coronoid Process .....	239
Antegonial Notch .....	240
The Mandibular Foramen .....	240
The Alveolar Process .....	240
Mental Foramen .....	241
The Chin .....	241
Recent Advances to Study the Growth and Development of Mandible .....	241
Age Changes in Maxilla and Mandible in mandible (Table 2) .....	241
In Maxilla .....	242
<i>At Birth</i> .....	242
In Adults .....	242
In Old .....	242
Applied Aspects of Development of Maxilla and Mandible (Table 3) .....	242
Reasons .....	243
Recent Updates on Growth and Development .....	243
<b>CONCLUSION</b> .....	244
<b>CONSENT FOR PUBLICATION</b> .....	244
<b>CONFLICT OF INTEREST</b> .....	244
<b>ACKNOWLEDGEMENT</b> .....	244
<b>REFERENCES</b> .....	244
<b>CHAPTER 11 DEVELOPMENT OF DENTITION AND OCCLUSION IN CHILDREN</b> .....	246
<i>Pratik Kariya and Bhavna Dave</i> .....	
<b>INTRODUCTION</b> .....	246
Evolution of Dentition .....	246
Characteristics of Human Dentition .....	248
▪ Based on the Mode of Attachment to Jaw .....	248

▪ Based on the Number of Successional Teeth sets: .....	248
▪ Based on the Type or Shape of Teeth .....	248
Development of Dentition- .....	248
A). Development during Prenatal Period .....	249
During the 5th week of IUL .....	249
1) Beginning of the Primary Dentition Development .....	250
2) The Formation of the Successional Lamina .....	250
3) Initiation of the Permanent Dentition .....	250
Morphological Changes in the Dental Lamina Occur in the Following Phases .....	250
Advanced Bell Stage .....	254
B). Status of Development at Birth .....	254
C). Development of Postnatal Period .....	254
Hertwig's Epithelial Root Sheath and Root Formation .....	257
Eruption of Teeth .....	257
Two types of Eruption .....	258
Patterns of Eruptive Tooth Movements .....	258
Theories of Tooth Eruption- .....	259
Histology of Tooth Movement .....	260
Factors Affecting Eruption .....	263
1. Genetic Factors .....	263
2. Environment Factors .....	263
Chronology of Primary and Permanent Dentition .....	263
Developmental Anomalies of Teeth .....	264
Development of Occlusion .....	265
Definition .....	265
Periods of Developing Occlusion .....	265
1. Pre-Dentate Period .....	266
a). Gum Pads .....	266
b). Neonatal Jaw Relationship .....	267
c). The Status of Dentition .....	268
2. Deciduous Dentition Period .....	269
Ovoid Arch Form .....	270
Interdental Spacing .....	271
Spacing in Primary Dentition .....	271
<i>Significance of Primate Spaces</i> .....	271
Molar Relationship in Deciduous Dentition .....	273
Upright Incisors .....	274
Shallow Intercuspal Interdigitation .....	274
Flat curve of Spee .....	274
3. Mixed Dentition Period .....	275
Phases of Mixed Dentition .....	276
<i>First Transition Period:</i> .....	276
First Transition Stage .....	276
Early Mesial Shift .....	278
Late Mesial Shift .....	278
Incisal Exchange .....	279
Incisal Liability .....	281
The Following Factors Overcome the Incisal Liability .....	281
Overjet and Overbite .....	281
Edge to Edge Bite .....	282
Inter-Transitional Period .....	282

Second Transition Period- .....	283
Ugly Duckling Stage .....	284
<b>PERMANENT DENTITION</b> .....	284
Features of Permanent Dentition .....	285
Andrew's Keys to Normal Occlusion .....	286
Self-Correcting Anomalies .....	289
<b>CONCLUSION</b> .....	292
<b>CONSENT FOR PUBLICATION</b> .....	292
<b>CONFLICT OF INTEREST</b> .....	292
<b>ACKNOWLEDGEMENT</b> .....	292
<b>REFERENCES</b> .....	293
<b>CHAPTER 12 MORPHOLOGY OF PRIMARY DENTITION</b> .....	295
<i>Parag D. Kasar, Dhanashree Sakhare and Shailaja Chatterjee</i>	
<b>INTRODUCTION</b> .....	295
Tooth Numbering System .....	296
Maxillary First Molar .....	305
Maxillary Second Molar .....	307
Mandibular Canine .....	309
Mandibular First Molar .....	310
Mandibular Second Molar .....	311
<b>CONCLUSION</b> .....	313
<b>CONSENT FOR PUBLICATION</b> .....	313
<b>CONFLICT OF INTEREST</b> .....	313
<b>ACKNOWLEDGEMENT</b> .....	313
<b>REFERENCES</b> .....	313
<b>CHAPTER 13 TEETHING IN CHILDREN – FACT AND FICTION</b> .....	315
<i>Shruti Balasubramanian and Dhanashree Sakhare</i>	
<b>INTRODUCTION</b> .....	315
Historical Perspective .....	316
Definitions .....	316
Signs and Symptoms .....	316
Management of Teething .....	318
Practices- Not Recommended .....	320
Problems Associated with Teething .....	320
Their Removal is Indicated .....	324
<b>CONCLUSION</b> .....	325
<b>CONSENT FOR PUBLICATION</b> .....	325
<b>CONFLICT OF INTEREST</b> .....	325
<b>ACKNOWLEDGEMENT</b> .....	325
<b>REFERENCES</b> .....	325
<b>CHAPTER 14 DEVELOPMENTAL DISTURBANCES OF ORAL STRUCTURE</b> .....	327
<i>Jay Gopal Ray, Deepika Bablani Popli, Aman Chowdhry and Priyanka Bhaje</i>	
<b>INTRODUCTION</b> .....	327
<b>DISTURBANCES OF TEETH</b> .....	328
Anomalies related to number of teeth .....	328
<i>Hyperdontia</i> .....	329
<i>Hypodontia</i> .....	330
Abnormalities Related to the Size of Teeth .....	332
<i>Microdontia</i> .....	332

<i>Macrodontia</i> .....	332
Abnormalities of Tooth Form .....	333
<i>Fusion</i> .....	333
<i>Concrescence</i> .....	334
<i>Gemination</i> .....	335
<i>Treatment</i> .....	335
<i>Dens in Dente (Dens Invaginatus/tooth within a Tooth/ Invaginatedodontome/ Dilated Gestantodontome/dilated Composite Odontome/ Dentinoid in Dente)</i> .....	335
<i>Dens Evaginatus</i> .....	337
<i>Talon Cusp</i> .....	337
<i>Taurodontism</i> .....	338
<i>Dilaceration</i> .....	339
Abnormalities of tooth structure .....	340
<i>Enamel Hypoplasia</i> .....	341
<i>Classification</i> .....	341
<i>Amelogenesis Imperfecta</i> .....	343
<i>Dentinogenesis imperfecta</i> .....	344
<i>Shell Teeth</i> .....	346
<i>Dentin Dysplasia</i> .....	346
<i>Regional Odontodysplasia</i> .....	347
<i>Syphilitic Hypoplasia</i> .....	348
Anomalies of tongue .....	348
<i>Macroglossia</i> .....	349
<i>Microglossia and Aglossia</i> .....	349
<i>Ankyloglossia</i> .....	350
<i>Treatment</i> .....	350
<i>Cleft Tongue</i> .....	350
<i>Fissured tongue</i> .....	351
<i>Treatment</i> .....	351
<i>Coated Tongue</i> .....	351
<i>Strawberry Tongue</i> .....	353
<i>Geographic Tongue (Benign Migratory Glossitis)</i> .....	353
<i>Median Rhomboid Glossitis</i> .....	354
<i>Black Hairy Tongue</i> .....	355
<b>DEVELOPMENTAL LESIONS OF ORAL MUCOSA</b> .....	355
Fordyce's Granules .....	356
Focal epithelial hyperplasia or Heck disease .....	356
Epstein's pearls and Bohn's nodules .....	356
<i>Treatment</i> .....	357
Persistent Buccopharyngeal Membrane .....	357
<i>Treatment</i> .....	357
Congenital Pits and Fistulas of the Lip .....	357
<i>Treatment</i> .....	358
Cheilitis Granulomatosa .....	358
<i>Treatment</i> .....	358
<b>CONCLUSION</b> .....	359
<b>CONSENT FOR PUBLICATION</b> .....	359
<b>CONFLICT OF INTEREST</b> .....	359
<b>ACKNOWLEDGEMENT</b> .....	359
<b>REFERENCES</b> .....	359



<b>CHAPTER 15 LESIONS OF ORAL MUCOSA</b> .....	362
<i>Jay Gopal Ray and Priyanka Bhaje</i>	
<b>INTRODUCTION</b> .....	362
White lesions of the Oral Cavity .....	363
<i>Benign Migratory Glossitis (Geographic Tongue)</i> .....	363
<i>Candidiasis/Moniliasis</i> .....	364
<i>White Spongy Nevus</i> .....	365
Vesicular, Erythematous, and Ulcerated Lesions of Viral Etiology .....	366
<i>Primary Herpetic Gingivostomatitis</i> .....	366
<i>Herpangina</i> .....	368
<i>Pigmented lesions</i> .....	369
<i>Hereditary Hemorrhagic Telangiectasia (Rendu-Osler-Weber syndrome)</i> .....	369
<i>Hemangioma</i> .....	370
<i>Sturge Weber Syndrome ('Encephalo- Trigeminal Angiomatosis')</i> .....	371
<i>Black Hairy Tongue</i> .....	372
Autoimmune Disorders .....	373
<i>Pemphigus/Pemphigoid</i> .....	373
<i>Systemic Lupus Erythematosus</i> .....	374
<i>Ectodermal Dysplasia</i> .....	376
<i>Papillon-Lefèvre Syndrome (PLS)</i> .....	378
<i>Aphthous Stomatitis</i> .....	379
Lesions of Idiopathic Etiology .....	380
<i>Pterygoid Ulcer or Bednar's Ulcer</i> .....	380
Lesions of Bacterial Origin .....	380
<i>Impetigo</i> .....	380
<i>Staphylococcal Scalded Shock Syndrome</i> .....	381
<i>Scarlet Fever</i> .....	381
<i>Syphilis</i> .....	382
<i>Oral Tuberculosis</i> .....	383
<i>Actinomycosis</i> .....	384
<i>Noma (Cancrum Oris, Gangrenous stomatitis)</i> .....	385
SOFT TISSUE ENLARGEMENTS .....	386
<i>Mucocele</i> .....	386
<i>Ranula</i> .....	387
B). Tumors or Neoplasms .....	388
(I). <i>Benign Tumours of Epithelial Origin</i> .....	388
<i>Oral Papilloma (HPV)</i> .....	388
II). <i>Benign Tumours of Mesenchymal Origin</i> .....	389
<i>Pyogenic Granuloma</i> .....	389
<b>CONCLUSION</b> .....	390
<b>CONSENT FOR PUBLICATION</b> .....	390
<b>CONFLICT OF INTEREST</b> .....	390
<b>ACKNOWLEDGEMENT</b> .....	390
<b>REFERENCES</b> .....	390
<b>SUBJECT INDEX</b> .....	393

## FOREWORD 1

It is my great pleasure to pen down a foreword for this tremendous book on Pediatric Dentistry for a legend and doyen of the subject, a mentor and guide to the brightest of minds in the field of dentistry.

Rising from the fundamentals, comprehensive in-built, contemporary and authoritative in construct and approach, and hands-on to the core, *Illustrated Pediatric Dentistry* is a wonderful work engineered by some of the best-known academics in this noble realm. The chief author, *Professor Satyawan Damle*, is a colossus among giants, having been a celebrated teacher, distinguished leader, and dynamic policymaker at several dental institutions and universities, including the most prized, the University of Mumbai.

Prof. Satyawan Damle is the rare blend of a gifted clinician and a carved-out academic guru whose intellect has emerged with decades of practice. It is no secret that the degree of acquisition of knowledge by students is one of the measures of the effectiveness of a medical curriculum; and with Pediatric Dentistry being one of the crucial epicentres of growth, it has the potential to make momentous advancements in the evolutionary trajectory of oral and general health.

His co-editors *Ritesh Kalaskar*, *Abdulkadeer Jetpurwala*, and *Dhanashree Sakhare* are examples excellence in their arena. The work reflects their collective understanding of where pediatric dentistry stands today, what have been the treasures and well-kept secrets of the past, and where this tree of knowledge finds fruition today paving way for the future.

Embedding best care practices of all times, *Illustrated Pediatric Dentistry* is a comprehensive yet concise work, which fulfils the essentials of the pediatric dentistry curriculum both for graduates and postgraduates across all universities.

Walking you through the nitty-gritties of preventive, curative and restorative childhood dentistry, be it the behavioral challenges, cariology, endodontics, traumatology, para-surgical themes such as the use of conscious sedation and general anaesthesia at that age, and the management of medically compromised children, the work is a tree of knowledge, nurtured with experiential learning, and carries wonderful blossoms of practical wisdom.

Let us savour and celebrate the chef-d'oeuvre. Indeed, *Illustrated Pediatric Dentistry* is a must-read and must-assimilate work for each one of us. Students, practitioners and teachers of Pediatric dentistry will cherish it as a treasured possession on their shelves. I congratulate Prof. Damle and Bentham Science, Singapore, for publishing this irreplaceable tome.

**Prof. (Dr.) Mahesh Verma**  
Vice Chancellor  
Guru Gobind Singh  
Indraprastha University,  
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India

## FOREWORD 2

I am delighted to write this foreword for a Book of Illustrated Pediatric Dentistry authored by Professor Satyawan Damle and other academicians. Prof. Satyawan Damle is a well-known researcher and academician with over 44 years of clinical and teaching experience in Dentistry. Besides the several posts and hats he wore in the various roles he played for the profession, he is also a recipient of several awards and recognitions, including the Lifetime Achievement Awards, Outstanding Public Servant Awards, and Research Awards and Fellowships. He is an active member of the Indian Council of Medical Research. Despite his extraordinary achievements as a Pediatric dentist, researcher, and academician, Prof Satyawan Damle will always be known as the longest-serving chief editor of Indexed journals. For almost 35 years. He dedicated himself to overseeing the publication of the highest-quality peer-reviewed studies and opinion pieces on child dental health.

Prof. Damle is actively involved in writing several books on Pediatric Dentistry and Dentistry, which is the testimony of his in-depth knowledge of the subject. The Book of Illustrated Pediatric Dentistry is their new venture initiated by him. I am confident that this book will be accepted by students and faculty involved in teaching Pediatric Dentistry. His work as a teacher, researcher, innovator, visionary and extraordinary academician made him a legend. His role as a mentor and friend made him a role model to those of us who know him and worked with him. His legacy persists not only in academics but also as an able administrator, as he proved his mettle as the Dean of a dental school, Director of Medical Education, Joint Municipal.

Commissioner of Mumbai and, ultimately, the Vice Chancellor of a University. Prof. Damle has worked conscientiously and untiringly to present an unmatched educational endeavour. The topics in this book display a clear and succinct clinical expertise and the capability of imparting updated education and information to Oral Health Professionals. The entire volume of this book deals with ultramodern and current state-of-the-art techniques. I take this opportunity to congratulate Prof. Satyawan Damle and his team of contributors - Ritesh Kalaskar, Abdulkadeer Jetpurwala and Dhanashree Sakhare for having published this Textbook for Bentham Sciences.

**Dr Ashok Dhoble. Hon. Secretary**  
General, Indian Dental Association H.O.  
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## PREFACE

It is imperative to have an established approach to handling Children's oral diseases. **'Illustrated Pediatric Dentistry,'** is an unpretentious endeavour to integrate the latest developments and up-to-date reviews in the field of Pediatric dentistry by distinguished writers. The book intends to allow students to understand the conceptions of Pediatric dentistry and create a spur to discover the subject by advance reading. Several illustrations, descriptions and graphic drawings have been included to attract the students and make the subject simple to comprehend. A healthy mouth is a gateway to a healthy body and the best time to inculcate healthy habits is through childhood. Prevention of the initiation of oral diseases and training appropriate oral hygiene methods are commenced best throughout the formative years of the child. With a substantial percentage of the worldwide population being in the Pediatric age group, it is imperious to have a scientific approach in the behaviour management, prevention and treatment modalities in the dental office, as Pediatric dentistry is a fast-growing division of dental disciplines that lays the basis for the impending dental health of the populace.

The book has been divided into several sections. The sections on child psychology and the emotional development of children are important to learn the basics of various behaviour management strategies. The section on dental caries sensitizes the reader towards the most common dental disorder that is seen in children, and preventive procedures aimed towards lessening dental caries are the necessity of the hour. While an endeavour has been made to include the growth and development of the facial structures and dentition and along with their disturbances and the interceptive and preventive procedures to monitor the erupting teeth.

Pediatric Operative techniques, including endodontics and management of teeth with immature apices affected due to Dental caries and traumatic injuries have been given prominence. Innovations in the field of Pediatric dentistry are transpiring amazingly fast, and it is crucial to stay up to date with the latest materials, equipment and techniques to deliver the highest quality of care to our little patients.

The New Book cannot be successfully compiled without the collective contribution regarding meticulous reviews of the manuscript to keep pace with the latest innovative novelties. The credit for introducing a New Textbook goes to the contributors for their engrossment, devotion and dedication in presenting a manuscript after applying prudent and well-adjudged scrutiny and analytical approach and have excelled in exploring the things to the ultimate.

Accumulation of information and its cogent management would not have been conceivable without the efforts of the contributors who have painstakingly submitted their manuscripts to shape this gargantuan task and to introduce this book in the service of Pediatric dentistry.

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We do not find such appropriate words to praise the unique nature of Dr. Mahesh Verma, Vice Chancellor of Guru Gobind Singh Indraprastha University, New Delhi, who himself being a great resolute and connoisseur of dentistry occupying an illustrious position with an eminent background in dentistry, has spared his valuable time from his busy schedule to inscribe the foreword for the Textbook of "Illustrated Pediatric Dentistry." We take it as inventiveness and encouragement rather than a morale-boosting for us to uphold and keep up our determination to satisfy our hunger for academics for the advantage of budding dental professionals.

We also do not find such befitting words to laud the unique nature of Dr. Ashok Dhoble Hon, General Secretary Indian, Dental Association Head Office, who himself being a great advocate and connoisseur of dentistry occupying a distinguished position with an illustrious background in dentistry has spared his precious time from his busy schedule to write the foreword for the Textbook of Illustrated Pediatric Dentistry. I take it as an inspiration and encouragement rather than a morale-boosting for us to uphold and keep up our determination to satisfy our hunger for academics for the advantage of budding dental professionals.

We are also indebted and beholden to the contributors for their altruistic and substantial contribution to make this Textbook of Illustrated Pediatric Dentistry, a great academic endeavour. The contributors are highly competent and knowledgeable clinicians known for their aptitude and capability, which have successfully recognized the most complex and convoluted details of each topic, duly integrating and blending the latest advancements and innovations in Pediatric Dentistry. They are a terrific hard worker and legendary luminaries known for their admirable accomplishments and remarkable involvement in dental education. They have made lots of efforts to lead things to excellence. Credit goes to these patrons and benefactors for the benevolent bequest of their vast knowledge and experience for the betterment of dental education.

We would also like to thank Dr. Priyanka Bhaje, Dr. Parag Kasar, Dr. Sharath Chandra, Dr. Prachi Goyal and Dr. Vidya Iyer for their painstaking efforts and intransigent toil during the editing of this book. They displayed exceptional patients, forbearance, and commitment during the preparation of the book Our dream has come true due to the support of our past and present students. Credit also goes to our family members for their tolerance, Love, and affection.

We would like to appreciate the efforts of Mrs. Humaira Hashmi of Bentham Science and the publishers Bentham Sciences for giving us an opportunity to pen down our ideas and academic work to reality. We also convey our kind and sincere appreciation to Pascali Pascalis.

Representative of Porter Instrument Business Unit of Parker Hannifin MatrX by Parker and Parker-Porter Product for permitting us to use the company products in our book.

*vi*

Lastly, we would like to state that fortune favours those who defy complexities and overcome them on their own. We also passionately believe that Man is the architect of his own destiny, and God is on the side of those who toil and perspire to make their providence.

We place our sincerest admiration and gratitude to all those who have delightfully contributed to this cause and for their wishes and devotions made for understanding our dream.

**Satyawan Damle**  
**Ritesh Kalaskar**  
**Dhanashree Sakhare**  
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## CHAPTER 1

# Introduction to Pediatric Dentistry

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<sup>2</sup> Former Vice Chancellor, Department of Pediatric Dentistry, Maharishi Markandeshwar University, Mullana, Ambala, India

**Abstract:** Pediatric dentistry is the only speciality that has an abundance of knowledge for the management and treatment of the oral health care needs of infants and children. Pediatric dentistry concentrates on the integration of appropriate tactics and knowledge of various specialities into a framework of quality oral health care for children. It is necessary to implement procedures that are safe, comprehensive, accessible, affordable, high quality, and respectful for children. The role of a Paediatric dentist is to promote the dental health of children as well as serve as a resource person to the parents.

**Keywords:** Pediatric Dentistry, Infants, Children, Parent, Management.

## INTRODUCTION

Various authors have rightly equated children with flowers. A few of them quoted: *Let them bloom by giving them our warm smiles, our soft gentle words falling on them like rain and our art of confidence. Water them with love, nourish them with praise, and compliment them every day. Be their sun when all you see is rain. Protect them from storms and shelter their pain. Children are like flowers that blossom every day* (Fig. 1).



**Fig. (1).** Children are as lovely as flowers.

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Satyawan Damle, Ritesh Kalaskar, Dhanashree Sakhare & Abdulkadeer Jetpurwala (Eds.)  
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To put it into a nutshell, children are the flowers of life! They bring joy and happiness to our world. Let us be kind to them, let us make them happy and let us help them to save that child inside them for the rest of their lives!

Pediatric dentistry a branch of Dentistry deals with these delightful children.

### **Definition**

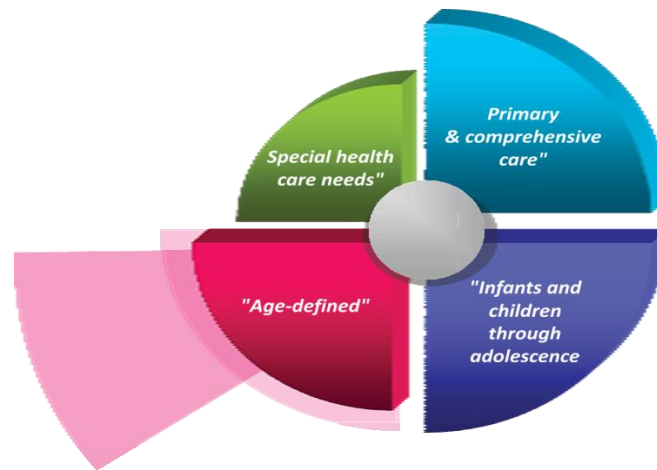
It is an age-specified speciality that provides both primary and comprehensive preventive and therapeutic oral health care for infants and children through adolescence, including those with special health care needs (Fig. 2). Pediatric dentistry is a speciality that adjusts techniques and procedures from general dentistry and other specialities to provide primary and comprehensive preventive and therapeutic oral health care for children [1, 2].



**Fig. (2).** Definition of Pediatric Dentistry (AAPD 2020).

Pediatric dentistry encompasses a variety of disciplines, techniques, procedures, and skills that reveal a common basis with other specialities however these practices are modified and adapted to the unique requirements of infants, children, adolescents, and those with special health care needs (Fig. 3). Being an age-specific speciality, pediatric dentistry encompasses disciplines such as behaviour guidance, care of medically and developmentally compromised and disabled patients, supervision of orofacial growth and development, caries prevention, sedation, pharmacological management, and hospital dentistry, as well as other traditional fields of dentistry. These skills are applied to the needs of children

during their ever-changing stages of development and to treating conditions and diseases unique to growing individuals [3].



**Fig. (3).** Pediatric Dentistry Encompasses Different Aspects.

## **DENTISTRY ENCOMPASSES DIFFERENT ASPECTS**

### **An Important Aspect of Children Being Treated in a Separate Speciality.**

What is the most appealing about children?

Is it their cute faces?

Their playfulness?

Their smile? Of course, yes, however!

Beyond all these aspects, children are beautiful because they possess something unique, that we as adults have lost and that is innocence as well as purity (Fig. 4A).

Pediatric dentists encourage the oral and dental health of children as well as provide educational resources for parents. It is advised that a dental visit should occur: within six months after the presence of the first tooth or at least by a child's first birthday. It is important to create a comprehensive and accessible ongoing association between the dentist and patient, so the healthy and beautiful smile and natural teeth always remain beautiful (Fig. 4B).

## **Emotional Development of a Child**

**Raghavendra M. Shetty<sup>1,\*</sup>, Trisha Gadekar<sup>2</sup> and Aditi Pashine<sup>3</sup>**

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**Abstract:** The emotional development of a child is the progressive process of the child's ability to control their feelings. The emotions of the child are expressed through facial expressions. Emotions in a child are influenced by their inborn temperament depending on the inherited genes. Crying, laughing, anger, fear, anxiety, or phobia represent different types of emotions. The impact of dental anxiety and fear often leads to avoidance or delay of dental treatment. Moreover, such individuals are difficult to treat and have behavioral problems further resulting in an unpleasant dental experience. All these factors lead to worsening oral health, which often requires complicated dental procedures. Hence, it becomes difficult for the patient to get out of this vicious cycle. Management of such patients is critical and requires careful handling and assessment. Various behaviour management techniques and advanced specialist care in the dental setting can assist fearful patients in attaining optimum oral health and significant overall improvement towards dentistry.

**Keywords:** Anxiety, Assessment Scale, Emotion, Fear.

### **INTRODUCTION**

The emotional development of children and adolescents is symbolised by a vast variation according to age, maturity, intellectual development, temperament, experience, family background, and cultural background. These factors play a vital role in influencing the child's development and underlying emotions.

Crying, laughing, and anger represent the physiological response of the emotions, whereas fear, anxiety, or phobia represents physiological causes of emotions. Fear and anxiety are considered evolutionary mechanisms essential for human existence. While every human being is afraid and anxious, it may be difficult to

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manage and understand another person's similar emotions. Usually, adults are aware of their fear and anxiety and often times, they have identified ways to regulate and control their anxiety, whereas it is a complex and sensitive issue while dealing with a child's fear and anxiety, especially in a dental setting. This is primarily due to its unknown nature and, secondly, due to difficulty in tackling the situation in the unique dental environment. Though pediatric dentists possess expertise in building and instilling a positive attitude toward dentistry during childhood, neutralizing a child's fear and anxiety requires proper implementation of behaviour shaping and management knowledge. They must be able to recognize the underlying reasons and provide an effective foundation for effective oral health care throughout an individual's life.

Assorted studies have suggested that avoidance of dental fear and anxiety often leads to poor oral health care. Hence, the primarily step towards successful dental treatment in children is to know the emotional development of the child and the recognition of dental fear and anxiety.

## **EMOTION**

American Psychological Association defines emotion as a complex reaction pattern involving experiential, behavioural, and physiological elements by which an individual try to deal with a personally significant matter or event. Emotional experiences have three components: a subjective experience, a physiological response, and a behavioural or expressive response.

### **Types of Emotions in Children**

**1. Subjective Responses** – These responses may vary with various kinds of expressions of the same emotion or different emotions.

Ex- Some children may be scared of sitting in a dental chair and would be fearful while some will be very much excited to get their check-ups done.

**2. Physiological Responses** – It results due to stimulation of the autonomic nervous system and may be expressed as fear, anxiety, or phobia.

**3. Behavioural Responses** – It is the actual expression of the emotion. Here the child's expression would exactly be the same as he/she is feeling inside, like crying, laughing, anger, disgust, *etc.*

### **Emotional Development in Children**

Bridge, in 1932, gave a model of emotional development which considered distress and delight as the basic manifestation of emotion which is present since

birth. In the next few months, primary emotions (positive and negative) can be noticed such as happiness and sadness, surprise and disgust, fear, and anger. With social interaction and personal experience, more complex emotions are seen, such as love and jealousy, empathy, shame, guilt, and so on. As per the model, “the emotional reactions are generalized and poorly organized to a single or more type of situations during early weeks of life where it takes more definite form to specific situations as the child ages,” thus leading to gradual development and maturation of different emotions such as anger, fear, affection, joy, *etc.* According to this model, the development of fear occurs during 5-6 months of life (Fig. 1).

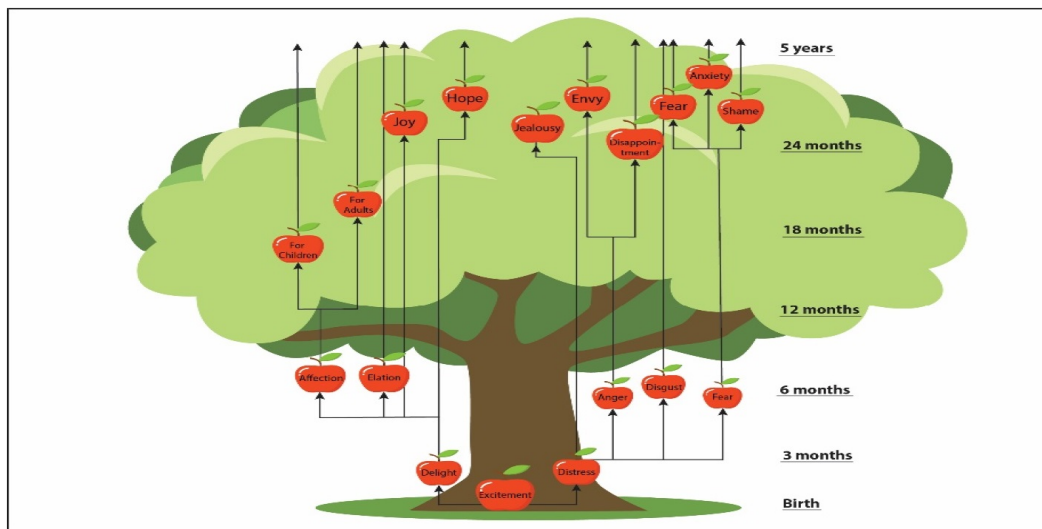


Fig. (1). Bridge's Classic Model of Emotional Development.

However, later a different approach known as the differential emotions theory suggested expressions of various emotions present even during the first months of life. Most recently, an upgraded differentiation model of emotional development was put forth by Widen and Russell in 2008 (Fig. 2). This is a two-dimensional model with one axis depicting the degree of a person's arousal and another one the degree of pleasure/displeasure. In this model, fear shows high arousal with displeasure.

There are three important components of emotional development: (i) the expression of emotion, (ii) the understanding of emotion, (iii) the regulation of emotion. Any emotion, whether positive or negative, is conveyed through the face, voice, hands, and physiological reactions. To understand one's own emotions and to understand those of others are two different entities with a close correlation. It is astonishing to know that understanding another person's

## **Psychological Development of a Child**

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**Abstract:** Child psychology is an important part of paediatric dentistry, which acts as a guide for understanding children who are in different stages of physical, mental, emotional, and social development. Understanding the psychological development of the child helps in professional recognition of the child's needs, fear and anxiety at each stage which helps in better execution of behaviour management techniques. Child psychology provides an insight into principles of behaviour management that should be tailor-made for each child for effective and efficient dental treatment. This would enable the child to have a better and more pleasant dental visit, and also give the clinician a sense of professional satisfaction and reduce the fatigue in treating an uncooperative child.

**Keywords:** Child psychology, Behaviour management, Emotional development, Fear.

### **INTRODUCTION**

Paediatric dentistry has evolved into a challenging speciality in which understanding the stages of psychological evolution of children is of utmost importance for correct diagnosis and achieving successful treatment. Understanding the psychology of the child helps in building a better relationship with the child and in gaining the child's trust which can eliminate fear and anxiety of dental procedures [1].

Psychologic growth and development of the child occurs gradually in a relatively predictable, logical and step-like sequential order which can be influenced by genetic, familial, cultural, inter-personal and intra-psychic factors. Psychological changes are examined in physical, cognitive, and social/emotional development across the lifespan. The Paediatric dentist needs to identify differences between

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each phase of a child's psychological development and the needs of the child at different levels to gain better compliance during the dental procedure.

### Definition

**Psychology** is defined as a branch of science dealing with human and animal behaviour and related mental processes.

**Child psychology** is defined as the science that deals with the mental power or interaction between the conscious and subconscious elements in a child (**Kenneth Clark and George Miller, 1970**).

### Importance of Child Psychology

- To treat the child more effectively and efficiently.
- To incorporate knowledge of cognitive and emotional development of the child.
- To improve patient compliance so that the dental procedure would be more comfortable for the child.
- Sense of calmness and security to the parent.
- It also brings a sense of professional satisfaction to the dental team, and it also becomes less stressful to treat an uncooperative child.
- Improves better promotion of child oral health [2].

### Theories of Child Psychology

Classified into Psychodynamic and Behaviour learning theory (Fig. 1):

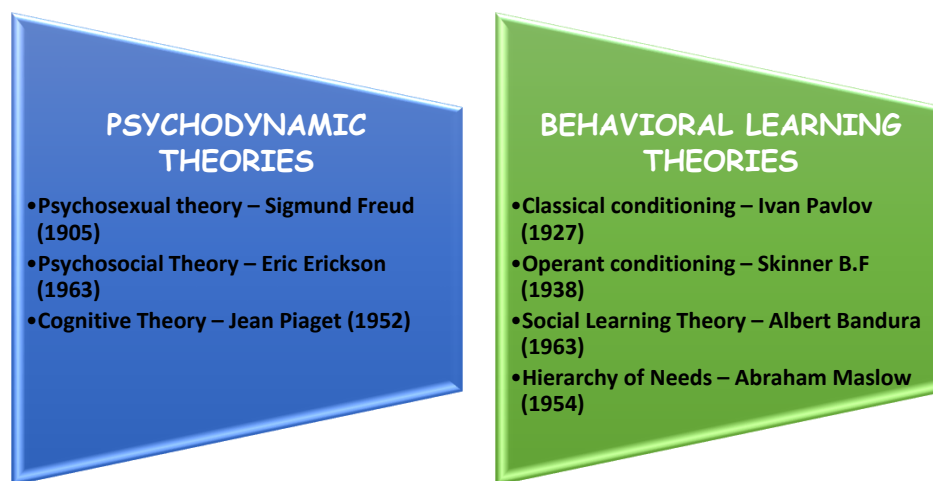


Fig. (1). Classification of theories of Child Psychology.

**PSYCHODYNAMIC THEORIES**

**Psychosexual/ Psychoanalytic Theory**

It was put forth by Austrian psychoanalyst and neurologist *Sigmund Freud*, who is often considered the first psychological theorist and pioneer of modern psychology. Freud emphasized the developmental aspects of personality and the decisive role of the early experiences during infancy and childhood in laying down the basic character structure of an adult person.

Freud developed a *topographical model* of the mental apparatus of the mind, which he divided into three systems based on awareness (Fig. 2).



Fig. (2). Levels of awareness.

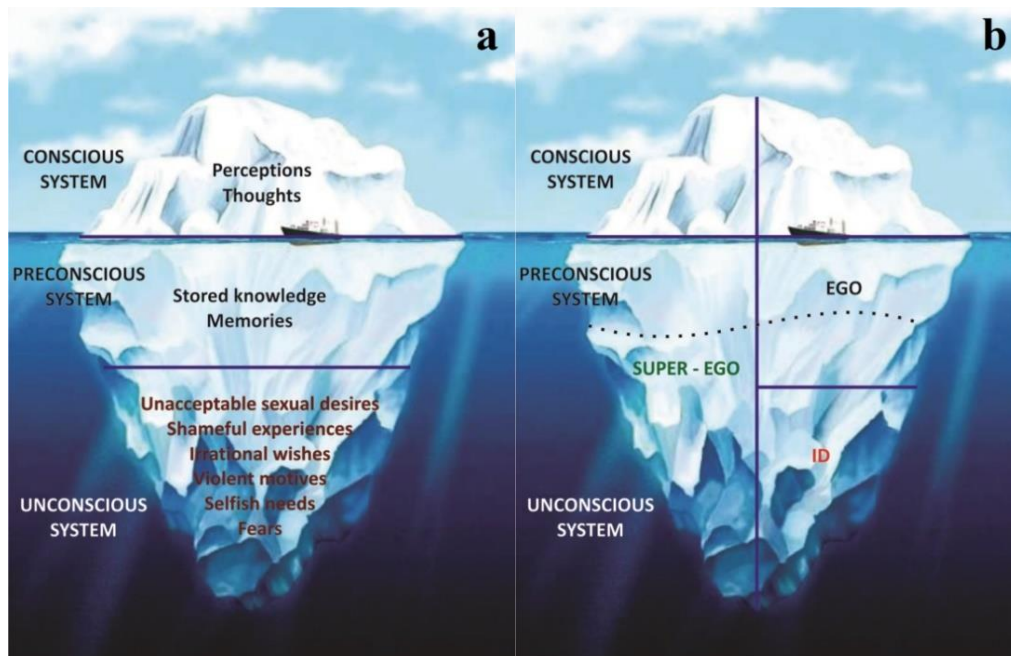


Fig. (3). a b. Freud's Topographical model.

**CHAPTER 4****Non-Pharmacological Behaviour Management****Raghavendra M. Shetty<sup>1,\*</sup>, Aditi Pashne<sup>2</sup> and Trisha Gadekar<sup>3</sup>**<sup>1</sup> Department of Clinical Sciences, College of Dentistry, Center of Medical and Bio-allied Health Sciences Research, Ajman University, Ajman, UAE<sup>2</sup> Associate Dentist, My Dentist, Aberystwyth, UK<sup>3</sup> Department of Pediatric Dentistry, Mamata Dental College, Khammam, Telangana, India

**Abstract:** Behaviour guidance, earlier known as behaviour management, of the child, is an essential part of paediatric dental practice. Various techniques are used by the dental health team for effective and efficient dental treatment of the child. At the end of the treatment, it is necessary to instil a positive dental attitude in the child's behaviour. The phrase 'behaviour management' has been replaced by 'behaviour guidance' in recent days, but both phrases are used as synonyms in most studies. Various behaviour management/guidance techniques can be used independently or in combination to ensure an efficient and effective dental treatment in the child patient. This chapter describes various behaviours of the child and appropriate non-pharmacological behaviour guidance techniques which can be employed by the dental health team for a successful dental treatment, thereby instilling a positive dental attitude in the child.

**Keywords:** Behaviour guidance, Behaviour management, Non-pharmacological.

**INTRODUCTION**

As per the American Psychological Association dictionary of psychology, behaviour can be defined as "an organism's activities in response to external or internal stimuli, including objectively observable activities, introspectively observable activities, and nonconscious processes."

**According to Wright (1975),** "Behaviour management is the means by which a dental team effectively and efficiently performs treatment for a child and at the same time, instils a positive dental attitude." It is of utmost importance to understand this definition, as firstly, as per this, any of the approaches (even if it involves drug use) would be considered as behaviour management, provided it fulfills other criteria of proving effective (*i.e.*, no compromise with the quality of

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treatment) and efficient (*i.e.*, providing maximum facilities and treatment accomplishment with time). The last and most important part is fostering a positive attitude over the whole course of dental treatment. And as per the famous McElroy's statement, "*Although the operative dentistry may be perfect, the appointment is a failure if the child departs in tears.*"

**Behaviour Modification** is defined as an attempt to alter human behaviour and emotion in a beneficial way and in accordance with the laws of learning.

**Behaviour Shaping** is the procedure that slowly develops behaviour by reinforcing a successive approximation of desired behaviour until the desired behaviour comes into being.

Recently, the terminology of behaviour management has changed to behaviour guidance. According to the American Academy of Paediatric Dentistry (AAPD), "**Behaviour Guidance** is a continuum of interaction involving the dentist, the dental team, the patient and the parent, directed towards communication and education which ultimately builds trust and allays fear and anxiety."

The objectives of behaviour guidance as per AAPD (2020) are:

- To establish proper communication.
- To alleviate a child's dental fear and anxiety.
- To promote patient's and parents' awareness of the need for good oral health and the process by which it is achieved.
- To promote the child's positive attitude toward oral health care.
- To build a trusting relationship between dentist/staff and child/parent.
- To provide quality oral health care in a comfortable, minimally restrictive, safe, and effective manner.

### **Behavioural Classification**

Various systems have been introduced for classifying children as per their behaviour, which can be an asset to managing them in the dental environment.

#### ***Wright's Classification (1975)***

- I. **Co-operative behaviour:** The child is relaxed with minimal apprehension that can be treated by behaviour guidance. Children develop a good rapport and are interested in the dental procedure. They laugh and enjoy being in the dental environment and allow the proper functioning of the dental team.

- II. **Lacking co-operative ability:** This type of children contrasts with the co-operative children. They are usually young children, less than 2½ years, disabled, handicapped, or with major behaviour problems.
- III. **Potentially co-operative behaviour:** This category has various sub-categories depending on the type of representing behaviour.
- Uncontrolled behaviour:** Usually belonging to 3-6 years. They throw tantrums in the reception area. They are incorrigible, presenting with tears, crying out loudly, and physically lashing out of their limbs.
  - Defiant behaviour:** They belong to the pre-school age group and present with stubborn or spoilt behaviour. However, they are highly cooperative once they develop trust.
  - Timid behaviour:** They are highly anxious, shy, and they whimper but do not cry hysterically. They are overprotected children and require building confidence in themselves.
  - Tense cooperative:** They have the varying type of behaviours.
  - Whining behaviour:** Children are complaining throughout the dental procedure.
  - Stoic behaviour:** Mostly physically abused children, but they are cooperative. They passively accept dental treatment without any facial expression.

### Behaviour Rating Scales

Frankl's behaviour rating scale was introduced in 1962 and later was modified by Wright in 1975 by adding symbols (+, -) to represent the severity (Fig. 1). It is the gold standard for behaviour rating in the dental clinic and is the most widely used to date. This classification is functional, quantifiable, and reliable.



Fig. (1). Frankl's Behaviour Rating Scale.

## Dental Caries: Etiology, Pathogenesis, and Caries Activity Tests

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**Abstract:** Oral disease is one of the most significant global health concerns. Oral diseases have a monetary impact on people in developing countries. Disease can occur at any age and across a variety of demographic and socioeconomic conditions. Dental caries is a chronic microbial disease caused by a variety of factors, including the production of acid by bacteria *via* carbohydrate fermentation, which causes demineralization of tooth enamel, eventually leading to the loss of tooth structures and pulp infection. Caries is caused by an imbalance between tooth minerals and dental biofilms, which can develop over time in many people. Symptoms of dental caries begin with tooth pain and cavities and can lead to tooth loss. To prevent disease and maintain good oral health conditions, caries risk assessment is critical for controlling the progress of dental caries. Risk assessment is done by performing caries activity tests. Knowing the etiological factors associated with dental caries is important for clinicians and patients to prevent the disease from developing or halt its development and complications.

**Keywords:** Bacteria, Biofilms, Dental Caries, Oral Disease, *Streptococcus Mutans*.

### INTRODUCTION

Oral diseases, which cause major health issues around the world, are economically affecting people of developing countries, as 10% of health expenditure is linked to dental care. These diseases can occur at any age and across all demographic and socioeconomic groups. Dental caries affects 2.43 billion individuals (36% of the global population) on their permanent teeth and affects 620 million individuals (9% of the global population) on their primary teeth. Latin America, the Middle East, and South Asia are regions with

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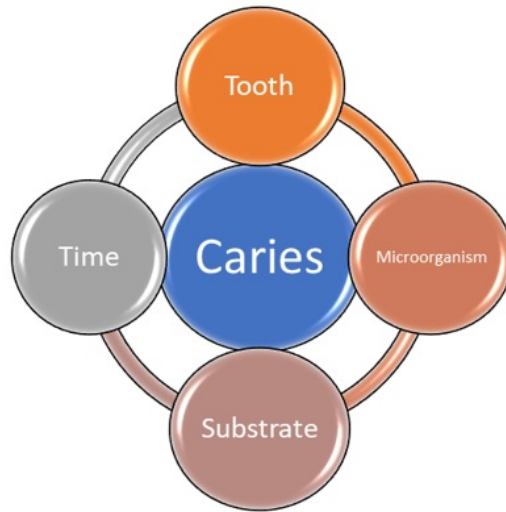
particularly high incidences of dental caries. According to the WHO, although there have been significant improvements in the oral health of the population in some countries, oral disease continues to occur in many individuals. The WHO has stated that poor oral health affects general health and quality of life, and that several oral diseases are associated with chronic systemic diseases. There are many debilitating symptoms associated with dental caries, including pain, mastication problems, aesthetic issues, and an inability to communicate due to damaged teeth or tooth loss [1, 2].

### **Etiology**

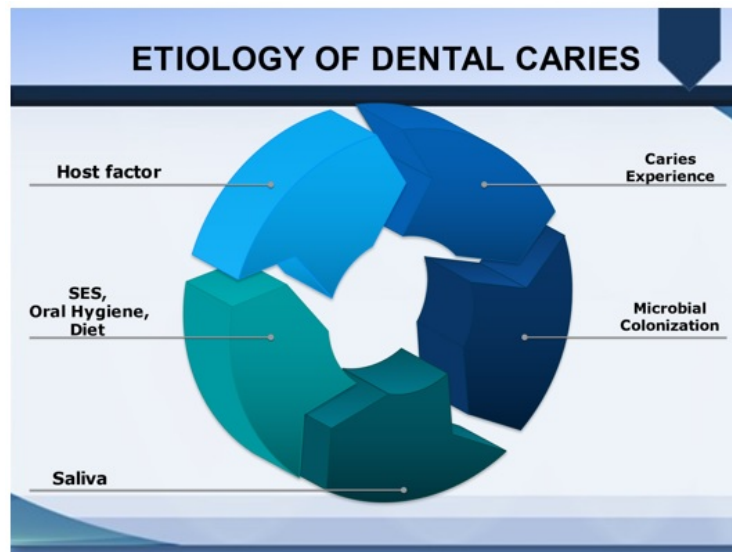
Dental caries is a chronic microbial disease with numerous causative factors. Due to its acid production *via* carbohydrate fermentation by bacteria, it leads to the demineralization of tooth enamel, resulting in the loss of tooth structures. The major bacteria that cause dental caries are *Streptococcus mutans*, *Streptococcus sobrinus*, and *Lactobacillus* species. Many facultative and obligate anaerobic bacteria are also involved in the process, such as the *Actinomyces*, *Bifidobacterium*, *Eubacterium*, *Parvimonas*, and *Rothia* genera. Other bacteria may also take part in the formation of caries, such as *Streptococcus mitis*, *Streptococcus anginosus*, *Propionibacterium*, *Enterococcus faecalis*, *Scardovia*, *Prevotella*, *Selenomonas*, *Dialister*, *Fusobacterium*, *Pseudoramibacter*, *Veillonella*, *Atopobium*, *Granulicatella*, and *Leptotrichia*. On the oral mucosa, the predominant bacterial genera with a high concentration in dental plaque and gingival crevicular fluid and on the tonsils are *Bacteroides*, *Prevotella*, and *Porphyromonas* [3]. These bacteria can produce acid substances due to the high substrate availability on our teeth. The most common type of substrate is leftover foods that are not cleaned properly after eating. Bacteria can break down these remnants into simple sugars, which they then continue to ferment for their own use. If this goes untreated, acid is accumulated that causes the overall oral pH level to go down, and demineralization occurs [4]. From this description, we can define dental caries as an occurrence of disease caused by the over-accumulation of acid produced by plaque microorganisms, which brings about the destruction of the tooth structure.

Therefore, four key factors are required for dental caries to occur [5]:

- The tooth, acts as the host.
- The microorganism, acts as the causative agent (Figs. 1 and 2).
- The substrate, acts as food for the causative agent.
- Time, required for the microorganism to ferment the substrate.



**Fig. (1).** Etiology of dental caries.



**Fig. (2).** Exhibiting etiological factors.

## **Pathogenesis**

### ***Dental Plaque and Biofilm***

Dental biofilm is a polymicrobial community established within a solid-liquid interface, such as that formed by the oral microbiota on the surface of the teeth. Since it requires a liquid interface, the constant covering of saliva on teeth makes



## Diagnosis of Dental Caries

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**Abstract:** A balance between demineralization and remineralization is crucial for caries progression. Dental caries can progress if demineralization, which is associated with pathogenic factors, outweighs remineralization, which is linked to protective factors. In some sites, carious lesions are benign, whereas in others they progress and invade deep cavities. Dental caries can be classified according to the site where they occur and their size. Untreated carious lesions can lead to pulpal and periapical diseases. Treatment plan options are based on the diagnosis (pulpal or periapical).

**Keywords:** Demineralization, Dental Caries, Microorganisms, Remineralization, Substrate, *etc.*

### INTRODUCTION

Dental caries is a common oral problem. In the absence of dental treatment, they can lead to tooth structure loss. Loesche stated that dental caries was associated with functional (mastication and pain) and nonfunctional issues (esthetics) and high treatment costs [1]. Dental caries is caused by host-related factors, such as tooth structure and diet (carbohydrate-rich) and microorganism-related factors, such as *Streptococcus mutans* and *Lactobacillus* spp. Host and microorganism factors are interrelated physically, functionally, and chemically. Other factors associated with dental caries are fluoride, saliva, individual behavior (laziness of maintaining oral health), education, dental health-related knowledge, income, and social class [1]. Hence, education also plays an important role in the risk of dental caries. Dental caries can progress when demineralization (pathogenic) factors outweigh remineralization (protective) factors. Acidic plaque (pH < 6.5) decreased salivary flow, impaired salivary buffer capacity, and poor oral hygiene

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act as pathogenic factors. Saliva, sufficient calcium ions ( $\text{Ca}^{2+}$ ) and phosphate ions ( $\text{PO}_4^{3-}$ ) levels, good oral hygiene, fluoride, and antibacterial agents (*e.g.*, chlorhexidine and xylitol) act as protective factors. To determine the optimum treatment, a full dental examination must be undertaken to determine the location and severity of existing caries. The treatment options for carious lesions include surgical and nonsurgical options, depending on the caries progression (Fig. 1) [2].

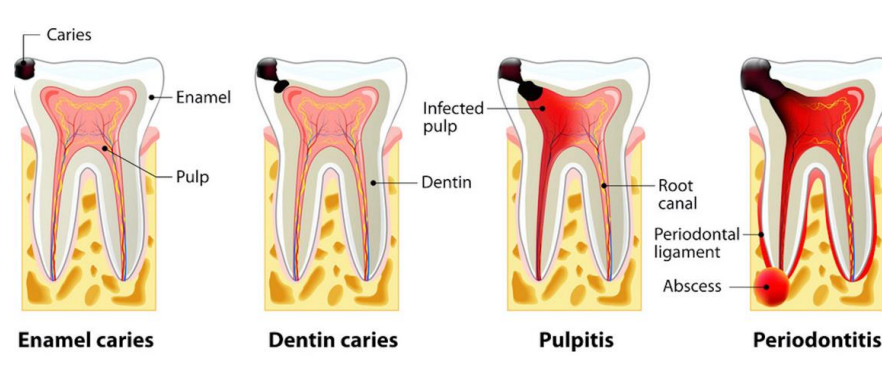


Fig. (1). Diagrammatic representation of dental caries progression [2].

## Definitions

Dental caries is defined as a chronic oral disease caused by the bacterium *Streptococcus mutans*, which converts sugars into acid, causing tooth demineralization [3]. Demineralization is defined as mineral ions removal from hydroxyapatite hard tissues, while remineralization is defined as the restoration of mineral ions into hydroxyapatite hard tissues. Demineralization by *S. mutans* and other bacteria of inorganic structures and destruction of organic substances increase the risk of dental caries [1]. Unbalanced demineralization and remineralization of enamel and dentin cause dental caries (Fig. 1). According to the World Health Organization (WHO), caries progression is a pathological process in which hard tooth tissue is softened, leading to cavity formation [3]. Based on the American Academy of Pediatric Dentistry Definitions, Oral Health Policies, and Clinical Guidelines, dental caries is the result of biofilm (plaque), mediated by saliva, with the biofilm inducing acid demineralization of enamel or dentin [3].

Four main factors are involved in tooth decay (Fig. 2), namely [4]:

1. Tooth (host)
2. Substrate (fermentable carbohydrate)
3. Microorganisms (bacteria)
4. Time

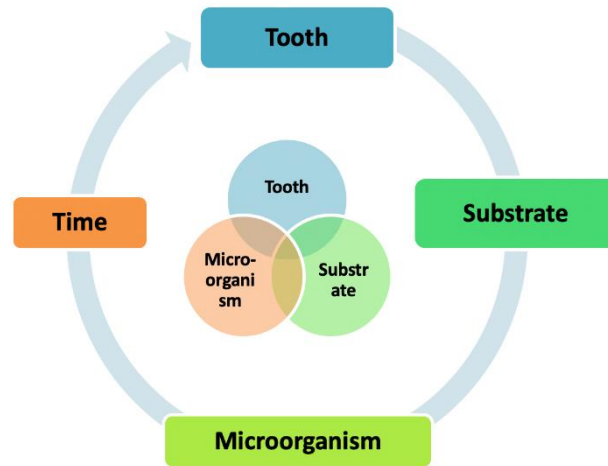


Fig. (2). Etiology of dental caries.

As depicted in Fig. (3), the components of a cariogram model are as follows:

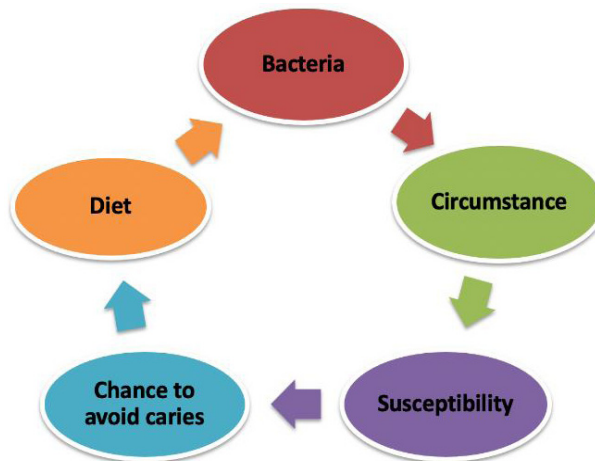


Fig. (3). Cariogram model [4].

**Chance:** Chance to prevent new cavities in the future

**Diet:** Consumption of food types and their sources

**Bacteria:** Numbers and types of bacteria in plaque

**Susceptibility:** Tooth defense (fluorides) and saliva characteristics

## **Role of Diet in Dental Caries**

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**Abstract:** The importance of sugars as a cause of dental caries is underemphasized and not prominent in preventive strategies. Quantitative analysis shows a log-linear dose-response relationship between sucrose or its monosaccharide intakes and the progressive lifelong development of caries. This results in a substantial dental health burden throughout life. Processed starches have cariogenic potential when accompanying sucrose. Dental diseases impair quality of life and hurt self-esteem, eating ability and health, causing pain, anxiety, and impaired social functioning. So, it was also thought that diet could be controlled or modified, to exert an anti-caries effect. Several experiments, studies and research have been carried out to assess the effect of diet on dental caries.

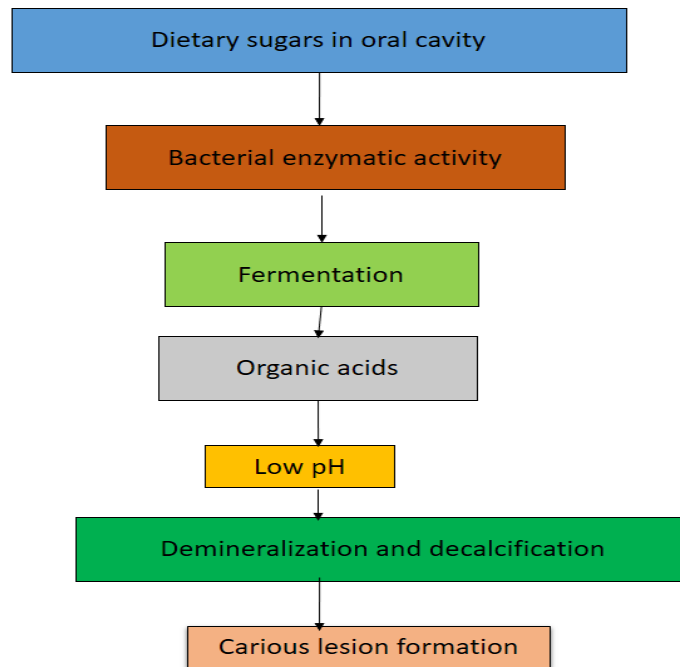
**Keywords:** Dental Caries, Diet counselling, Sugar studies, Sugar Substitutes.

### **INTRODUCTION**

Dental caries is the most prevalent Non-Communicable Disease (NCD) globally and affects all age groups across the life course. Despite the accepted scientific evidence that caries creates incredibly significant personal, societal, and economic burdens across the world and that caries presents the largest numerical impact on oral health, the disease has typically been invisible in health policies. This situation appears to be paradoxical, as the burdens and pain caused by caries and cavities are preventable and addressing the risk factors for cavities can also reduce other non-communicable diseases and improve general health. The main cause of tooth loss is dental caries (Fig. 1), in which diet plays an important role.

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**Fig. (1).** Factors and sub-factors that influence caries development.

Oral health is related to diet in many ways; for example, nutrition influences craniofacial development and oral mucosal and dental diseases, including dental caries, enamel defects and periodontal disease. Dental diseases impair quality of life and hurt self-esteem, eating ability and health, causing pain, anxiety, and impaired social functioning. Tooth loss reduces the ability to eat a nutritious diet, the enjoyment of food and confidence to socialize. It was also thought that diet could be controlled or modified, to exert an anti-caries effect. A few experiments, studies and research have been carried out to assess the effect of diet on dental caries. After the Second World War, advice about a nutritious diet often encouraged mothers to give their young children a diet rich in calcium and vitamin D, so that they would develop strong bones and teeth, which would be less susceptible to decay. Although this was sound advice as far as the bones are concerned, there has always been little evidence to substantiate the view that good nutrition in early life helps to prevent dental decay by a systemic effect. This certainly does not mean that good nutrition should be discouraged; it merely reflects the current view, that diet has a much greater effect locally in the mouth than it does pre-eruptively, while the teeth are still forming.

## Definition

**Dental Caries** is a biofilm-mediated, diet modulated, multifactorial, non-communicable, dynamic disease resulting in a net mineral loss of dental hard tissues. It is determined by biological, behavioural, psychosocial, and environmental factors. Owing to this process, a caries lesion develops [1].

“In dentine, when no cavities are detected, it is termed as cavity-free. In enamel, when no cavities are detected, it is termed caries-free.” However, thorough clinical examination may reveal the presence of non-cavitated and/or micro-cavitated carious lesions. Occult caries is known as PEIR (pre-eruptive intracoronal resorption).

**Caries Prevention** refers to the inhibition of the initiation of caries lesions. Effective primary prevention interventions allow this to be successful. However, once the caries process has been initiated, movement to an appropriate caries care/management program is desirable to ensure that the lesions do not progress and that caries is arrested.

Dental caries is the result of complex interactions involving the individual (nutrition, genetics, behaviour, race, and age), plaque bacteria, saliva flow and composition and the environment. Diet is one very important element of the environment that can be at risk and so contribute to dental caries. Diet exerts a profound effect on dental caries locally in the mouth by reacting with the enamel surface and serving as a *substrate for cariogenic* microorganisms, which produce acid thereby reducing the pH and causing dissolution of the tooth surface [2].

## Cariogenicity of Diet

**Cariogenic Potential** – “A food’s ability to foster caries in humans under conditions conducive to carious lesion formation”.

**Cariogenicity** – “The true cariogenicity of a food can only be established by experimentally determining in humans the extent of tooth decay associated with a given food.” (Stamm JW *et al.*, 1986)

- When a tooth enters the ‘restorative spiral’, it becomes more and more complex and expensive, often resulting in multiple replaced restorations of increasing.
- The severity of the affected tooth at each stage of the cycle reaches a significantly higher risk of eventual extraction.
- Despite this knowledge, and some notable attempts to change, in many countries, the balance of dental education remains largely focused on a surgical

## **Early Childhood Caries**

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**Abstract:** Early childhood caries (ECC) is a serious and common public health problem affecting young children across the globe. It is prevalent in both developing and developed countries. ECC starts and progresses rapidly in high-risk children. It can lead to various physical, psychosocial and financial consequences for the child and their family, leading to compromised quality of life. There are some factors unique to this type of caries due to the developmental stage and dependence of the child on the mother or caretaker for feeding and oral hygiene practices. The faulty feeding practices can affect the primary dentition severely. ECC also indicates higher risk of caries development in later stages of life.

The disease can be challenging to manage in advanced stages due to limited specialized personnel and resources and behavioral management problems in young children. An effective prevention protocol is our best tool to manage this disease, reducing the burden the healthcare system and society.

**Keywords:** Early childhood caries (ECC), Etiology, Clinical features, Prevention and management.

### **INTRODUCTION**

Early childhood caries is one of the most debilitating and common diseases of preschool-aged children leading to the destruction of tooth tissues by combined effects of acids generated from the fermentation of dietary carbohydrates by bacteria, interplay host factors, such as teeth and saliva and the effect of home oral hygiene measures including the use of fluoride.

Decay of primary teeth in children under 6 years of age is referred to as early childhood caries (ECC). The consequences of ECC and poor oral health can influence the overall general health of children and the quality of life of children as well as their parents.

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Dental caries is a preventable disease, yet it is the most prevalent childhood disease in the world. In India, this is one of the most common conditions with unattended health needs in children.

### **Definitions**

Early Childhood Caries (ECC) is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of six (AAPD 2020).

Severe early childhood caries (S-ECC) is any sign of smooth-surface caries in a child younger than three years of age, and from ages, three to five, a decayed, missing or filled score of greater than or equal to four (age 3), greater than or equal to five (age 4), greater than or equal to six (age 5) [1].

<p style="text-align: center;"><b>S-ECC</b> <b>FOHV score <math>\geq</math> age in</b> <b>years + 1</b></p>
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Early childhood caries has also been termed as Nursing Bottle Caries, Nursing caries, Baby bottle tooth decay, Bottle rot and Maternally Derived *Streptococcus mutans* Disease.

While a child is said to have early childhood caries when even a single tooth shows signs of decay, restoration or is missing, nursing caries is associated with patterns of decay wherein the mandibular anterior teeth are spared from caries.

### **Rampant Caries**

Massler defined rampant caries as ‘suddenly appearing, widespread, rapidly burrowing type of caries, resulting in early involvement of the pulp and affecting those teeth regarded as immune to ordinary decay.

Early childhood caries may also manifest as rampant caries where distinguishingly, the proximal surfaces of mandibular anterior teeth are affected by decay.

ECC, nursing caries and rampant caries can often be considered as a continuum of the same condition when allowed to progress unabated without preventive and therapeutic intervention in the early stage of the disease.



**Classification**

For the past 20 years, different research groups have attempted to develop classification systems for Early Childhood Caries (ECC) (Fig. 1). The various classification systems developed include:

1. Based on the severity and the associated etiology (Wyne,1999) [2].



Mild to Moderate ECC	Moderate to Severe ECC	Severe ECC
Isolated carious lesions	‘Labiolingual lesions’	Carious lesions affecting almost all surfaces
Incisors and/ or molars are involved	maxillary incisors, with or without molar caries are involved Mandibular incisors are typically unaffected	all teeth including the mandibular incisors are involved
Etiological factors are combination of semi solid/solid food and oral hygiene	Etiological factors are inappropriate use of feeding bottle or at-will breast-feeding or combination of both, with or without poor oral hygiene	Combination of cariogenic food substances and poor oral hygiene

Fig. (1). Classification systems for Early Childhood Caries (ECC).

## Craniofacial Growth and Development in Children

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**Abstract:** Human growth, development, and maturation are multifaceted processes that involve different aspects, including biological, physical, social, and intellectual aspects. Between conception and maturity, the size and complexity of the human body change dramatically. A multitude of changes in sensory, cognitive, and motor coordination are also associated with the development of an individual from infancy to adolescence and are related to brain growth and maturation. All the different facets of development are, however, interrelated. This chapter summarizes the various concepts, principles, theories, factors affecting growth and the parameters used to measure and assess maturity from time to time.

**Keywords:** Craniofacial Growth, Growth theories, Growth maturity, Growth assessment, Human Development.

### INTRODUCTION

Growth involves an increase in size resulting from cell multiplication, expansion, and maturation of tissues. It implies development, from the time of birth to eventual senescence or death. It is an incredibly circuitous phenomenon, which involves large changes in body form, metabolism, and body processes, all occurring at different rates.

Complex mechanisms are involved in the regulation of craniofacial growth and development. The final morphology of the craniofacial bone is derived from the interactions between hormones, genes, nutrients, and environmental factors. These components grow and develop in a predictable, sequential, and orderly fashion throughout life, albeit with great variation in the amount and timing of

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growth (Nanda, 2000). However, any disturbances in this mechanism may result in a deviating growth pattern.

Understanding normal growth and its varying patterns from infancy to adolescence is essential to planning treatment involving dental and skeletal malocclusions as it may jeopardize post-treatment retention and stability.

## Terminologies

### *Growth*

- **Todd** (1931): An increase in size.
- **Stewart** (1982): Developmental increase in mass.
- **Proffit** (1986): Increase in size or number.
- **Moyer** (1988): Changes in the amount of living substance.
- **Stedman** (1990): Increase in the size of a living being or any of its parts, occurring in the process of development.
- **Pinkham** (1994): An increase, expansion, or extension of any given tissue.
- **Moyer**: Quantitative aspect of biologic development per unit time.

### *Development*

- **Todd** (1931): Increase in complexity; Progress toward maturity.
- **Proffit** (1986): Development is in complexity.
- **Moyers** (1988): Naturally occurring unidirectional changes in the life of an individual from its existence as a single cell to its elaboration as a multifunctional unit terminating in death
- **Stedman** (1990): The act or process of the natural progression from a previous lower or embryonic stage to a later, more complex, or adult age.
- **Pinkham** (1994): Development addresses the progressive development of tissue.
- **Enlow**: A maturational process involving progressive differentiation at the cellular and tissue levels

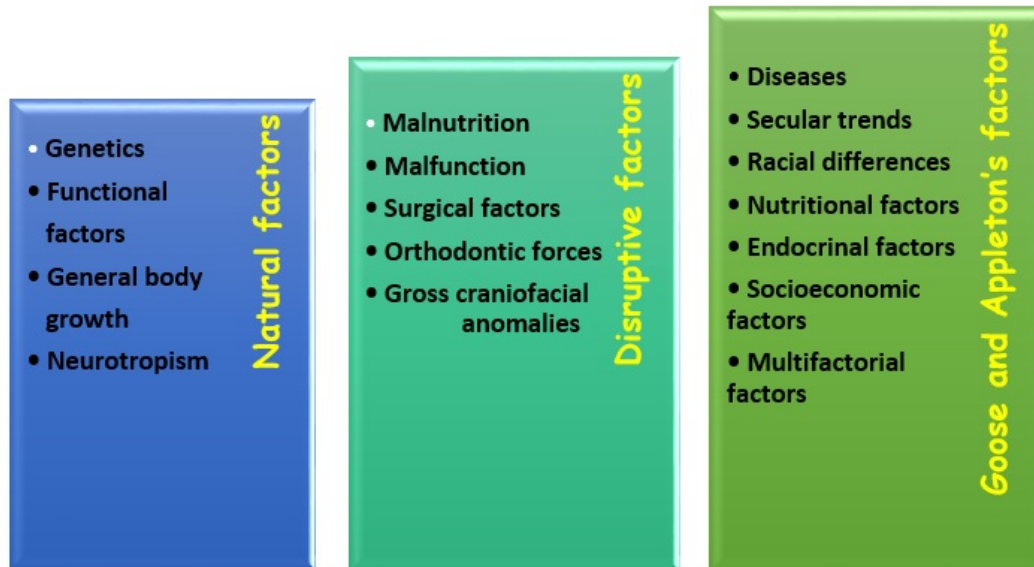
## Factors Affecting Growth

The regulation of the rate, timing, form, and character of growth is orchestrated by the interactions between various genetic and environmental factors.

Enlow and Moyer classified factors into Natural or Disruptive. Goose and Appleton also listed certain factors affecting growth (Fig. 1).

## Genes and Heredity

The size of an organism, the rate and onset of growth and growth spurts are influenced by genes to a great extent. The genes within each cell are necessary to produce an organism as a whole and to orchestrate the normal growth of the individual (Kohn, 1991).



**Fig. (I).** Factors affecting the growth.

After birth, the infant's growth rate becomes independent of maternal factors and depends solely on his genetic makeup. A significant postnatal shift occurs after 1-2 years which is reflective of the mid-parental height of a child. During adolescence, the growth of a child correlates more with parental size. The size of parents should therefore be considered as the best marker for predicting the future size of a newborn baby.

## Family Size and Birth Order

The family size may be correlated with the differences among different family members in size, maturation level, and intelligence. Studies have also concluded a first-born child usually weighs less at birth and has less stature but has a high IQ level (Belmont and Marolla, 1973).

## Growth and Development of Maxilla and Mandible

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**Abstract:** Growth is defined as the normal changes in the amount of living substance. Development refers to all the naturally occurring unidirectional changes in an individual's life, from its existence as a single cell to its elaboration as a multifunctional unit terminating in death. It encompasses the normal sequential events between fertilization and death. Note that development to the biologist refers to the individual in contradistinction to species. The life of the individual does not start as a gamete or zygote, but as primordial germ cells that give rise to gametes. In some invertebrates and plants, life starts from almost any cell which is properly stimulated and maintained. The term multifunctional unit emphasizes the elaboration of multiple functions rather than multiple cellularities. Unidirectional changes continue until death. Therefore, development is a result of a combination of growth, differentiation, and translocation. These terms are not synonymous.

**Keywords:** Postnatal, Prenatal, Development, Growth, Mandible, Maxilla.

### INTRODUCTION

Every dentist especially Pediatric Dentists needs a thorough knowledge of craniofacial growth and development. Even for those who have worked with children, it is difficult to comprehend conditions observed in adults without understanding the process that produced these problems.

### Scope

- Differentiate whether growth changes are normal or pathological.
- Follow the child's growth over a period using growth charts.

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- Since we deal with not only the development of dentition but the entire dentofacial complex, we should be able to manipulate facial growth for patient benefit.
- Orthodontic treatment continued growing children, during the growth period. Growth does not always take place uniformly. There seem to be periods when a sudden acceleration of growth occurs, this sudden increase in growth is termed growth spurts.

### **Prenatal Growth and Development of Maxilla and Mandible-Maxilla**

Development of the maxilla includes the development of:

1. Maxilla proper
2. Premaxilla
3. Accessory cartilages.

#### **1. Maxilla Proper**

It develops in the mesenchyme of the maxillary process of the mandibular arch as intramembranous ossification. It has a centre of ossification, which appears in a band of fibro cellular tissue immediately lateral to and slightly below the infraorbital, giving off its anterior superior dental branch. The ossification center lies above that part of the dental lamina from which develops the enamel organ of the canine [1].

#### **The Ossified Tissue Appears as a Thin Strip of Bone. It Spreads in Different Directions as:**

- Backward: Below the orbit toward the developing zygomatic bone.
- Forward: Toward the future incisor region.
- Upward: To form the frontal process of the maxilla.

As a result of this pattern of bone deposition, a bony trough formed (infraorbital groove) where the infraorbital nerves lie. The inner and outer edges of this groove grow up, meet, and fuse forming a canal that encloses the nerve & opens anteriorly at the infraorbital foramen [2].

- **Downward:** To form the outer alveolar plate for the maxillary tooth germs [2].
- **Toward the midline:** Ossification spreads with the development of the palatal process in the substance of the united palatal folds to form the hard palate. At the union between the palatal process and the main part of the developing

maxilla, a large mass of bone is produced. From this region & on the inner side of the dental lamina & tooth germs, the inner alveolar plate of deciduous canines and molars develops.

**Development of the maxillary sinus:** At 4 MIU a small depression of the mucosa of the lateral wall of the nasal cavity. In its gradual extension, the sinus comes into relation with the maxilla above the level of the palatal process & hollow out the interior of the bone, separating its upper orbital surface from its lower or dental region.

## 2. Premaxilla

Two Centres of Ossification for the Premaxilla:

A. **The palate-facial centre:** Appear at the end of 6 WIU. It starts close to the external surface of the nasal capsule, in front of the anterior superior dental nerve and above the germ of the lateral deciduous incisor. From this center bone formation spreads:

1. Above the teeth germ of the incisors.
2. Then downward behind them- To form the inner wall of their alveoli & palatal part of the premaxilla.

B. **The prevomerine center (paraseptal centre):** It begins at about 8-9 WIU along the outer alveolar wall. It is situated beneath the anterior part of the vomer bone, and it forms that part of the bone that lies mesial to the nasal paraseptal cartilage. At 8 WIU union occurs between the maxilla and premaxilla [3].

## 3. ACCESSORY CARTILAGES

Unlike the mandible, the development and growth are little affected by the appearance of secondary cartilages:

- The accessory cartilaginous center appears in the region of the future zygomatic or molar process, and this undergoes rapid ossification & adds considerable thickness to the bulk of this part.
- Also, small areas of the secondary cartilaginous center appear along the growing margin of the alveolar plate.
- In the middle line of the developing hard palate between the two palatine

## Development of Dentition and Occlusion in Children

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**Abstract:** The development of dentition and occlusion is an integral part of craniofacial growth as the formation, eruption, exfoliation, and exchange of teeth occur during this period. It is an assimilation of facts, predictions, and studies in static and dynamic situations, the factors influencing them, and their clinical implications. The development of dentition and occlusion is a dynamic concept. The first sign of tooth development appears late in the third week of intrauterine life. An ideal occlusion is the perfect interdigitation of the upper and lower teeth, which results from a developmental process consisting of three main events, jaw growth, tooth formation, and eruption. Development of occlusion starts before the eruption of first teeth in the oral cavity and lasts lifelong thereafter.

**Keywords:** Anomalies, Dentition, Development, Growth, Occlusion, Terminal planes.

### INTRODUCTION

The development of dentition and occlusion is a dynamic concept. The formation of teeth, dentition development, and craniofacial growth are closely related to prenatal and postnatal development periods. The development, emergence, resorption, and shedding of deciduous teeth and the development and emergence of permanent teeth constitute a continuous series of maturational events from before birth to adulthood available for assessment of dental maturation and even for prediction of growth in individuals.

### Evolution of Dentition

During evolution, the jaws and teeth display several significant changes (Fig. 1). The literature revealed that when the reptilian evolved into mammals, the

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dentition moved from Polyphyodont (having many successive sets of teeth, as fishes and other lower vertebrates compared diphyodont) to Heterodont. (having teeth of different types *e.g* in mammals).

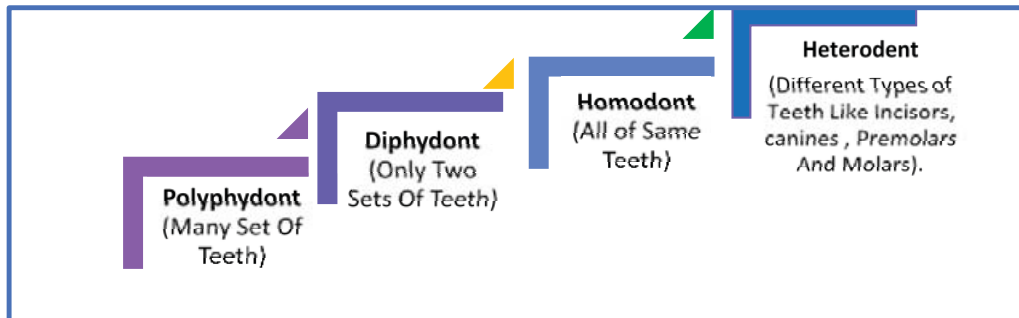


Fig. (1). Evolution of dentition.

There are four stages of Tooth Evolution:

1. The reptilian stage (Haplodont)
2. Early mammalian stage (Triconodont)
3. Triangular stage (Tritubercular Molars)
4. Quadritubercular molars.

**1) The reptilian stage (Haplodont)** is represented by the simplest tooth form—single cone type confined to single hinge movement of the jaw.

**2) Early mammalian stage (Triconodont)** exhibits three cusps in the line of development of posterior teeth. One larger original cusp is located between a smaller cusp anteriorly and another posteriorly.

**3) Triangular stage (Tritubercular Molars)**— According to the study of evolutionary tooth development, three triconodont lines evolved to three cones shaped with teeth still by-passing each other more or less when the jaw is opened or closed. Dogs and other carnivorous (predatory) animals have the tritubercular molar type of dentition.

**4) Quadritubercular stage** shows projection on the triangular form that finally occludes with the antagonist of the opposing jaw. The articulation of the jaws changed accordingly as an accommodation to the changes in the tooth form and anatomy.

## Characteristics of Human Dentition

The teeth of vertebrates characterize depending upon the following:

1. Mode of attachment
2. Number of successive sets
3. Type or Shape of teeth.

### ▪ Based on the Mode of Attachment to Jaw:

Acrodont-- Teeth are attached to the jaw (without socket) by connective tissue.

Pleurodont-- Teeth are directly embedded (fused) inside the jaw.

Thecodont-- Teeth bases enclose into a bony socket.

### ▪ Based on the Number of Successional Teeth sets:

Polyphyodont-- Teeth replaces throughout life. *E.g.*, shark (Unlimited set of successional teeth sets)

Diphyodont-- Two sets of teeth, *e.g.*, human beings (One set of Successional teeth set)

Monophyodont-- One set of teeth, *e.g.*, sheep, goat. (No Successional set of dentitions)

### ▪ Based on the Type or Shape of Teeth

Homodont-- Dentition consists of similar types of teeth.

Heterodont-- Dentition consists of different kinds of teeth, *e.g.*, Incisor, Canine, Premolar, Molar

Thus, Human Dentition characterizes Acrodont, Diphyodont, and Heterodont.

### Development of Dentition-

Dentition refers to the natural teeth in the jawbones. It is defined as the type, number, and arrangement of teeth, or it relates to all the upper and the lower teeth collectively. Humans exhibit two sets of dentitions during their lifetime, Deciduous and Permanent (Diphyodont). Teeth development usually begins in the 5<sup>th</sup> to 6<sup>th</sup> week of IU life. Deciduous teeth generally develop between 6-30 months after birth, depending on the type of tooth. Crown completion and mineralization are completed before the eruption, while root formation continues for 18 months.

## Morphology of Primary Dentition

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**Abstract:** Study of dental morphology or characteristics refers to phylogenetic data related to different species. The morphology of a tooth is affected by the genetic constitution, environmental factors, habit of digit sucking, and a variety of parafunctional habits. Tooth development is a long process that involves interactions at molecular and cellular levels, which are influenced by environmental, genetic, and epigenetic factors. Human dentition is undergoing constant evolutionary changes. However, these changes are occurring at different rates in different geographical populations. Knowledge and information about the morphological features of each primary tooth are crucial for pediatric operative dentistry and forensic dentistry. The mesiodistal dimensions of individual teeth provide important information related to human evolution. The differences in tooth eruption, shape, and size can reflect the process of evolution and provide a method of studying evolutionary mechanisms. Measurements of teeth and dental arches have been used for the description and comparison of different populations or racial groups.

**Keywords:** Crown Size, Mesiodistal Dimensions, Morphology, Primary teeth.

### INTRODUCTION

The study of morphological features of the individual primary teeth is very useful for improving the quality of pediatric operative dentistry. The dimensions of the teeth vary according to race and gender [1]. Data regarding the morphological features and dimensions of teeth are valuable in anthropological studies [1, 2]. Genetic and environmental factors influence tooth size. The tooth size estimation is also crucial for determining the abnormal development of dental occlusion.

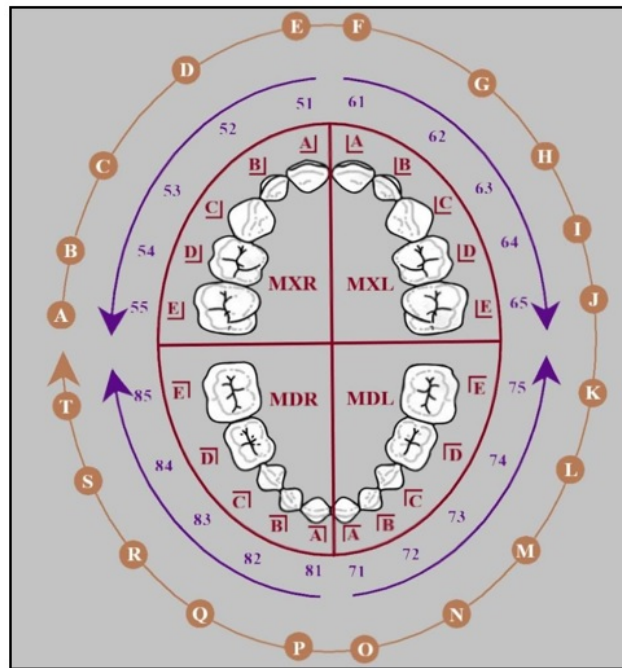
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## Tooth Numbering System

Commonly used tooth numbering systems for teeth identification in dentistry are:

### 1. Universal Numbering System (Figs. 1 and 2):

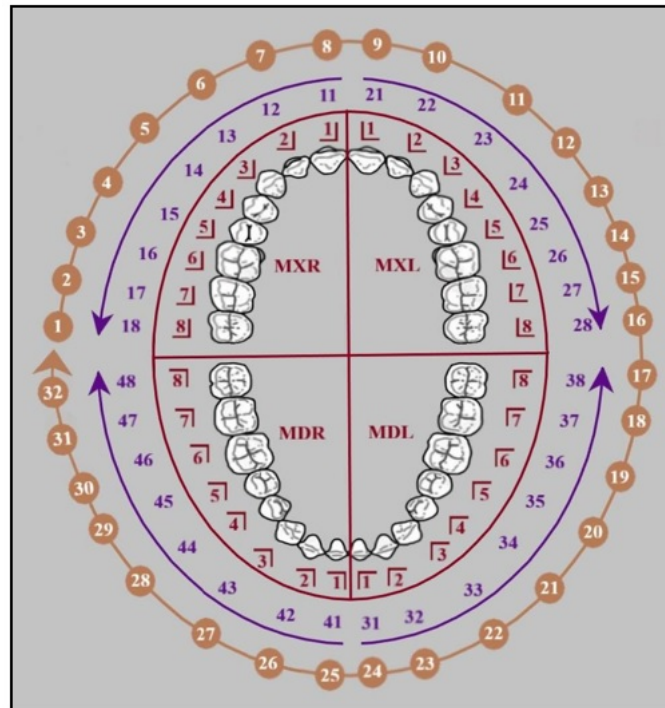


**Fig. (1).** Primary Dentition Numbering system **Brown: Universal Numbering System; Blue: FDI Numbering System; Red: Palmer Notation System.** MXR: maxillary right quadrant, MXL: Maxillary left quadrant, MDL: Mandibular left quadrant, MDR: Mandibular right quadrant.

A: The Primary Universal Numbering System (Fig. 1) was adopted by the ADA in 1968 [3]. The farthest back tooth on the right side of the maxillary jaw is labelled as A. The letters continue along with the maxillary teeth toward the front and across the midline to the farthest back tooth on the left side of the maxillary jaw labelled by the letter J. The letters continue by dropping down to the farthest back tooth on the left side of the mandibular jaw, labelled as K. Letters continue again toward the front and across the midline to the farthest back tooth on the mandibular right side, labelled as T.

B: The Permanent Universal Numbering System (Fig. 2): The ADA adopted it [3]. The farthest back tooth on the right side of the maxillary jaw is numbered as 1. The numbers continue along with the maxillary teeth toward the front and across the midline to the farthest back tooth on the left side of the maxillary jaw,

numbered 16. The numbers continue by dropping down to the farthest back tooth on the left side of the mandibular jaw, numbered 17. Numbers continue again toward the front and across the midline to the farthest back tooth on the mandibular right side, numbered 32.



**Fig. (2).** Permanent Dentition Numbering System. **Brown: Universal Numbering System; Blue: FDI Numbering System; Red: Palmer Notation System.** MXR: maxillary right quadrant, MXL: Maxillary left quadrant, MDL: Mandibular left quadrant, MDR: Mandibular right quadrant.

## 2. Palmer Notation System (Figs. 1 and 2):

A: The Primary Palmer Notation Numbering System [3]: The mouth is divided into 4 sections called quadrants. Vertically mouth is divided into right and left halves by a line passing between maxillary and mandibular central incisors while the horizontal line divides the mouth into maxillary and mandibular arches. The letters A through E and a unique symbol (Fig. 1 red lines) is used to identify the teeth in each quadrant. The letters run from the tooth adjacent to the midline to the farthest back tooth of the mouth on the same side. In the upper right quadrant tooth, A denotes the central incisor; the letters continue to the right and back till the second molar, which is denoted by the letter E. Fig. (1).

## Teething in Children – Fact and Fiction

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**Abstract:** Teething is a natural process of eruption of the first deciduous teeth. Over the years, teething has been blamed for a wide array of childhood illnesses. Hippocrates (fourth century B.C) and others observed that teething was associated with fever, convulsions, diarrhea, and inflammation of the gums. The association of teething with infant mortality was popular in medieval times. By the twentieth century, the controversy surrounding teething subsided and the morbid conditions initially associated with teeth in infants were found to have other causes. It is assumed that the inflammatory mediators present in the dental follicle are responsible for the local symptoms of teething. The most frequent signs and symptoms associated with teething are irritability, drooling, decreased appetite, sleeping problems, rhinorrhea, fever, diarrhea, rash, and vomiting.

**Keywords:** Deciduous teeth, Dental Follicle, Eruption, Teething.

### INTRODUCTION

In Latin, the term teething was known as “*Dentio difficilis*” which means pathologic dentition or difficult dentition. In medical terminology, it is termed “*Odontiasis*” which means the eruption of baby teeth through the gums. Teething is considered an index of normal growth and development of children. In the majority of cases, teething does not cause any distress to the infant, but sometimes it may be accompanied by pain and discomfort. The process of primary teeth eruption commences with the eruption of mandibular incisors around the 4<sup>th</sup>-8<sup>th</sup> month and is completed with the eruption of deciduous second molars at the age of 30-36 months. However, a variation of as much as 6 months may be observed in the timing of eruption. Disturbances associated with the process of teething are transient but may occur repeatedly for 4-36 months.

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## Historical Perspective

The effect of teething on the general health of infants has been documented for more than five thousand years. Teething has been associated with morbidity by Hippocrates, Homer, Celsus and Aristotle. Various conditions include fever, diarrhea, convulsions, photophobia, blinking eyes, vomiting, neuralgia, severe headache, loss of weight, cold, inflammation of tonsils, toxemia, para-paresis, cholera, meningeal infections, tetanus, mental illnesses, and sometimes penile discharge have also been associated with teething. Till the nineteenth century, teething was the cause of a substantial number of infant fatalities. It was believed that the link between teething and life-threatening illnesses was the irritation of nerve endings of the 5<sup>th</sup> cranial nerve in the mucous membrane which led to reflex stimulation of other spinal and cranial nerves. The controversy surrounding teething has subsided in recent decades as morbid conditions initially attributed to teething infants have been associated with other etiologies [1].

## Definitions

1. Teething is defined as the process of sequential appearance of an infant's first primary tooth by emerging through the gums.
2. Teething is the process of teeth eruption through the gums.
3. Tooth eruption is a physiologic process wherein the tooth moves from its developmental position within the alveolar bone to its final position in the oral cavity [2].

## Signs and Symptoms

There is a window of eight days for the eruption of the tooth. It includes 4 days before the eruption, the day of tooth eruption and the 3 days following it. The signs and symptoms associated with teething are summarized in Table 1 and Fig. (1).

**Table 1. Signs and symptoms of teething [3, 4].**

Mild fever	Gastrointestinal upset which ranges from constipation to diarrhea
Lethargy	Lack of sleep/ disturbed sleep/wakefulness
Soreness of gums	Finger sucking
Inflammation of mucous membrane overlying the tooth (with small haemorrhages)	Loss of appetite/alteration in volume of fluid intake
Ear infection	Weight loss
Rubbing of gums/chewing/sucking/biting of objects	Tend to rub ears on the side same as that of erupting tooth

(Table 3) cont....

Mild fever	Gastrointestinal upset which ranges from constipation to diarrhea
General irritability/malaise	Facial flushing /circumoral rash
Gingival pain	Drooling/sialorrhea



Fig. (1). Signs and symptoms of teething.

1. Drooling - The most common manifestation of teething is drooling. This excessive salivation may be due to increased irritation of the gums. From around three to four months of age, drooling is greater than normal.



## **Developmental Disturbances of Oral Structure**

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**Abstract:** Childhood developmental disorders have serious adverse impacts on the psychological and social well-being of children and their families. Despite the burden that developmental disorders impose on children and adolescents, most countries do not provide satisfactory care to those in need. These developmental disorders can either be present as a single finding or as a part of syndrome. This chapter focuses on the developmental disorders affecting the teeth, tongue, and lip. The spectrum of these developmental disorders varies widely. In each case, the anomaly is first described, followed by diagnostic information, including the availability of various treatment options. Early diagnosis is often crucial for the effective treatment of functional and developmental aspects. This will improve the prognosis for better functional and aesthetic outcome for these patients and lead to a better quality of life, not only for the patients themselves but also for their families.

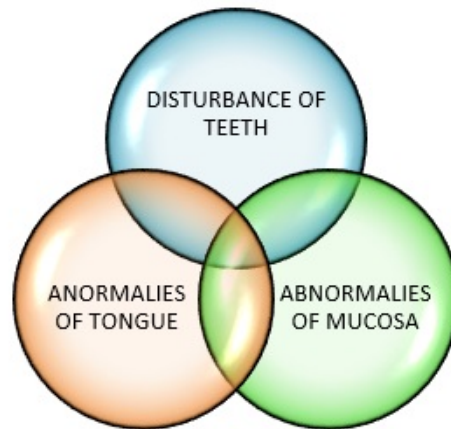
**Keywords:** Developmental disorders, Early diagnosis, Quality of life.

### **INTRODUCTION**

Developmental disorders of teeth, tongue and mucosa are of prime importance in children because of their unsightly appearance and even the loss of functioning sometimes (Fig. 1). Identification of these defects and managing them effectively is the primary task of a Pediatric Dentist. Thus, the knowledge of these conditions can help the Pediatric Dental Surgeon to identify the problem accurately and diagnose & treat it effectively.

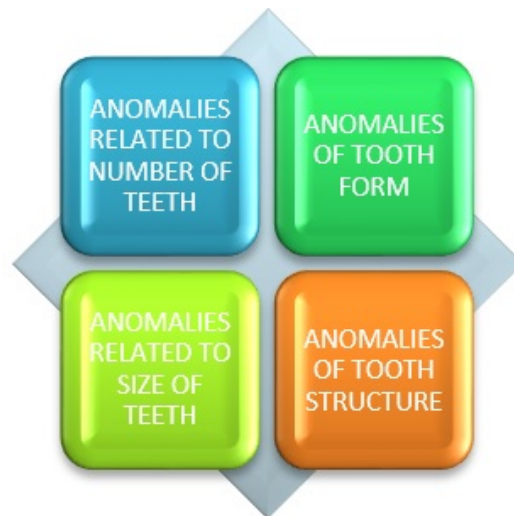
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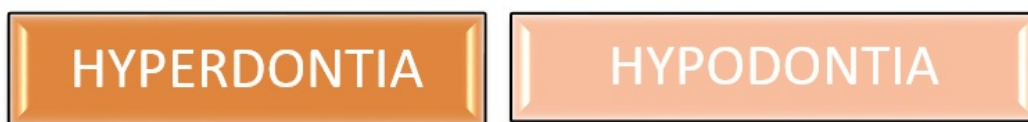
**Fig. (1).** Developmental disturbances of teeth, tongue, and mucosa.

**DISTURBANCES OF TEETH (FIG. 2)**



**Fig. (2).** Disturbances of teeth.

**Anomalies related to number of teeth (Fig. 3)**



**Fig. (3).** Anomalies related to number of teeth.

Alterations in the number of teeth result due to interruptions in the normal developmental stages.

### ***Hyperdontia***

- In this condition, teeth are more than normal in number and these extra teeth are known as ‘supernumerary teeth’.
- Associated syndromes include Apert’s syndrome, Gardner syndrome, Cleidocranial dysplasia and Sturge Weber syndrome.
- Different theories have been mentioned in the formation of the supernumerary tooth which include:
  - Hyperactivity theory suggests that supernumeraries are formed as the result of hyperactivity of dental lamina.
  - Dichotomy of tooth bud.
- Hyperdontia more frequently occurs in the upper arch compared to the lower arch (Fig. 4). Most found supernumerary tooth is Mesiodens. Males are more commonly affected, with a male to female ratio of 2:1.
- Horizontal proliferation or hyperactivity of the permanent or deciduous dental lamina are the reasons for the development of the majority of supernumerary teeth.
  - i. Supplemental supernumerary teeth duplicate the typical position and structure of anterior and posterior teeth.
  - ii. Rudimentary supernumerary teeth are dysmorphic & may assume conical forms. This condition is generally found in some syndromes, such as Cleidocranial dysplasia, Gardner’s syndrome, Orofacial digital syndrome, *etc.*



**Fig. (4).** Hyperdontia: ectopically erupted rudimentary supernumerary seen on the palate.

### **Treatment**

- Management is based on the type and position of the supernumerary tooth and its potential effects on the adjacent tooth. Hypodontia in a young child.

## Lesions of Oral Mucosa

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**Abstract:** In children, lesions of the oral mucosa are common, and they can have various clinical signs such as ulceration, changes in the colour of mucosa or the presence of nodular lesions. Some lesions are asymptomatic, whereas others are symptomatic and sometimes even can disturb the routine activities of a child. It is important that, while evaluating the soft tissue lesions, dentists should be able to distinguish between normal, pathological conditions and normal anatomical variations. Sometimes children can present with oral mucosal lesions like those present in adults with a predisposition for some lesions. It was also observed that most of the common oral diseases were dental caries and mucosal diseases associated with cancer treatment. In literature, there is a scarcity of information about oral lesions in children. This chapter explains various oral mucosal lesions in children along with their clinical presentation and management.

**Keywords:** Children, Color Change, Oral Lesions, Soft Tissue Nodules.

### INTRODUCTION

Oral mucosal lesions always appear frightening to patients, especially in the pediatric age group. The clinical features of oral mucosal lesions can show variation and differ from common oral pathologies seen in adults. As substantial literature is found in the oral cavity of a child (Fig. 1), it becomes important to make an accurate diagnosis and the right treatment plan. Thus, a Pediatric dentist should be knowledgeable in identifying these conditions to alleviate the fear of the parents, and in counselling for treatment, as per the need.

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<p><b>WHITE LESIONS</b> Geographic tongue Geographic tongue Candidiasis White sponge nevus</p>	<p><b>AUTOIMMUNE DISORDERS</b> Pemphigus/pemphigoid Systemic Lupus erythematosus Ectodermal dysplasia Papillon-lefevre syndrome Apthous stomatitis</p>	<p><b>PIGMENTED LESIONS</b> Hereditary hemorrhagic telangiectasis Hemangioma Sturge Weber Syndrome Black hairy tongue</p>
<p><b>VESICULAR ERYTHMATOUS AND ULCERATIVE LESIONS</b> Primary herpetic gingivostomatitis Herpangina</p>	<p><b>LESIONS OF BACTERIAL ORIGIN</b> Impetigo Scarlet fever Syphilis Tuberculos gingivitis Actinomycosis Noma</p>	<p><b>SOFT TISSUE ENLARGEMENTS</b> Reactive tumors/ neoplasms</p>
		<p><b>IDIOPATHIC LESIONS</b> Pterygoid ulcer/ Bednar ulcer</p>

Fig. (1). Different oral mucosa lesions in children.

### White lesions of the Oral Cavity (Fig. 2)

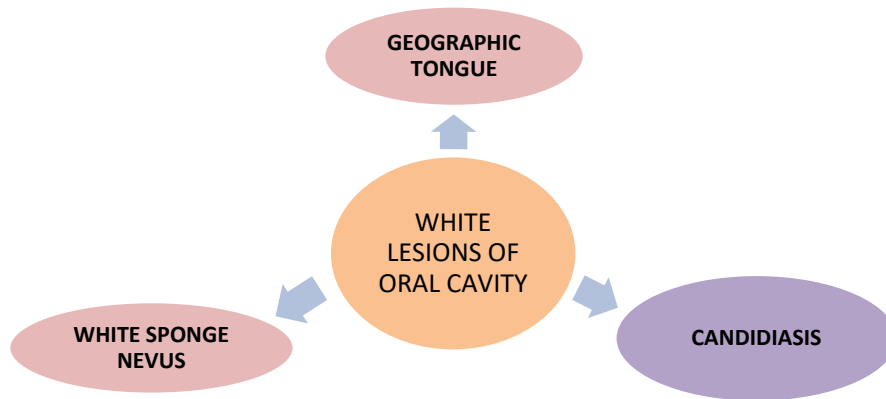


Fig. (2). White lesions of Oral Cavity (Representative diagram).

### *Benign Migratory Glossitis (Geographic Tongue)*

- Patchy, multifocal, circinate, sharply demarcated and irregular areas of surface erosion, characterized by the loss of filiform papillae constitute the lesions of the geographic tongue. At the periphery, whitish serpiginous lines at least partially surround the lesions. The fungiform papillae remain. They may show evidence of swelling and erythema. Most of the cases are asymptomatic. Some patients complain of glossodynia (Fig. 3).
- The lesions wax and wane. Remissions occur, and during recurrence, the lesions appear in various locations. The apparent movement of the lesions and the geographical appearance of the lesion have led to the descriptive terminology. Psychological stress is associated with this condition and is also seen in people with psoriasis.
- Microscopically, filiform papillae are lost with a spongiotic abscess (Monroe's abscess) appearing in the epithelium. This appearance, including the presence of

neutrophils, is like that seen in Reiter syndrome and psoriasis. A mild chronic inflammatory infiltrate is seen in underlying connective tissue [1].



**Fig. (3).** Benign migratory glossitis.

### **Treatment**

- Usually, no treatment is required.
- In severe cases, topical steroids like prednisolone and antifungals can be prescribed.

### ***Candidiasis/Moniliasis***

- Candidiasis or Oral thrush is a common opportunistic fungal infection in infants and neonates. The spectrum of infections caused by species of *Candida* includes infections of the nails, skin, mucous membrane, and internal organs. *Candida albicans* is the commonest causative agent.
- The factors which predispose to Candidiasis include infancy, pregnancy, immunosuppression, prolonged use of wide-spectrum antibiotics and malnourished state.
- Candidiasis which affects neonates, is known as acute pseudomembranous candidiasis. It is characterized by multiple white, curdy, loosely attached patches on any part of the oral mucosa. Preferred sites are the buccal mucosa and tongue. The patches can be easily wiped off with a wet gauze piece leaving a denuded, erythematous surface (Fig. 4).
- Diagnosis by PAS stain is of importance. It shows thread-like magenta-coloured hyphae and budding spores [1].

## SUBJECT INDEX

### A

- Abeer children dental anxiety scale (ACDAS)  
36, 37
- Abscess, spongiotic 353, 363
- Achondroplasia 242, 243
- Acid-fast bacillus *Mycobacterium* 383
- Acidification 155
- Acidifying resorption lacuna 260
- Acids 102, 103, 106, 107, 108, 110, 112, 119,  
121, 135, 137, 142, 163, 172, 173, 174,  
369, 379
  - decay-causing 163
  - folic 379
  - lactic 106, 107
  - natural 107
  - organic 110, 121
  - tranexamic 369
- Actinomyces 384
- Actinomyces 103
- Actinomycosis 384, 385
- Activity 31, 47, 89, 90, 106, 114, 123, 142,  
255, 375, 388
  - glucosyltransferase 142
  - mitotic 388
  - reinforcers 89
  - salivary amylase 142
- Acute 131, 364, 367
  - apical abscess 131
  - herpetic gingivostomatitis 367
  - pseudomembranous 364
- Adrenogenital syndrome 323
- Adsorption 139, 383
  - treponemal antibody 383
- Aerobic dehydrogenase transfers 115
- Aggressive periodontitis 378
- Allergic reactions 341, 358
- Aluminium hydroxide 367
- Alveolar margins 237
- Amalgam tattoo 321
- Amelogenesis 175
- American 11, 92, 130, 183
  - Academy of Pediatric Dentistry 11, 92, 183
  - Association of Endodontists (AAE) 130
- Amphotericin 365
- Amyloidosis 349
- Anaemia 382, 386
- Anaesthesia 14
- Angiography 371
- Animal assisted therapy (AAT) 98, 99
- Animated emoji scale (AES) 39
- Ankyloglossum superium syndrome 350
- Anodontia hypodontia 289
- Anorexia 136, 383
- Antegonial Notch 240
- Anti-angiogenic effects 370
- Antibacterial 119, 174, 188
  - agents 119
  - defenses 174
  - effect 188
- Antibiotics 364, 381
  - oral 381
  - wide-spectrum 364
- Anti-cariogenic effects 140, 159
- Antifibrinolytic agents 369
- Antifungal agents 358
- Anti-inflammatory 319, 379
  - agents 379
  - effects 319
- Antimalarial drugs 375
- Antimicrobial action 159
- Antinuclear antibodies 375
- Anti-tubercular regimen 384
- Antiviral agents 367
- Apert's syndrome 329
- Applied behaviour analysis (ABA) 96
- Aromatherapy 96, 97
- Asymptomatic 130
  - apical periodontitis 130
  - irreversible pulpitis 130
- Atopobium 103
- ATP technique 96
- Audio analgesia 83, 94
- Audio tactile performance technique 96

Audio-visual distraction 64, 91, 92  
  aids 64  
Austrian psychoanalyst 43  
Autism spectrum disorders 99  
Autoantibodies 374  
Autoimmune disorders 373  
Autosomal dominant disorder 346

## B

Bacitracin 113  
Bacteria 102, 103, 105, 106, 107, 108, 110,  
  111, 114, 119, 120, 139, 140, 142, 145,  
  146, 186, 187  
  acidogenic 142  
  acid-resistant 106  
  aciduric 108, 111  
  aerobic 105  
  anaerobic 103  
  oral 146  
  salivary 114  
Bacterial 106, 115, 142, 383  
  digestion 142  
  enzyme 115  
  infection 106, 383  
Bacteriocins 187  
Bacteroides 103  
Beckwith-Widermann syndrome 349  
Bednar's Ulcer 380  
Behaviour 32, 42, 68, 71  
  evaluation scale (BES) 32  
  learning theories 42, 68, 71  
  profile rating scale (BPRS) 32  
Behaviour management 19, 41, 82, 83, 100  
  of children 83  
  techniques 19, 41, 83, 100  
  non-pharmacologic 82  
Behcet syndrome 379  
Beverages 138, 172, 177, 181  
  cold 181  
  sugar-containing 138  
  sweetened 177  
Bifidobacterium 103  
Bifurcation 305, 307, 311

Binders syndrome 243  
Biological causative factor 106  
Biological therapies 375  
Black 142, 355, 372  
  hairy tongue 355, 372  
  tea extract 142  
Bolton's tooth ratio 286  
Bone 192, 196, 199, 203, 204, 207, 209, 212,  
  217, 223, 229, 231, 233, 234, 236, 237,  
  238, 239, 240, 241  
  craniofacial 192  
  deposition 207, 209, 223, 233, 234, 236,  
  237, 238, 240, 241  
  endochondral 217, 231  
  endosteal 239  
  ethmoid 229  
  forming elements 207  
  growth 196, 199, 203, 207  
  metabolism 196  
  neighboring 209  
  remodeling theory 204  
  translation 209  
  zygomatic 212, 237  
Bone formation 231, 236  
  tension-related 236

## C

Calcium 113, 122, 134, 140, 141, 142, 161,  
  187, 188, 341  
  bioavailable 187  
  silicophosphate 188  
  sucrose phosphate 188  
Canals, gubernacular 260  
*Candida albicans* 364  
Candidiasis 364, 365  
Capsule 209, 224, 229  
  enveloping 209  
  nasal 224  
  orofacial 209  
  otic 229  
Carbohydrates 106, 107, 119, 121, 138, 139,  
  143, 151, 152, 153, 154, 160, 165, 171  
  dietary 152, 165



- fermentable 119, 138, 143
- Caries 123, 128, 135, 185
  - assessment spectrum and treatment (CAST) 123, 128
  - classification system (CCS) 123
  - lesions 135, 185
- Caries on proximal surfaces 127
  - of anterior teeth 127
  - of posterior teeth 127
- Cariogenic 105, 107, 135, 159, 160, 173, 182
  - bacteria 105, 107, 173
  - environment 182
  - microorganisms 105, 135, 160
  - plaque bacteria 159
- Cariostat test 111
- Carious lesions, micro-cavitated 135
- Cartilage 205, 206, 207, 208, 209, 211, 212, 224, 229, 232
  - cone-formed 232
  - growth 212, 232
  - nasal paraseptal 224
  - nasoseptal 206
- Cartilaginous theory 204, 205
- Casein phosphopeptides 188
- Cavities 17, 30, 102, 107, 118, 127, 128, 133, 135, 143, 321, 357
  - cystic 321
  - primitive oral 357
- Cementoblast 255
- Cementum deposition 255, 334
- Cephalocaudal development 197
- Cerebral palsy 94
- Cheese 140, 142, 148, 163
  - consumption 140, 142
- Cheilitis granulomatosa 351, 358
- Chhota bheem chutki (CBC) 38
- Child behaviour management 4
- Childhood 315, 327, 359
  - developmental disorders 327, 359
  - illnesses 315
- Child 14, 41, 42, 75
  - management 14
  - psychology 41, 42, 75
- Children 1, 3, 57, 79, 97
  - abused 79
  - compromised 97
  - dental health of 1, 3
  - healthy 57
- Chilled teething 319
- Choline salicylate preparations 319
- Chondroectodermal dysplasia 335
- Chronology 263
- Cleidocranial dysplasia 329
- Cognitive 30, 50, 58, 59, 67, 85, 98
  - development 58, 59, 67, 85, 98
  - distortions 30, 50
  - theory 58
- Collagen fiber bundles 260
- Communities 57, 104, 105, 137, 144, 150, 186
  - microbial 105
  - polymicrobial 104
- Comorbidities, systemic 339
- Components 5, 225, 343
  - mesodermal 343
  - neural 225
  - of pediatric dentistry 5
- Composite resin restorations 343
- Condition 115, 315, 316, 322, 329, 330, 334, 335, 336, 339, 340, 345, 346, 348, 349, 351, 352, 353, 355, 362, 371, 372, 374, 388
  - aerobic 115
  - dermatologic 374
  - genetic 349
  - life-threatening 371
  - morbid 315, 316
  - premalignant 388
  - teeth 330, 334
- Conducted restriction endonuclease analysis 129
- Condylar processes 241
- Cone-funnel mechanism 278
- Confectionery industry 149
- Congenital 242, 323, 343, 348, 349, 352, 382
  - anomalies 242
  - heart disease 352
  - macroglossia 349
  - syphilis 323, 343, 348, 382
- Conjunctivitis 383
- Conservative restorations 188

- Constructivism 64
  - Consumption 122, 139, 141, 143, 151, 154, 155, 156, 157, 158, 160, 177, 352
    - alcohol 352
    - fat 151
    - restricting total carbohydrate 156
  - Contractile filaments 260
  - Contraction bone formation 259
  - Corah's dental anxiety scale (CDAS) 32, 33
  - Coronoplasty 291
  - Corticosteroids 367, 371, 374, 375
    - systemic 371, 374
  - Corticosteroid therapy 374, 375
    - aggressive systemic 374
  - Counseling, genetic 345
  - Cow's milk 142
  - Coxsackie viruses 368
  - Cranial base 195, 202, 219
    - prediction 219
    - synchondroses 195, 202
  - Craniofacial 205, 213, 219, 243, 323
    - dysostosis 323
  - Crouzon syndrome 330
  - Crown 343, 345
    - polycarbonate 345
    - stainless steel 343, 345
  - Cutaneous lesions 370
  - Cybernetic(s) 212
    - principles 212
    - theory 212
  - Cyclophosphamide 374
  - Cyclopia 323
  - Cysts, dental laminal 322
- D**
- Dark field microscopy 383
  - Decayed, missing and filled (DMF) 123, 148
  - Deep developmental groove 291
  - Defects 168, 244, 325, 327, 330, 342, 344, 365, 371, 383, 388
    - facial 383
    - fissure 168
    - multilocular radiolucent 371
    - neurological 342
  - Deficiency, masticatory 178
  - Defined thaumatogy 98
  - Demineralising effect 137
  - Demineralization process 106, 121, 122
  - Dental 3, 5, 6, 11, 14, 15, 16, 19, 27, 30, 31, 33, 37, 39, 53, 54, 56, 75, 78, 79, 80, 81, 85, 86, 88, 92, 96, 97, 98, 99, 100, 102, 104, 105, 106, 108, 131, 133, 134, 135, 139, 157, 183, 246, 254, 251, 255, 265, 290, 295, 315
    - ailments 6
    - anxiety 16, 19, 27, 30, 33, 37, 39, 80, 92, 97, 100
    - biofilms 102, 104, 105, 106
    - capacity system 11
    - decay 134
    - diseases 16, 133, 134, 183
    - disorders 265
    - erosion 139
    - fear and anxiety assessment 31
    - follicle 315
    - health problems 157
    - infection 5
    - intervention 16
    - maturation 246
    - occlusion 295
    - operation 81
    - papilla 251, 255, 290
    - plaque and biofilm 104
    - problems 92
    - restoration 108
    - surgeons 11, 14, 15
    - trauma 5
    - treatment 11, 14, 15, 27, 30, 75, 78, 79, 80, 85, 86, 88, 98, 99
  - Dental care 6, 10, 34, 102, 177
    - disparities 10
    - services 10
  - Dental caries 107, 119, 123, 147, 161, 170, 171, 182
    - incidence 123, 147
    - pathogenesis 107
    - prevention 161
    - process 171

progression 119, 170, 182  
Dentinal dysplasia 346  
Dentin 346, 347  
    deposition 346  
    dysplasia 346, 347  
    dysplasia 346, 347  
Dentistry, forensic 295  
Deposition 212, 236, 237, 239, 240, 255, 259, 375  
    mucin 375  
    rhythmic 255  
Desensitization 24, 28, 82, 83, 84, 88  
    systematic 84  
    techniques 28, 88  
Developing zygomatic bone 223  
Development, craniofacial 134, 204  
Developmental 168, 181, 311, 354, 355  
    defects 168, 181, 354  
    depression 311  
    lesions of oral mucosa 355  
Developmental disorders 327, 359  
    of teeth 327  
Developmental condition 337, 371  
    nonhereditary 371  
Development disorders 12, 359  
Dewar's test 113  
Diaper dermatitis 374  
Diarrhea 315, 316, 317, 318  
Dichotomy 329  
Diet 134, 135, 137, 140, 161, 185  
    balanced 140, 161, 185  
    cariogenicity of 135, 137  
    nutritious 134  
Dietary restrictions 151  
Differential emotions theory 21  
Diffuse radiopaque lesion 131  
Digital syndrome 329, 350  
    oral-facial 350  
Disease 102, 103, 107, 127, 133, 135, 136, 143, 149, 165, 166, 169, 172, 173, 176, 179, 181, 291, 362, 374, 375, 381, 383, 384  
    bacterial 143  
    chronic 136, 149, 172  
    chronic microbial 102, 103

    common non-communicable 143  
    dynamic 135  
    fibrosing 384  
    granulomatous 383  
    metabolic 291  
    mucosal 362  
    multifactorial 107  
    pandemic 169  
    transmissible 173  
Disorders, inherited 376  
Display enamel hypoplasia 268  
Distal 308, 311, 312, 313  
    developmental groove 308  
    triangular fossa 308, 311, 312, 313  
Distolingual cusp 305, 306, 307, 308, 311, 312  
Distraction techniques 91, 92, 98  
DNA, digest 129  
Down syndrome 243, 331, 351  
Dubowitz syndrome 331  
Dysfunction 48, 49, 289, 290  
Dysplasia 388

**E**

Eating disorders 136  
ECC lesions 168, 182  
Echoviruses 368  
Ecological plaque hypotheses 173  
Ectodermal dysplasias 330, 331, 376  
Ectomesenchyme 264  
Eczema herpeticum 374  
Edema 375  
Egocentrism 62, 63, 65, 66  
Ehlers-Danlos syndrome 330  
Electrocautery 369  
Embryogenesis 243, 354  
Enamel hypoplasia 150, 175, 292, 341, 342, 343  
    enamel dysplasia 292  
Encephalopathy 319  
Encephalo-trigeminal angiomatosis 371  
Endochondral growth 239  
Endocrine dysfunction 323

- Endodontic 290, 337, 344, 345, 346
    - intervention 337, 344, 345
  - Endodontic therapy 291, 331, 334, 338, 339
    - non-surgical 334
  - Energy 46, 48, 159, 160, 161, 189
    - psychosexual 46
  - Enlow's counterpart principle 213
  - Enterococcus faecalis* 103
  - Enteroviruses 368
  - Environment 23, 24, 30, 52, 58, 60, 64, 65, 71, 80, 135, 136, 139
    - abnormal oral acid 136
    - dental office 80
  - Environmental factors 123, 135, 192, 193, 206, 211, 212, 214, 215, 295
  - Enzymes 106, 139, 160
    - metabolizing 160
    - salivary 139
  - Epidemiologists 127
  - Epigenetic 214
    - antithesis 214
  - Epithelial cells 254
  - Epithelium 106, 250, 254, 264, 353, 363, 374
    - odontogenic 250
    - oral 254
  - Erik Erikson's psychosocial theory 52
  - Erupting 170, 259, 316, 318, 321
    - teeth 170, 321
    - tooth 259, 316, 318, 321
  - Eruption 11, 246, 248, 249, 257, 258, 263, 264, 265, 269, 275, 278, 282, 284, 285, 315, 316, 318, 320, 321, 322, 323
    - cyst 320, 321
    - hematoma 320, 321
    - mandibular 263, 264
    - maxillary 263, 264
    - of posterior teeth 282, 318
    - permanent molar 275, 278
    - tooth's 258
  - Erythema 353, 363, 376, 381
    - diffuse 381
  - Erythrotoxic exotoxin 382
  - Erythromycin 385
  - Essential oil therapy 96
  - Evaluation 12, 25, 108, 161, 322, 339, 359
    - radiographic 322
  - Events 20, 49, 50, 63, 66, 96, 228, 246, 258, 263, 265
    - blocking external 49
    - maturational 246
  - Exfoliation 246, 258, 263, 264, 275, 284, 347
    - mandibular 263, 264
    - maxillary 263, 264
  - Extracellular polymeric substances (EPSs) 105
- F**
- Facial 37, 241, 242,
    - hemiatrophy 242
    - hemihypertrophy 242
    - image scale (FIS) 37
    - imaging system 241
  - Factors 177, 230, 263
    - neurotrophic 230
    - pathological 177
    - preconception 263
  - Fatigue 41, 374
  - Fermentable carbohydrates polysaccharides 161
  - Fever 315, 316, 318, 325, 352, 368, 369, 374, 381, 382, 383, 386
    - and congenital heart disease 352
  - Fibrinoid necrosis 375
  - Flat-topped papular lesions 356
  - Flooding technique 83, 87
  - Fluoridated toothpastes 141, 187, 345
  - Fluorosis 342
  - Focal 330, 331, 356
    - dermal hypoplasia 330, 331
    - epithelial hyperplasia 356
  - Foetal teeth 268
  - Food 141, 163, 351
    - debris 351
    - diaries 141
    - intake 163
  - Foods 122, 134, 135, 138, 139, 140, 142, 144, 150, 151, 155, 156, 157, 161, 162, 163, 171, 172, 185

carbohydrate-containing 157  
cariogenic 139  
sugary 122, 144, 162, 185  
Formation, microcolony 105  
Fosdick calcium dissolution test 112, 113  
Frankl behaviour rating scale (FBRs) 32  
Frankl's behaviour rating scale 79  
Frenulectomy 350  
Freud's 43, 44  
    developmental theories 44  
    topographical 43  
Fructose 106, 122, 139, 143, 144, 151, 153, 154  
    hepatic 151  
Fructosemia 151  
Fucosidosis 331  
Functional matrix 204, 208, 210, 211, 214  
    hypothesis (FMH) 208, 214  
    theory 204, 208, 210, 211, 214  
Functions, orofacial 244  
Fusobacterium 103, 385  
    nucleatum 385

**G**

Gardner's syndrome 329  
Gardner syndrome cleidocranial 329  
Gastroenteritis 171, 383  
Gene(s) 19, 106, 176, 192, 194, 196, 343, 369, 378  
    expression 106  
    inherited 19  
    regulation 196  
Genetic 27, 147, 171, 173, 176, 204, 205, 211, 214, 249, 263, 295, 378  
    constitution 295  
    diversity 173  
    factors 147, 171, 176, 214, 249, 263  
    mutations 378  
    theory 204, 205, 211  
    vulnerability 27  
Genital organ growth acceleration 216  
Geomorphology 313  
Germicidal agent 186

Gestation 175, 357  
GI disturbances 379  
Gingival margin 178, 179  
Glass 66, 122, 188, 343  
    bioactive 122, 188  
    ionomer cement 343  
Glaucoma 372  
Glossectomy 349  
Glossodynia 353, 363  
Glucans 106, 121, 144, 145  
    insoluble 145  
    water-insoluble 144, 145  
Glucocorticosteroids 375  
Glucosyltransferases 106  
Glyoxide rinse 367  
Granuloma 374, 383  
Granulomatous clusters 358  
Grooves 187, 223, 227, 266, 274, 291, 306, 344, 350, 351  
    anatomic 187  
    gingival 266  
    nasolacrimal 227  
    supplementary 306  
    transverse 266  
Growth 2, 192, 196, 199, 202, 205, 211, 214, 223, 235, 236, 259, 267, 318, 371  
    acceleration of 199, 223  
    brain 192, 202  
    cephalic 214  
    chondrocranial 211  
    displacement theory 259  
    facial 223  
    factors 196, 211, 318  
    hormone 196  
    mandibular arch 267  
    maturity 192  
    nasomaxillary 235  
    of maxillary tuberosity 235  
    of surrounding soft tissue transform 236  
    orofacial 2, 205  
    tumour 371  
Gubernacular cord 260

**H**

Habits 16, 47, 150, 162, 163, 169, 181, 263, 295  
 dietary 163, 169, 181, 263  
 tooth care 162  
 Haemorrhage 324, 386  
 Hallucination 319  
 Hand-wrist radiograph 217  
 Harvesting method 155  
 Health care 2, 16, 20, 141  
 effective oral 20  
 therapeutic oral 2  
 Healthcare system 165, 189  
 Heck disease 356  
 Hemangiomas 321, 349, 370, 370, 371  
 developed 370  
 Hemangiomatous, massive 372  
 Hemihypertrophy 333  
 Hemorrhagic 369, 370  
 telangiectasia 369  
 telangiectasis 370  
 Hepatosplenomegaly 382  
 Herpangina 368  
 Herpes simplex 366  
 Heterotopic lobular aggregations 356  
 Homoeopathic oils 325  
 Hutchinson teeth 382  
 Hydroxyapatite 119, 122, 140  
 Hyperactivity theory 329  
 Hyperdontia 329  
 Hyperkeratosis 388  
 Hyperplasia 388  
 Hypersensitive 30, 155  
 Hyperthermia 94  
 Hypnosis 83, 95  
 Hypocalcaemia 150  
 Hypodontia 289, 329, 330, 331  
 Hypohidrosis 376  
 Hypomineralisation of enamel 175  
 Hypoplasia 168, 175, 176, 341, 342, 343  
 Hypoplastic teeth 343

**I**

IgG immunoglobulins 174  
 Illnesses 197, 316, 366  
 acute 366  
 life-threatening 316  
 mental 316  
 Imagination 60, 92  
 mental 60  
 Immune 106, 176, 187, 375  
 defenses 106  
 response 176, 187  
 system 375  
 Immunoglobulin 374  
 Immunohistochemistry 367  
 Immunological impairment 379  
 Immunosuppression 364  
 Immunosuppressive drugs 375  
 Incisor transition 276  
 Infantile cortical hyperostosis 242  
 Infections 316, 385, 388  
 ear 316  
 meningeal 316  
 mucosal HPV 388  
 stomatitis 385  
 Infectious disease 105  
 Infiltrate 354, 364, 386, 387  
 dense inflammatory cell 386  
 mild chronic inflammatory 354, 364  
 mild inflammatory 354  
 Inflammation 130, 315, 316, 318, 357, 374, 387  
 Inflammatory reaction 131  
 Influence, skull cartilages 211  
 Inhibition 135, 140, 197, 330  
 stress display 197  
 Injury 92, 206, 290, 324, 334  
 traumatic 290, 334  
 Insulin 196  
 Intake 139, 140, 152, 156, 157, 161, 316, 368  
 dietary 161  
 fluid 316  
 Interactive computer-based software 97  
 Interplay host factors 165

Interstitial keratitis 382  
Intervention 11, 16, 31, 136, 166, 176, 182,  
258, 358, 359, 387  
    medical 16  
    preventive 136  
    surgical 182, 258, 358, 387  
    therapeutic 166, 176  
Intracellular cytoplasm 186  
Ions 119, 121, 122  
    ammonia 122  
    mineral 119

**J**

Junction 203, 204, 240, 255, 257, 258, 345  
    cementoenamel 255, 257, 258  
    ramus corpus 240

**K**

Kawasaki disease and scarlet fever 353  
Keratin 355, 365, 372  
    microfilaments 365  
    production 355, 372  
Keratinocytes 374  
Keratomalacia 343  
Klinefelters Syndrome 243

**L**

Labial inclination 274, 300  
Labio-lingual crown inclination of maxillary  
    287  
    incisors 287  
Leptotrichia 103  
Lesion(s) 123, 125, 126, 127, 128, 138, 147,  
168, 173, 187, 188, 353, 354, 358, 362,  
363, 365, 368, 380, 387, 384, 388, 390  
    formation 147  
    progression 173  
    genital 368  
    granulomatous 358  
    intraoral 390  
    labial-lingual 168

    of idiopathic etiology 380  
    oral 362, 368, 384, 390  
    severity 123, 125, 138  
Leucomethylene 115  
Leukocytosis 382, 386  
Leukoplakia 352  
Leukotrienes 318  
Life 47, 356  
    child's fantasy 47  
    embryonic 356  
Lingual 127, 178, 179, 180, 181, 230, 231,  
237, 238, 239, 278, 291, 300, 306, 308,  
309, 312, 337, 356  
    cusps 278, 291, 312, 337  
    developmental groove 308  
    facial 179  
    mucosa 356  
    nerve 230  
    tuberosity 237, 238  
Lingual extension 250  
    dental lamina's 250  
Lips 7, 93, 285, 286, 292, 327, 357, 369, 377,  
383, 385, 389  
    protuberant 377  
Long-lasting sources of sugars 138  
Loss 17, 127, 162, 178, 181, 316, 318, 327,  
334, 353, 363, 375  
    memory 375  
Lung destruction 383  
Lymphangioma 321, 349  
    alveolar 321  
Lymphocytes 358, 375, 384

**M**

Macro glossia, secondary 349  
Macrostomia 243  
Malnutrition 175, 195, 263  
Malocclusion 56, 200, 218, 265  
Mandibular 166, 179, 180, 200, 205, 206, 212,  
219, 223, 225, 226, 231, 237, 266, 267,  
269, 270, 271, 273, 274, 278, 281, 283,  
285, 286, 289, 291, 296, 297, 298, 299,  
301, 309, 345, 356

- anterior 345
- arch 179, 180, 223, 225, 266, 270, 271, 278, 285, 297, 298, 299
- canines 271, 309
- condylar cartilage 205
- condyle resorbs 206
- dental arch 212
- growth 219, 237
- nerve 231
- process 225, 226, 356
- prognathism 200
- retrognathism 267
- Marfans syndrome 243, 331
- Masticatory 196, 292
  - muscle hyperfunction 196
  - system 292
- Maturation 21, 58, 107, 174, 192, 197, 343
  - bacterial 107
  - progressive 58
- Maturity 19, 92, 192, 193, 197, 217, 218
  - skeletal 217, 218
  - somatic 218
- Maxilla mandible 280
- McElroy's statement 78
- Meal snacking 177
- Meckel's cartilage ossification 230
- Median 226, 354
  - nasal process 226
  - rhomboidal glossitis 354
  - rhomboid glossitis 354
- Medicines 10, 146, 320, 373
  - social 10
  - sugar-based 146
- Memory restructuring 83
- Mental 42, 43, 44, 202, 233, 241
  - ossicles 233
  - processes 42, 43, 44, 202
  - protuberance 241
- Mesenchyme 223, 291
- Mesial triangular fossa 306, 308, 311, 312
  - well-developed 312
- Mesio-distal crown angulation 286
- Mesiolingual cusp 305, 307, 308, 311, 312
- Metabolic 107, 115, 186
  - activities 107, 115
  - pathways 186
- Metalloproteinase 379
- Methods 12, 186, 217
  - age-appropriate oral hygiene 12
  - carpel bone 217
  - economical 186
- Methylene blue 115
- Microabrasion 343
- Microbial glycosyltransferases 144
- Microdontia 290, 332
- Microglossia 349
- Micrognathia 242, 243
- Microorganism(s) 103, 105, 106, 110, 112, 115, 118, 119, 121, 129, 139, 143, 160
  - acid-producing 143
  - aerobic 115
  - oral 129
  - sorbitol-fermenting 160
  - transmission 129
- Microstomia 243
- Midfacial deformities 206
- Milk 115, 122, 138, 142, 143, 148, 162, 163, 178, 383
  - drinks 138
  - sterile 115
  - unpasteurized 383
- Miniature glass electrodes 155
- Modified 33, 34, 339
  - child dental anxiety scale (MCDAS) 33, 34
  - obturation technique 339
- Mongoloid ancestry- Chinese 337
- Morphogenesis 260
- Motivational theory 72
- Mount-Hume system 128
- Mouth disease 368
- MR syndrome 351
- Mucosa 224, 327, 328, 362, 365, 369, 374, 383, 385
  - alveolar 365, 383
  - gingival 385
  - oropharyngeal 369
- Multifactorial theory 211
- Multinucleation 367
- Murine monoclonal 367



**N**

Nasal septum 205, 206, 212, 234  
 cartilage 205, 206  
 Theory 205  
 Nasocapsular theory 205  
 Natal teeth 268, 322, 323  
 Nausea 97, 151, 381  
 Necrosis 131, 319, 385  
 renal tubular 319  
 Neonatal 11, 268, 322, 323, 324, 349  
 hypoglycemia 349  
 teeth 11, 268, 322, 323, 324  
 tooth 323  
 Neonates 259, 266, 364, 381  
 Nerves 209, 223, 230, 371  
 inferior alveolar 230  
 trigeminal 230, 371  
 Nervous system 210  
 Neurofibroma 349  
 Neuromuscular trophism 210  
 Neurotropism 210, 211  
 Neutrophils 354, 364  
 Nitrous oxide inhalation 82  
 Non-communicable disease (NCD) 133, 143  
 Non-genetic environmental factors 212  
 Nutritional deficiencies 341  
 Nutrition counseling-dietary 185

**O**

Obstetricians 189  
 Occlusal aspect-occlusally 311  
 Occlusal surface narrow buccolingually 300  
 Occlusal surfaces 93, 126, 127, 179, 180, 187,  
 305, 306, 308, 311, 312  
 Odontiasis 315  
 Odontoblast 255  
 Odontogenesis 243, 249  
 Odontogenic cyst 242  
 Odontogenic tumour 242  
 Odontolyticus 384  
 Odontoma 290  
 Oil 96, 97, 352

aromatic 96  
 lavender 96, 97  
 Oils, essential 96  
 Operant conditioning theory 70  
 Operative dentistry 78, 295  
 pediatric 295  
 Oral 5, 10, 13, 17, 96, 102, 103, 104, 118,  
 139, 149, 159, 171, 177, 184, 345, 352,  
 362, 366, 367, 378, 383, 388, 389  
 clearance properties 139  
 diseases 5, 13, 17, 102, 103  
 hygiene 10, 96, 118, 149, 171, 177, 184,  
 345, 352, 366, 367  
 lesion of tongue 389  
 microbiota 104  
 microflora 159  
 mucosal lesions 362  
 papilloma 388, 389  
 retinoids 378  
 tuberculosis 383  
 Oral health 1, 5, 6, 10, 15, 19, 20, 42, 75, 78,  
 97, 103, 108, 119, 133, 134, 165, 170,  
 177, 184, 189  
 care 1, 15, 20, 75, 78, 97, 177, 184, 189  
 care management 15  
 education programs 108  
 policies 119  
 Orofacial digital syndrome 243  
 Orthodontic 200, 223, 284, 334, 340  
 retraction 340  
 treatment 200, 223, 284, 334  
 Orthodontists 109, 243  
 Osler-Weber-Rendu syndrome 369  
 Ossification 195, 217, 223, 224, 231, 233  
 endochondral 195  
 intramembranous 223  
 of symphysis 233  
 Osteogenesis 230  
 Oxygen depletion 115

**P**

Pain 130, 317, 383  
 gingival 317

- pleuritic 383
- thermal 130
- Palatinit 158
- Palmer notation system 296, 297
- Panoramic orthopantomogram 377, 378
- Papillae 353, 363, 381
  - filiform 353, 363
  - fungiform 353, 363
- Papillon–Lefèvre Syndrome (PLS) 378
- Parakeratosis 388
- Paralysis 319, 351
- Parasym-pathetic system 22
- Parathormone 196
- Parvimonas 103
- Pathogenicity 105
- PCR analysis 173
- Pediatric 3, 4, 6, 9, 12, 13, 14, 15, 16, 17, 20, 189, 325, 327
  - dental surgeon 189, 327
  - dentists 3, 4, 6, 9, 12, 13, 14, 15, 16, 17, 20, 325, 327
- Penicillin 383, 385
- Peptides 174, 196, 375
  - based therapies 375
  - histatin 174
- Periodontal disease 105, 134
  - etiopathogenesis 105
- Periodontal surgery 344
- Periods of developing occlusion 265
- Periosteum 205, 209, 211, 212, 266
  - dense 266
  - fibrous 266
- Permanent 265, 274, 279, 281, 282, 283, 291, 338
  - dentition period 265
  - incisors 274, 279, 281, 282, 283, 291, 338
- Pharyngitis 383
- Phenylketonuria 149
- Phosphate aldolase 151
- Phosphates 140, 161, 171, 187, 188
  - amorphous calcium 188
- Picture exchange communication system (PECS) 84
- Pitting enamel hypoplasia 342
- Pneumatization 234
- Polymers 82, 83, 106, 251, 277
  - glucan-mutan 106
  - producing glucose 106
- Polymorphism 263
- Polymorphonuclear leukocytes 385
- Porphyromonas 103
- Premature teeth 268
- Prenatal counseling 177
- Pressure, tissue fluid 259
- Preventive 7, 16, 292
  - dental care 16
  - dentistry procedures 7, 292
- Primary 254, 270, 273, 274, 275, 296, 297, 304, 366, 367, 383
  - dentition period 275
  - herpetic gingivostomatitis 366, 367
  - intestinal TB 383
  - mandibular molars 274
  - maxillary canine 304
  - molars 254, 270, 273
  - palmer notation numbering system 297
  - universal numbering system 296
- Primary tooth 166, 181, 258, 275, 295, 310, 316, 323
  - abscess 181
  - agenesis 323
- Probiotic(s) 187
  - bacteria 187
  - influence 187
- Process 46, 187, 192, 193, 225, 226, 227, 339
  - frontonasal 225, 226, 227
  - inflammatory 187
  - irrigation 339
  - maturational 193
  - multifaceted 192
  - psychophysiological 46
- Prodrome of fever 368
- Profiles 129, 265, 285, 377
  - facial 265
  - oral microbiome 129
- Progesterone 196, 369, 389
  - therapy 369
- Prognosis 109, 323, 327, 330
- Progression 11, 108, 116, 176, 181, 187, 188, 193, 243

irreversible 11  
   natural 193  
 Proinflammatory cytokine 379  
 Prolactin hormone 196  
 Proliferation 184, 207, 250, 255, 291, 337,  
   370, 371, 372  
   cellular endothelial 371  
   endothelial cell 370  
 Prolonged oral retention of cariogenic  
   components 138  
 Properties 159, 186, 206  
   antimicrobial 186  
 Propionibacterium 103  
 Prostaglandins 318  
 Protein 106, 140, 161, 214, 369  
   metabolism 214  
   synthesis 214  
 Prothrombin 324  
 Protrusion 213, 287  
 Psoriasis 353, 354, 363, 364  
 Psychoanalytic theory 43  
 Psychodynamic theories 42  
 Psychological 98, 178  
   disorders 98  
   problems 178  
 Psychosexual development 45  
 Psychosocial 50, 135, 165  
   development 50  
   theory 50  
 Psychosomatics 95  
 Pterygoid ulcer 380  
 Public health problem 180  
 Pulmonary hypertension 369  
 Pulpal 130, 131, 300, 347  
   diseases 130  
   infection 131  
   inflammation 130  
   morphology 300  
   necrosis 347  
 Pulp 84, 102, 130, 336  
   infection 102, 336  
   necrosis 130  
   therapy 84  
 Pyogenic granuloma 321, 372, 389

**R**

Radiation exposure 289  
 Radiographs, cephalometric 216  
 Radiography 94  
 Rashes 315, 317, 318, 374, 375, 376  
   circumoral 317  
   malar 376  
   photosensitive 375  
 Recreational activities 49  
 Reflexes, sensory 60  
 Regulation, servo system's 228  
 Reinforcements 70, 88, 96  
 Reiter syndrome 354, 364  
 Relationship 78, 285  
   harmonious 285  
   trusting 78  
 Remineralization 107, 121, 122  
   agents 122  
   processes 107, 121, 122  
 Remission 109, 353, 363  
 Remnants, trapped epithelial 356  
 Rendu-Osler-Weber syndrome 369  
 Replacing sucrose 158  
 Resin 188, 343, 348  
   composite 348  
   infiltration of early lesions 188  
 Resorption of alveolar bone 242, 260  
   by osteoclasts 260  
 Resorptive nature 238  
 Resources 3, 75, 165  
   educational 3  
 Respiratory depression 318  
 Responses 20, 26, 28, 30, 34, 68, 69, 70, 71,  
   77, 84, 208, 212, 301, 387  
   adaptive emotional 84  
   granulation tissue 387  
   inflammatory 301  
 Restoration 119, 126, 166, 188, 332, 333, 335,  
   338, 343, 345, 347  
   anterior tooth 343  
   ceramic 345  
   esthetic 332, 333, 335, 338  
 Restorative 131, 188, 343

rehabilitation 343  
 treatment 131, 188  
 Restriction endonuclease analysis (REA) 129  
 Reversible pulpitis 130  
 Reynaud's phenomenon 375  
 Rheumatism 375  
 Rifampicin 384  
 Riga-fede disease-ulceration 324  
 Risk 10, 139  
   pediatric oral health 10  
   relative cariogenic 139  
 Risk factors 133, 169, 176, 181, 183, 188  
   environmental 176  
 Roots 254, 256, 257, 259, 291, 292, 300, 303,  
   305, 306, 307, 309, 311, 323, 334, 340  
   distobuccal 306, 307  
   mesiobuccal 306, 307  
 Rudimentary supernumerary teeth 329

## S

Saliva 104, 105, 106, 107, 110, 111, 112, 113,  
   114, 115, 119, 122, 159, 174, 182  
   gum-stimulated 113  
   malfunction 182  
 Salivary 114, 387  
   enzyme reductase 114  
   gland ducts 387  
   reductase test 114  
 Saliva tests 182  
 Sclerotherapy 371  
   agents 371  
 Scott's hypothesis 205  
 Sebaceous glands 356  
 Secondary prevention approaches 188  
 Second world war 134, 151  
 Secretion, growth hormone 197  
 Selenomonas 103  
 Separation 23, 24, 321, 335  
   surgical 335  
 Servo system 212  
   theory 212  
 Severe 166, 169, 343  
   early childhood caries 166, 169

  enamel hypoplasia 343  
 Sicher's hypothesis 207  
 Sigmund freud 43, 49, 50  
   neurologist 43  
 Signals, transmitting 196  
 Silver diamine fluoride (SDF) 188  
 Single root canal system 335  
 Situations 11, 88, 246  
   distressing 88  
   dynamic 246  
   stressful 11  
 Skin 374, 376, 381, 382  
   biopsy sections 374  
   lesions 374  
   problems 376  
   rash 381, 382  
 Skinner's operant conditioning theory 88  
 Smiley faces program (SFP) 37  
 Snyder 110, 112  
   acid production test 110  
   test 112  
 Sobs 25, 26  
   breath-catching 25  
 Social 50, 71, 72, 73, 89  
   dynamics 50  
   learning theory 71, 72, 73, 89  
 Socioeconomic 102, 195  
   conditions 102  
   factors 195  
 Soft tissue lesions 362  
 Solid-liquid interface 104  
 Somatic gigantism 349  
 Somatotrophic hormone 212  
 Somatotypes 215, 216  
 Sorbitol, metabolize 160  
 Spirochetal disease 382  
 Squamous 388  
   cell carcinoma 388  
   papillomas 388  
 Staphylococcal 381  
   scalded shock syndrome 381  
   toxin 381  
 Starch, cooked 156  
 Starchy foods 122, 139, 155, 156  
   cooked 155

- staple 156
  - Steroids 354, 358, 364
    - topical 354, 364
  - Stockholm syndrome 50
  - Strawberry Tongue 353, 381, 382
  - Streptococci 105, 381, 382
    - beta-hemolytic 382
  - Streptococcus* 103, 172, 382
    - anginosus* 103
    - mitis* 103
    - scarlatina* 382
    - sobrinus* 103, 172
  - Streptococcus mutans* (SM) 102, 103, 106, 118, 119, 172, 173, 178
    - bacterium 119
  - Stress 177, 182, 318, 379
    - psychological maternal 177
    - sugar-induced biofilm 182
  - Sturge Weber syndrome 371
  - Succedaneous teeth 181
  - Successional teeth set 248
  - Sucking 23, 47, 60, 266, 295
    - digit 295
    - reflex 47
  - Sucralose 158
  - Sucrose 106, 107, 133, 139, 140, 142, 143, 144, 145, 146, 150, 151, 153, 154, 156, 157
    - hydrolysis 146
  - Sugar(s) 139, 141, 142, 150, 151, 156, 157, 184
    - consumption 139, 141, 142, 150, 151, 156, 157
    - lactose 142
    - metabolize 184
  - Superimposed candidiasis 358
  - Supernumerary 268, 324, 322, 329, 330, 334
    - erupted rudimentary 329
    - teeth 322, 329, 330
    - tooth 322, 329, 334
  - Surgical resection 385
  - Sutural 204, 206, 207, 208, 211, 233
    - dominance theory 204
    - growth 206, 208, 233
    - growth theory 207
    - theory 211
  - Sutures 195, 205, 207, 208, 211, 212, 233, 234, 235, 236
    - calvarial 195
    - paired parallel 207
  - Sweat glands 376
  - Swollen fungiform 381
  - Synchondroses 202, 203, 205, 212
    - sphenoethmoidal 202
    - spheno-ethmoidal 203
  - Syndromes 327, 329, 330, 331, 350, 351, 376, 378, 379
    - congenital lip pits 350
    - hereditary Down's 330
    - oral-facial-digital 351
  - Syndromic comorbidity 349
  - Synthesis 144, 145
    - sucrose-mediated 145
    - water-insoluble glucan 145
  - Syphilitic hypoplasia 348
  - Systemic 365, 374
    - antifungal agents 365
    - lupus erythematosus 374
- ## T
- Tachycardia 386
  - Tactile sense 96
  - Taurodontism 291, 338, 339
  - Tea polyphenols 142
  - Techniques 2, 14, 24, 31, 54, 77, 82, 84, 87, 89, 90, 94, 95, 98, 99, 100, 334
    - audiovisual 90
    - brushing 54
    - child management 14
    - desensitizing 84
    - surgical separation 334
  - Teeth 16, 17, 33, 103, 104, 142, 162, 178, 218, 233, 247, 248, 257, 258, 259, 264, 268, 289, 290, 295, 299, 316, 321, 322, 323, 328, 332, 334, 346, 347, 356, 377
    - congenital 268, 322
    - damaged 103
    - distorted 377

- eruption 218, 233, 257, 258, 259, 268, 316
- fetal 322
- misalignment 16
- molar 321, 356
- natal and neonatal 322, 323
- wisdom 17
- Teething infants 316, 320
- Tell-show-do technique 28, 85
- Tertiary circular reactions 60
- Testosterone 228, 229
- Thaumaturgy 98
- Theories 42, 204
  - of child psychology 42
  - of Craniofacial Growth 204
- Therapy 98, 290, 342, 354, 367, 370, 371, 381
  - antifungal 354
  - anti-streptococcal 381
  - laser 370, 371
  - palliative 367
  - radiation 342
- Threadlike telangiectasias 370
- Thrombovasculitis 386
- Thyroid hormone 195
- Thyrotropic hormone 196
- Tinea 374
  - capitis 374
  - corporis 374
- Tissues 192, 193, 196, 198, 201, 202, 208, 209, 210, 211, 214, 241, 255, 259, 376, 385, 390
  - fibrous 241
  - fluid theory 259
  - granulation 385
  - lymphoid 201
  - mesenchymal 255
  - neural 202
  - oral 390
  - systems 198
- Tongue 93, 266, 267, 327, 328, 348, 349, 350, 351, 353, 354, 355, 364, 365, 372, 381, 388, 389
  - depressors 93
  - bifid 350
  - fissure 351
  - gingival 388
  - hairy 355, 372
- Tonsils 103, 316
- Tooth 11, 16 17, 102, 103, 106, 119, 120, 122, 130, 131, 133, 134, 135, 136, 139, 140, 144, 146, 162, 188, 224, 243, 244, 246, 249, 250, 251, 255, 257, 258, 259, 260, 261, 270, 273, 291, 295, 296, 297, 298, 302, 305, 307, 309, 313, 316, 321, 323, 324, 329, 330, 334, 335, 336, 338, 339, 345
  - abrasion 345
  - breakdown 188
  - buds 249, 250, 329, 335
  - cavity 106
  - crown 273, 334, 335
  - decay 11, 16, 17, 119, 122, 135, 139, 146, 162
  - defense 120
  - development 243, 244, 246, 249, 251, 258, 260, 261, 295, 313, 335
  - enamel 102, 103
  - erosion 140
  - eruption 257, 258, 259, 260, 295, 316, 321
  - germs 224, 250, 255, 260, 270, 335
  - loss 102, 103, 133, 134, 136, 144
  - numbering system 296
- Tooth pain 102, 257, 323
  - multi-rooted 257
  - natal 323
- Tooth surface 105, 106, 107, 114, 121, 122, 123, 127, 129, 135, 137, 138, 153, 159
  - swabbing buccal 114
- Topical 325, 379
  - anaesthetic agents 379
  - anaesthetics 325
- T. Pallidum* haemagglutination assay (TPHA) 383
- Transformation, secondary compensatory 209
- Trauma 81, 87, 92, 130, 218, 291, 320, 324, 339, 340, 341, 358, 380, 384
  - emotional 81
  - epithelial 384
  - psychological 92
  - soft tissue 320, 358
- Treacher collins syndrome 243

**Subject Index**

Treatment 13, 65, 77, 84, 108, 123, 180, 220,  
322, 331, 334, 335, 340, 345, 346, 348,  
349, 351, 352, 357, 362, 354, 355, 357,  
358, 362, 364, 366, 372, 390  
cancer 362  
endodontic 13, 335  
planning dentofacial 220  
prosthetic 357  
prosthodontic 346  
smartphone-based exposure 84  
surgical 180  
therapeutic 108  
Treatment planning 13, 31, 131, 193, 292  
effective dental 31  
*Treponema pallidum* 382  
Triamcinolone 358  
Trichotillomania 374  
Triconodont 247  
Tubercular gingivitis 384  
Tuberculosis 383  
Turner's 341, 342  
hypoplasia 341, 342  
tooth 341  
Turners syndrome 243, 330

**U**

Ulceration 362, 374, 375, 380  
oral 380  
Ulcers 366, 368, 376, 379, 380  
fibrin-covered 368  
ovoid 379  
painful 366  
Umbilical hernia 349

**V**

Van limborgh multifactorial hypothesis 204,  
211  
Van Limborgh's composite hypothesis 211  
Vascular 369, 372  
dysplasia 369  
hyperplasia 372  
Ventral tongue 365

Verbal 32, 96  
information and tactile sense 96  
skill scale (VSS) 32  
Virtual reality-based distraction 97, 98  
Visceromegaly 349  
Vomiting 136, 151, 315, 316, 318, 325, 368

**W**

Water 1, 43, 74, 114, 136, 148, 161, 162, 163,  
185, 369  
drinking 161  
fluoridated 185  
fresh 163  
Whining behaviour 79  
Wiedemann-Rautenstrauch syndrome 323  
WITAUL technique 98  
Workers 146, 149, 228  
confectionery industry 149  
Woude syndrome 323, 357

**X**

X-linked hypophosphatemia 149

**Z**

Zsigmondy system 298



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Professor Damle is a colossus giant, a celebrated teacher, distinguished leader, and policy-maker at several institutions and universities. He is the rare blend of a clinician and a scholar and has emerged with decades of teaching. He possesses more than 44 years of teaching experience. He was the Dean of Nair Hospital Dental College, Mumbai, for 13 years, also has been a postgraduate teacher for 30 years. He remained Director of Medical Education. He was the first Dental Surgeon promoted as Joint Municipal Commissioner, Medical Education. Prof. Damle is actively involved in research and has numerous publications in Indian and International journals.



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Dr. Dhanashree Sakhare has been enthusiastically involved in teaching and research activities with wide-ranging experience working in India at MM College of Dental Sciences & Research, Mullana. She was a lecturer of Orthodontics and then worked as an associate professor of Orthodontics & Dentofacial Orthopedics. Currently, she is actively pursuing Australian Dental aspects and teaching aspirant overseas dentists in Australia. She has won best paper awards, delivered several lectures, and demonstrated clinical presentations at various Dental conferences. She has numerous publications to her credit.



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