

SIXTH EDITION

Pediatric Dentistry

INFANCY THROUGH ADOLESCENCE

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Pediatric Dentistry

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Pediatric Dentistry: Infancy Through Adolescence

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Foreword

Pediatric Dentistry: Infancy Through Adolescence was first published in 1988, has been translated into multiple foreign languages, and is now proceeding into another edition. When honored to write a foreword for this edition, I reviewed what was written in 1988 and realized that what was offered then was still applicable today. Citing some of the language of that preface:

This book exists because the editors believe that a reference textbook on dentistry for children was needed that was, by design, developmentally organized. This book has been written in the belief that age is so incredibly relevant to pediatric dentistry that by presenting information according to a developmental organization, a student's appreciation of the science and techniques needed to effectively practice dentistry for children will be enlarged.

Those words are still critical for this new edition. In 1988 they seemed almost pioneering in that they allowed the book to use the word "infancy" in its title. It was felt by the editors that the next refinement in preventive dentistry for children had to embrace all children as early in age as possible. Prevention should not wait for the child's linguistic maturity. This customary age of 3 just did not make sense in terms of diet, home care, fluoride needs, habits, and other preventive dentistry concerns. Infancy has to be embraced by the contemporary dentist who values the prevention of dental disease in his or her child patients. Having a dental home cannot come too early for any child.

The developmental design also allows for a focus on the adolescent patient whose needs are unique when compared with children age 12 years and younger. Issues like periodontal disease, trauma, and esthetic dentistry, though important for children of all ages, often become pivotal concerns for these maturing patients.

The other two developmental divisions of the book are the primary dentition years (3 to 6) and the transitional years (6 to 12). All four age-related divisions have their own diagnoses and treatment planning as well as prevention chapters. This allows for the age-related focus that parallels the realities of clinical pediatric dental care.

At some point in the maturity of the clinician who treats children there is an appreciation of how dynamic the world of pediatric dentistry is when assessed by age. The 3-year-old presents an entirely different dentition than the 15-year-old. The panoramic x-ray of a 5-year-old is an image very different from that of a 10-year-old. The behavior of children changes from one recall appointment to the next. Their treatment needs tend to fit into different age zones. This dynamism of change is one of the challenges of pediatric dentistry and for many practitioners one of the joys of this area of clinical practice. This book honors that dynamic.

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Preface

Why a new edition now?

We live in a world of change. New information is constantly being reported. With the explosion of the internet into every office, home, and pocket, we are inundated with information on new discoveries, new drugs, and new procedures. Time-honored treatments are challenged and replaced with new evidence-based possibilities. And so it is in pediatric dentistry.

Since the 2013 edition, our understanding of the importance of oral health in systemic health has grown; children can grow and develop without cavities; the caries process is preventable; early stress in the infant's life can have profound effects on the child's growth, development, and behavior; common risk factors have been identified that lead to both obesity and cavities; we know more about the contribution of genetics to susceptibility or resistance to dental caries; infant oral health is embraced by many primary care providers, dentists, and parents; the importance of caries risk assessment early in the baby's life during the well-baby visits by primary care providers is now understood; fluoride content of community waters has been updated; fluoride varnish applications have become standard practice; use of esthetic crowns to restore badly destroyed primary teeth is now a common treatment option; use of medicinal agents to arrest the caries process is common; new treatments for vital and necrotic primary pulps are now available; retention of traumatized teeth has been extended; regenerative endodontic techniques for luxated teeth with open apices hold promise; and adolescent health, risky behaviors including smoking/vaping, bullying, and suicide, and transition from pediatric to adult dental supervision have become a part of our practice.

This sixth edition is intended for all audiences from the undergraduate dental student, to residents in training, and, finally, to seasoned practitioners. In addition, those in the allied health

professions will also find the text an excellent reference for understanding the oral health needs of all children.

With this edition, we introduce four new associate editors whose enthusiasm and creativity were greatly appreciated by the senior editor. In addition, 35 new contributors have been invited to continue the work contributed by 57 colleagues in the first five editions.

The support this textbook receives is greatly appreciated. The text is recognized by educational programs throughout the world. All chapters have been comprehensively reviewed and updated with evidence-based references and guideline-supported recommendations.

What else is new? The text is now available electronically through the Expert Consult platform. Many chapters are accompanied by case studies and videos to enhance the learning experience.

Thirty years ago the first edition of the textbook was designed around developmental stages of childhood, whereby most textbooks were disease oriented. This format highlights the dramatic changes in the patients we treat as they develop from infancy through adolescence and has proven its benefit to learners.

The foundation for a lifetime of good oral health is established early in the child's life, maybe even before a child is born. We hope this new edition of *Pediatric Dentistry: Infancy Through Adolescence* will provide you with information and tools to provide optimal oral health care for all your pediatric patients.

Lastly, I would like to acknowledge the following individuals from Elsevier who helped produce this edition: Jennifer Flynn-Briggs, Senior Content Strategist; Kelly Skelton and Angie Breckon, Content Development Specialists; Rae Robertson, Senior Content Development Specialist; Brian Salisbury, Book Designer; and Kristine Feeherty, Book Production Specialist.

Arthur J. Nowak

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Fundamentals of Pediatric Dentistry

- 1 The Importance of Pediatric Dentistry
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Children are not small adults. Children have unique needs based on their ethnicity, stage of development, family composition, medical history, temperament, and mental well-being. Therefore this first part with 12 chapters provides information and themes pertinent to children of all ages. Unfortunately, children continue to be vulnerable to dental and oral diseases, and those from poor and minority families are the most at risk. This first part will further your understanding of children and set the stage for the remaining four age-related parts.

1

The Importance of Pediatric Dentistry

PAUL S. CASAMASSIMO AND JANICE A. TOWNSEND

CHAPTER OUTLINE

Prevention and Diagnosis

Behavior Guidance

Treatment Options

Dental Disease Emphasis and Systemic Disease

Contemporary Practice and Care of Children

This Edition

The world continues to change around us, and since the last edition of this textbook, changing social mores in this country and events around the world have shown that children, now more than ever, are vulnerable to oral disease and its complications. The dentist unquestionably has the responsibility to educate and advocate for a childhood free of pain and dental disease for all children regardless of nationality, ethnicity, or socioeconomic background. Fortunately science and technology have improved our ability to care for these children. This chapter attempts to place the changes affecting the oral health of children into a clearer picture for the general practitioner and pediatric dental specialist and create a broader concept of the dental home to best serve the interests of children.

Table 1.1 provides a timeline that depicts the evolution of dentistry for children. The historic mission of pediatric dentistry was threefold: stop the advance of early childhood caries (ECC) with restoration, pulp therapy, and extraction; establish prevention to stop recurrence of disease; and develop a regular care seeker to help ensure oral health into adulthood. In truth, the mission differed little from that for adults. It was not until the turn of the last century that the dental profession recognized the continuing epidemic of ECC and its disparate effect on the poor and underserved minority communities and a broader view of pediatric dentistry began to emerge.^{1,2} Overlaying this continued epidemic was a changing social matrix that altered traditional doctor-directed care into a more complex mosaic that still accounted for management of dental caries but within a more complicated set of expectations and conditions.³ Parents, society, the media, other professionals, and a host of environmental and scientific variables emerged to challenge traditional approaches to the tripartite mission of pediatric dentistry.⁴ In Table 1.2, we attempt to lay out these changes, using the multidimensional model of Fisher-Owens et al.⁵ The remainder of this chapter explains how these new variables

impact the delivery of care to children and preview much of what will follow in more detail on current therapies used in pediatric dentistry.

Prevention and Diagnosis

For decades, our preventive arsenal remained the same, with a four-part message of drink fluoridated water, brush teeth with fluoridated dentifrice, eat wisely (which meant low sugar intake), and see a dentist twice a year. We have moved from a general blanket preventive message to one that is keyed to the individual child and the family's characteristics based on caries risk assessment (CRA), better diagnosis of caries, and an ever-increasing choice of preventive agents, including fluoride varnish and silver diamine fluoride (SDF).⁶ Digital radiography and other electronic diagnostic tools offer better assessment of caries progression, adding to our ability to more conservatively and individually manage this disease.⁷ Dental sealants have withstood critical review and achieved universal acceptance as a caries preventive technique promising a significant reduction in the lifelong caries experience of many Americans.⁸ Also gaining universal acceptance is CRA, which promises to be a useful chairside diagnostic also supporting individualized, patient-centered care. More research is needed to achieve the sensitivity and specificity of a truly useful clinical tool. When CRA is matched with early intervention, the promise of a "cavity-free generation" may finally be realized.⁹

Behavior Guidance

Along with advances in dental science are changes in how children and families engage the dental profession in oral health care. Longstanding beliefs on how best to manage a child's in-office behavior and communicate with families have been reassessed as society changes and views on the value of oral health, acceptance of advice and trust of health professionals, and parental involvement in direct provision of care evolve. No doubt, the generational changes that affect both providers and parents have made interaction with children at chairside more challenging.^{10,11} Similarly, the concentration of ECC in the poor and minority child populations and the emergence of cultural subgroups needing care have complicated a hierarchical approach to child behavior.^{12,13} The application of basic behavior guidance techniques advocated by the American Academy of Pediatric Dentistry (AAPD) now must be meshed with our deeper understanding of adverse childhood experiences (ACEs) in the lives of those most affected with dental caries and, even more simply, the cultural overlays that, for example, limit touch and gender interactions in a clinical setting.¹⁴ Parents

TABLE
1.1

Milestones in Dentistry for Children in the United States

1900	Few children are treated in dental offices. Little or no instruction in the care of “baby teeth” is given in the 50 dental schools in the United States.
1924	First comprehensive textbook on dentistry for children is published.
1926	The Gies Report on dental education notes that only 5 of the 43 dental schools in the United States have facilities especially designed for treating children.
1927	After almost a decade of frustration in getting a group organized to promote dentistry for children, the American Society for the Promotion of Dentistry for Children is established at the meeting of the American Dental Association (ADA) in Detroit.
1932	A report of the College Committee of the American Society for the Promotion of Dentistry for Children states that in 1928, 15 dental schools provided no clinical experience with children and 22 schools had no didactic information in this area.
1935	Six graduate programs and eight postgraduate programs exist in pedodontics.
1940	The American Society for the Promotion of Dentistry for Children changes its name to the American Society of Dentistry for Children.
1941	Children’s Dental Health Day is observed in Cleveland, Ohio, and Children’s Dental Health Week is observed in Akron, Ohio.
1942	The effectiveness of topical fluoride applications at preventing caries is described. The Council on Dental Education recommends that all dental schools have pedodontics as part of their curriculum.
1945	First artificial water fluoridation plant is begun at Grand Rapids, Michigan.
1947	The American Academy of Pedodontics is formed. (To a large degree, the start of the Academy was prompted by the need for a more scientifically focused organization concerned with the dental health of children.)
1948	The American Board of Pedodontics, a group formulated to certify candidates in the practice of dentistry for children, is formally recognized by the Council on Dental Education of the ADA.
1949	The first full week of February is designated National Children’s Dental Health Week.
1955	The acid-etch technique is described.
1960	Eighteen graduate programs and 17 postgraduate programs in pedodontics exist.
1964	Crest becomes the first ADA-approved fluoridated toothpaste.
1974	The International Workshop on Fluorides and Dental Caries Reductions recommends that appropriate fluoride supplementation begin as soon after birth as possible. (This recommendation was later modified by authorities to start at 6 months of age.)
1981	February is designated National Children’s Dental Health Month.
1983	A Consensus Development Conference held at the National Institutes of Dental Health endorses the effectiveness and usefulness of sealants.
1984	The American Academy of Pedodontics changes its name to the American Academy of Pediatric Dentistry.
1995	A new definition is adopted for the specialty of pediatric dentistry by the ADA’s House of Delegates: <i>Pediatric dentistry</i> is an age-defined specialty 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.
2003	The AAP establishes “Policy Statement on Oral Health Risk Assessment Timing and Establishment of a Dental Home,” and issuance of this policy statement will be manifested in several outcomes, including the need to identify effective means for rapid screening in pediatricians’ offices, and the mechanisms for swift referral and intervention for high-risk children.
2011	The AAPD establishes the Pediatric Oral Health Research and Policy Center to inform and advance research and policy analysis to promote optimal oral health care for children.
2017	Pediatric Dentistry MATCH results show 676 applicants for 408 positions, which exceeds all other specialties.

AAP, American Academy of Pediatrics; AAPD, American Academy of Pediatric Dentistry.

want to be present during treatment and will seek providers who will commit to that practice.¹⁵

Pharmacologic management of behavior continues to be a major consideration in pediatric dental care but has also seen dramatic change. Sedation deaths have prompted new guidelines, better training, and better patient monitoring and, of course, greater scrutiny of how this service is delivered.^{16,17} Drugs such as chloral hydrate, long a staple of pediatric sedation, have largely

been replaced by medications thought to be safer and reversible.¹⁸ General anesthesia for dental care has seen a dramatic increase, in part due to the epidemic of ECC. In spite of that pharmacologic option being the top choice of parents, it too is challenged by cost, availability of surgical sites, and growing research on possible effects of anesthetics on early brain development.¹⁹ Also driving the changes in behavior guidance is a greater recognition of the role of pain in behaviors, both chairside and in care seeking.²⁰

TABLE 1.2 A Cross-Millennium View of the Changing Character of Pediatric Dentistry

Traditional Elements of Pediatric Oral Care for Children	Current and Future Directions and Their Drivers
Prevention	
<ul style="list-style-type: none"> • Diagnosis with traditional radiography and caries diagnostics • A preventive arsenal composed largely of fluoride options including water fluoridation, fluoride dentifrice, office fluoride, fluoride supplements, and at home over-the-counter (OTC) fluoride rinses 	<ul style="list-style-type: none"> • Digital radiography and electronic caries detection • Prevention continues to emphasize most traditional modalities but now includes fluoride varnish, silver diamine fluoride (SDF), and a caries risk paradigm to the application of fluoride and other techniques, discontinuing supplementation
<ul style="list-style-type: none"> • Dental sealants to prevent occlusal and pit and fissure caries selectively applied 	<ul style="list-style-type: none"> • Dental sealants now evidence-based and accepted universally as a primary preventive technique and may have therapeutic implications
<ul style="list-style-type: none"> • Caries risk assessment not considered essential to provision of preventive services 	<ul style="list-style-type: none"> • Caries risk assessment now considered integral to preventive therapeutic plans and compensation for preventive services
Behavioral Guidance	
<ul style="list-style-type: none"> • Simplistic application of communicative and more advanced techniques based on chairside behaviors and special needs with dentist directing choice 	<ul style="list-style-type: none"> • More sophisticated application of techniques with attention to chairside and other aspects of behavior with a strong parental advisement component
<ul style="list-style-type: none"> • Parental separation from clinical aspects of care 	<ul style="list-style-type: none"> • Recognition of the changing parental attitudes toward restraint, pharmacologic management, and parental presence
<ul style="list-style-type: none"> • All children managed with the same paradigm and hierarchy of behavior techniques without regard to systemic, emotional, and other mitigating factors 	<ul style="list-style-type: none"> • Recognition of the effects of poverty on child behavior from toxic stress and adverse childhood experiences (ACEs)
<ul style="list-style-type: none"> • Pain and anxiety addressed primarily as preoperative treatment need 	<ul style="list-style-type: none"> • Greater understanding and subsequent management of pain and anxiety as factors in care avoidance, social and developmental behaviors, and intraoperative outcomes during dental treatment
<ul style="list-style-type: none"> • Largely office-based nonpharmacologic management of behavior 	<ul style="list-style-type: none"> • Newer models of advanced behavior guidance using sedation, general anesthesia in-office with dental and medical anesthesiologists and surgery centers
<ul style="list-style-type: none"> • Simplistic vision of behavior in the dental office based on traditional family structure, majority social characteristics, and middle-class value system 	<ul style="list-style-type: none"> • Recognition of the contribution of culture, poverty, and other nontraditional factors on behavior in the dental office
Treatment of ECC	
<ul style="list-style-type: none"> • Simplistic armamentarium of composite, amalgam, stainless steel crowns 	<ul style="list-style-type: none"> • Fuller integration of veneered crowns, zirconia crowns, resin infiltration
<ul style="list-style-type: none"> • Pulpotomy as a preferred therapy using formocresol, ferric sulfate 	<ul style="list-style-type: none"> • Pulp therapy with fuller range options, including indirect techniques, mineral trioxide aggregate (MTA)
<ul style="list-style-type: none"> • Emphasis on immediate and primary tooth lifespan success in choice of materials and techniques 	<ul style="list-style-type: none"> • Addition of safety and toxicity concerns in choices of restorative care
<ul style="list-style-type: none"> • Definitive treatment (restoration or extraction) in most cases of ECC 	<ul style="list-style-type: none"> • Consideration of a range of treatment options including deferral of treatment, use of fluoride and other caries-static agents like SDF teamed with more frequent interventions
Dental Diseases Emphasis	
<ul style="list-style-type: none"> • Dental caries as the preeminent singular driver of care for children 	<ul style="list-style-type: none"> • Greater recognition of esthetic concerns (fluorosis, tooth whiteness) in pediatric dentistry
	<ul style="list-style-type: none"> • Emergence of new conditions such as molar-incisal hypocalcification (MIH) and dental erosion as treatment considerations
Systemic Disease and Conditions and Oral Health	
<ul style="list-style-type: none"> • Traditional disease entities occurring in predictable patterns allowing application of consistent management 	<ul style="list-style-type: none"> • New disease entities such as obesity and its management considerations; other eating disorders; increase in autism spectrum
<ul style="list-style-type: none"> • Predictable dental outcomes based on disease progression in special needs patients 	<ul style="list-style-type: none"> • Lifespan elongation with complications of end-organ damage, effects of new medication and growing technology dependence to support life and function

TABLE
1.2

A Cross-Millennium View of the Changing Character of Pediatric Dentistry—cont'd

Traditional Elements of Pediatric Oral Care for Children	Current and Future Directions and Their Drivers
Practice Considerations	
<ul style="list-style-type: none"> Paper-based records and office management 	<ul style="list-style-type: none"> Digitalization of records, billing, imaging, and laboratory procedures
<ul style="list-style-type: none"> Simplistic safety orientation (OSHA, NIOSH, CDC) 	<ul style="list-style-type: none"> Office safety including risk mitigation, growing concerns about radiation exposure with introduction of CBCT and other digital advances; HIPAA changes, waterline management
<ul style="list-style-type: none"> Global dental consent procedures 	<ul style="list-style-type: none"> Changing consent requirements based on procedures
<ul style="list-style-type: none"> Regional and training-based care patterns 	<ul style="list-style-type: none"> Emergence of evidence-based guidelines for pediatric dental care

CBCT, Cone-beam computed tomography; *CDC*, Centers for Disease Control and Prevention; *ECC*, early childhood caries; *HIPAA*, Health Insurance Portability and Accountability Act of 1996; *NIOSH*, National Institute for Occupational Safety and Health; *OSHA*, Occupational Safety and Health Administration.

We more often confront a very young child who has been in pain from dental caries for many days, challenging the simple notion that pain control is confined to administration of local anesthesia.²¹

The science and clinical translation of anxiety, pain, and pharmacologic behavior guidance will likely continue. Our tools will also change as we add more powerful local anesthetics, such as articaine and intranasally administered local anesthesia, and as reversal agents like phentolamine sodium gain acceptance.^{22,23} The subsequent chapters in this text address both longstanding and new approaches to management of pain, anxiety, and chairside behavior.

Treatment Options

The treatment of ECC continues to change with the science of materials and understanding of biology of the oral cavity and teeth. Today, clinicians can approach pulpal therapy with more choices and better outcomes. Mineral trioxide aggregate (MTA) and bioactive glass stand to revolutionize both permanent and primary teeth pulpal therapy.²⁴ Indirect pulp caps with various agents, including traditional calcium hydroxide and more recent glass ionomer cements, have challenged traditional thinking that a primary tooth with a large carious lesion is doomed to invasive pulp therapy.^{25,26} Traumatic injuries now benefit from larger and longer studies that direct clinicians to better outcomes. Autotransplantation is now an accepted technique for hopeless permanent teeth due to caries or trauma.^{27,28} Advances in regeneration techniques can now add vitality to immature teeth that traditionally had a poor long-term prognosis and may lead to full tooth regeneration in the future, as well as other systemic therapies.²⁹

Restorative choices for primary teeth continue to increase. The strip crown, long a stalwart of anterior primary tooth restoration, has been joined by the veneered stainless steel crown. Zirconia crowns, offering better esthetics, strength, and technique ease, are gaining favor, especially for posterior primary teeth.³⁰ The open-faced stainless steel crown has joined its less esthetic stainless steel crown in the annals of pediatric history. Bioactive restorative materials may lead to a class of restorative materials with intrinsic reparative abilities.³¹

Perhaps the most exciting advance in care of ECC, especially for very young children, is the expansion of our thinking about

treatment urgency, restoration longevity, and adjunctive nonrestorative care. Restoration or extraction once dominated treatment of ECC, and application was often immediate, with accompanying use of behavioral techniques to accomplish care. Today, clinicians can reliably use nonrestorative techniques to stop ECC's advance, such as fluoride varnish and SDF, and avoid a costly general anesthetic that too often is just a precursor to another one later on.^{32,33} A Hall technique crown can also be reliably and safely placed to stop caries and restore function, requiring minimal cooperation by the child.³⁴ The advances in treatment of ECC have made care safer, more effective, and more palatable to many families.

Dental Disease Emphasis and Systemic Disease

ECC has long been and remains the driver of attendance in a dental home, but other conditions have emerged as considerations in pediatric dental care, such as fluorosis, esthetic challenges, and management of molar-incisor hypocalcification.³⁵ Dental erosion has moved from an isolated condition suggestive of an eating disorder to a more widespread condition of children.³⁶ These conditions join inherited disorders of the dentition, such as amelogenesis imperfecta, intrinsic staining, and tooth number irregularities, as important intersection points in childhood oral assessment.

Systemic diseases affecting children fall into the purview of dentists caring for children by default. Caring for those children with special needs requires a working knowledge of medical, functional, and social and programming aspects of the lives of these children. Medical advances have prolonged life in many conditions but brought into play technology dependence, such as cerebral shunts and implanted devices, and organ effects from drugs, surgery, or the continued onslaught of the original condition. Care of these children requires the dentist to understand the disease, its treatment, and the effects on oral physiology and function, but more so today, the social and programmatic aspects of the lives of these children.³⁷ Although pediatric dentists continue to take the lead in caring for the very young with special needs, the intent of our health care system is to transition them to adult care as their dental needs grow outside the usual concerns of pediatric dentistry.^{38,39}

Contemporary Practice and Care of Children

As all dental practice moves along the path of growing sophistication and digitalization, those areas addressing care of children follow. Paper-based offices are a thing of the past, and movement to the full electronic office means systems that can track caries risk, health histories, referrals, and serial disease manifestations and treatment. Models, radiographs, and analyses of the developing dentition are now electronic files.⁴⁰ As treatment techniques advance using lasers and other approaches, consent procedures for children become more complicated, especially with changing family structures. Office design, toys, and other aspects of dental offices have special considerations when children are a part of the patient family.

The concern of parents about safety of their children requires a more detailed attention to safety considerations, regulations, and office environment. Basic infection control remains a keystone of patient safety, but waterline safety, chemicals in dental materials, and radiation have emerged as special considerations in the dental care of children.⁴¹ A growing area is interprofessional care, which suggests that dentists treating children need to heed obesity, immunizations, and other areas not necessarily considered in the realm of dentistry. Child abuse continues to be a required safety consideration for those treating children.

This Edition

Many of these topics are dealt with in depth in this latest edition. New chapters on management of patients with cleft lip and palate and cariology have been added to address the changing nature of oral health care for children. New online content has been added to enhance the understanding of basic principles and to address advanced topics in pediatric dentistry. The textbook retains its developmental view of pediatric dentistry, validating its changing science, including the benefits of early intervention and new age-related conditions and treatments. The text continues to offer in-depth chapters on many techniques and its age epoch diagnostic sections. Welcome to this sixth edition!

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2

Differential Diagnosis of Oral Lesions and Developmental Anomalies

CATHERINE M. FLAITZ

A wide variety of oral lesions and soft tissue anomalies are detected in children, but the low frequency at which many of these entities occur makes them challenging to clinically diagnose. The purpose of this chapter is to highlight selected oral lesions that are most commonly found in children and pathologic entities that primarily develop in this age group. In addition, oral lesions associated with several genetic disorders and specific malignancies, which may mimic benign or inflammatory conditions, are included to broaden the disease scope. The material is outlined in tables to make this comprehensive subject more succinct and easier to review. The brief description for each entity summarizes the most important clinical information that is relevant to the child patient. Representative examples of these conditions are included to illustrate the characteristic clinical or radiographic features.

Each oral lesion is described according to key points: (1) the most common pediatric age group affected and the gender predilection, (2) the characteristic clinical and radiographic findings of the lesion, (3) the most frequent location for the lesion, (4) the pediatric significance of the lesion, (5) the treatment and prognosis for the lesion, and (6) the differential diagnosis that is pertinent to this age group.

Except for the first table on selected developmental anomalies, the other tables are arranged to capture the primary clinical or radiographic characteristics for the purpose of comparison. The sequential headings for each of the tables include the following disease categories:

Developmental anomalies (Table 2.1, Fig. 2.1)

White soft tissue lesions (Table 2.2, Fig. 2.2)

White surface thickening lesions

White surface material lesions

White subsurface lesions

Dark soft tissue lesions (Table 2.3, Fig. 2.3)

Red or purple-blue lesions

Brown-black lesions

Ulcerative lesions (Table 2.4, Fig. 2.4)

Soft tissue enlargements (Table 2.5, Fig. 2.5)

Papillary lesions

Acute inflammatory lesions

Tumor and tumorlike lesions

Radiolucent lesions of bone (Table 2.6, Fig. 2.6)

Mixed radiolucent and radiopaque lesions of bone (Table 2.7, Fig. 2.7)

Radiopaque lesions of bone (Table 2.8, Fig. 2.8)

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TABLE 2.1 Developmental Anomalies (see Fig. 2.1)

Condition	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
Fissured tongue (scrotal tongue)	First and second decades No gender predilection	Deep central groove; multiple, short furrows; tender, if irritated; may occur with <i>erythema migrans</i>	Dorsal and lateral tongue	Polygenic or autosomal dominant trait; occurs in <i>Down syndrome</i> , dry mouths, diabetes; detected in 1% of children; source of halitosis	Brush tongue; becomes more prominent with age	Erythema migrans Macroglossia with crenations Hemihyperplasia of tongue Orofacial granulomatosis
Ankyloglossia (tongue-tie)	Present at birth Male predilection	Short, thick lingual frenum or attachment to tip of tongue; may cause slight cleft at tip	Ventral tongue and floor of mouth	Occurs in 2%–11% of infants; rarely causes speech, feeding, swallowing or periodontal problems; multiple frenula associated with <i>oral-facial-digital syndrome</i>	Infrequently frenectomy is indicated; many self-correct with age	Bifid tongue Microglossia Palatoglossal adhesion (ankyloglossia superior) Tongue scar
Lingual thyroid	Second decade Female predilection	Nodular mass with pink or red, smooth surface; may cause dysphagia, dysphonia, or dyspnea	Midline base of tongue; <i>thyroglossal duct cyst</i> is variant that occurs in midline neck	Symptoms develop during puberty or pregnancy; normal thyroid absent in 70%; important cause of infantile hypothyroidism	Thyroid hormone therapy, excision or radioactive iodine ablation; carcinomas arise in <1%	Lymphoid hyperplasia Hemangioma Lymphangioma Epiglottitis
Commissural lip pits	Second decade Male predilection	Unilateral or bilateral depressions or fistulas; fluid may be expressed	Corners of mouth	Occurs in <1% of children; an association with preauricular pits	None required	Paramedian lip pits Angular cheilitis
Paramedian lip pits (congenital lip pits)	Present at birth No gender predilection	Bilateral and symmetric depressions or swellings; fluid may be expressed	Adjacent to the midline of the lower lip vermilion	Autosomal dominant trait; associated with cleft lip and palate; van der Woude and other syndromes	None required; surgery, if cosmetic problem	Mucocele Soft tissue abscess Median lip fissure Double lip Lip piercing
Retrocuspid papilla	First and second decades Female predilection	Asymptomatic, pink, sessile papule or nodule; usually bilateral	Lingual attached gingiva, adjacent to mandibular canines	Very common in children and regresses with age	None required; normal anatomic variation	Irritation fibroma Giant cell fibroma Soft tissue abscess
Bifid uvula	Present at birth No gender predilection	Midline groove or splitting of uvula; may have speech impairment	Midline, posterior soft palate	Minimal expression of cleft palate; marker for submucous palatal cleft; associated with <i>Loeys-Dietz syndrome</i> and others	None required; genetic counseling may be indicated	Traumatic defect

Continued

TABLE 2.1 Developmental Anomalies (see Fig. 2.1)—cont'd

Condition	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
Hyperplastic labial frenum	Present at birth No gender predilection	Thick triangular band of pink soft tissue; may be associated with gingival recession or diastema	Midline labial mucosa and gingiva; both maxillary and mandibular lip	Bleeds freely when lacerated; multiple frenula associated with <i>oral-facial-digital syndrome</i> ; rare breastfeeding problems	None required; frenectomy for some large diastemas, gingival recession or lip mobility problems	Traumatic scar Frenal tag
Torus palatinus (palatal torus)	Second decade Female predilection	Bony hard mass that varies in size and shape; asymptomatic, unless traumatized; rarely seen as radiopacity on radiographs	Midline hard palate	Most tori in this age group are slightly elevated with a smooth surface; autosomal dominant inheritance or multifactorial influence	None required; will continue to grow during adulthood	Prominent median palatal raphe Palatal exostosis Median palatal cyst
Torus mandibularis (mandibular torus)	Second decade Male predilection	Bony hard mass that varies in size and shape; asymptomatic, unless traumatized; radiopacity may be superimposed over roots of teeth	Bilateral, lingual mandible	Less common than torus palatinus; genetic and environmental influence	None required; will continue to grow during adulthood	Exostosis Peripheral osteoma Proliferative periostitis Fibrous dysplasia Condensing osteitis Idiopathic osteosclerosis
Exostosis	Second decade No gender predilection	Single or multiple bony hard nodules; asymptomatic, unless traumatized; radiopacity may be superimposed over roots of teeth	Maxillary and mandibular alveolar ridge on the facial aspect; usually bilateral; may occur on the palate	Exostoses that are traumatized mimic odontogenic infection because of the location; may be tender to palpation in children	None required; will continue to grow during adulthood	Peripheral osteoma Proliferative periostitis Ectopic tooth eruption Condensing osteitis Idiopathic osteosclerosis



• **Figure 2.1** Developmental anomalies. (A) Fissured tongue. (B and C) Partial ankyloglossia with lingual frenum attachment at the tip of the tongue (B). Note the restricted mobility of the tongue with extension (C). (D) Lingual thyroid of the midline base of the tongue. (E) Thyroglossal duct cyst with sinus tract, midline neck.

Continued



• **Figure 2.1, cont'd** (F and G) Commissural lip pit (F) with depth illustrated by periodontal probe (G). (H) Paramedian lip pits. (I) Retrocuspid papilla of the lingual mandibular gingiva. (J) Bifid uvula. (K) Hyperplastic maxillary labial frenum. (L) Torus palatinus of the midline hard palate. (M) Small exostosis of the anterior mandibular alveolus, facial aspect. ([D] Courtesy Dr. G.E. Lilly, University of Iowa College of Dentistry.)

TABLE 2.2 White Soft Tissue Lesions (see Fig. 2.2)

Lesion	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
White Surface Thickening Lesions						
Frictional keratosis and Morsicatio mucosae oris	First and second decades No gender predilection	Localized to diffuse, white, rough or shredded patches; adherent; asymptomatic	Mucosa adjacent to occlusal plane, including buccal, labial mucosa, lateral tongue; attached gingiva	Caused by chronic nibbling habits (<i>morsicatio</i>), irritation from orthodontic appliances, fractured teeth, and improper tooth brushing	Elimination of cause; lesion regresses; acrylic splint therapy for severe cases of <i>morsicatio</i>	Leukoedema Linea alba Smokeless tobacco keratosis Cinnamon contact stomatitis Lupus erythematosus Hyperplastic candidiasis
Smokeless tobacco keratosis (tobacco pouch keratosis)	Second decade Male predilection	Diffuse, white, wrinkled patch; adherent; asymptomatic; gingival recession; tooth staining; caused by snuff or chewing tobacco	Vestibular, labial and buccal mucosa; usually mandibular site	Highly addictive habit; lesions develop after 1–5 years of use; increased risk for periodontal disease, dental caries, tooth sensitivity, and halitosis	Discontinuation of habit results in lesion reversal; biopsy of persistent lesions; low risk for malignant transformation	Leukoedema Frictional keratosis Cinnamon contact stomatitis Chronic hyperplastic candidiasis
Leukoedema	First and second decades No gender predilection	Widespread, filmy white, wrinkled mucosa; adherent; disappears when stretched	Bilateral buccal, labial mucosa and soft palate	Most prominent in black children; condition increases with age; more pronounced in cigarette smokers	None required; common variant of normal mucosa	Frictional keratosis Linea alba White sponge nevus
Cinnamon contact stomatitis	Second decade No gender predilection	Oblong to broadly linear, white plaques with a shaggy, thickened surface; diffuse erythema; tender	Gingiva, mucosa adjacent to occlusal plane, including buccal mucosa and lateral tongue	Cinnamon flavoring in candy, chewing gum, toothpaste, mouth rinses	Identify and discontinue use of offending product; lesions resolve within 1 week	Morsicatio mucosae oris Hyperplastic candidiasis Smokeless tobacco keratosis Hairy leukoplakia

Continued

TABLE 2.2 White Soft Tissue Lesions (see Fig. 2.2)—cont'd

Lesion	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
Linea alba	Any age following the eruption of teeth; female predilection	Smooth or shaggy white line; may be scalloped; asymptomatic	Bilateral buccal mucosa, along occlusal plane	Associated with biting irritation or sucking habit; may be associated with leukoedema	None required; may spontaneously regress	Cinnamon contact stomatitis Scar formation Morsicatio mucosae oris
Hairy tongue	Second decade No gender predilection	Cream to brown discoloration; diffuse elongation of filiform papillae	Dorsal tongue	Contributes to halitosis; associated with cigarette smoking, poor oral hygiene, antibiotics, dry mouth, overuse of mouth rinses; coated tongue is more common in children	Eliminate cause; brush tongue	Coated tongue Frictional keratosis Hyperplastic candidiasis
White sponge nevus	First decade, may be present at birth No gender predilection	Diffuse, symmetric, corrugated, or velvety white plaques; adherent; asymptomatic; persistent	Bilateral buccal mucosa is most common; also found on labial mucosa, ventral tongue, floor of mouth, and soft palate	Autosomal dominant skin disorder; defect in <i>Keratin 4</i> and <i>keratin 13</i> ; extraoral sites may be involved; reaches full expression during adolescence	None required; condition stabilizes in young adulthood	Leukoedema Hereditary benign intraepithelial dyskeratosis Frictional keratosis Hyperplastic candidiasis Syndrome-related leukoplakia
Pseudomembranous candidiasis (thrush)	Any age, especially infancy No gender predilection	Widespread, white plaques that wipe off leaving a normal or red, raw base; mild burning	Any mucosal site but common on buccal mucosa, tongue, and palate	Caused by <i>Candida albicans</i> and other species; contributing factors are antibiotics, steroids, immune suppression; infants may have diaper rash; pacifiers, orthodontic appliances, and toothbrushes may harbor fungus	Antifungal medication and proper oral hygiene; may recur if cause is not eliminated	Plaque Chemical burn Coated tongue Oral mucosal peeling Morsicatio mucosae oris Koplik spots of rubella

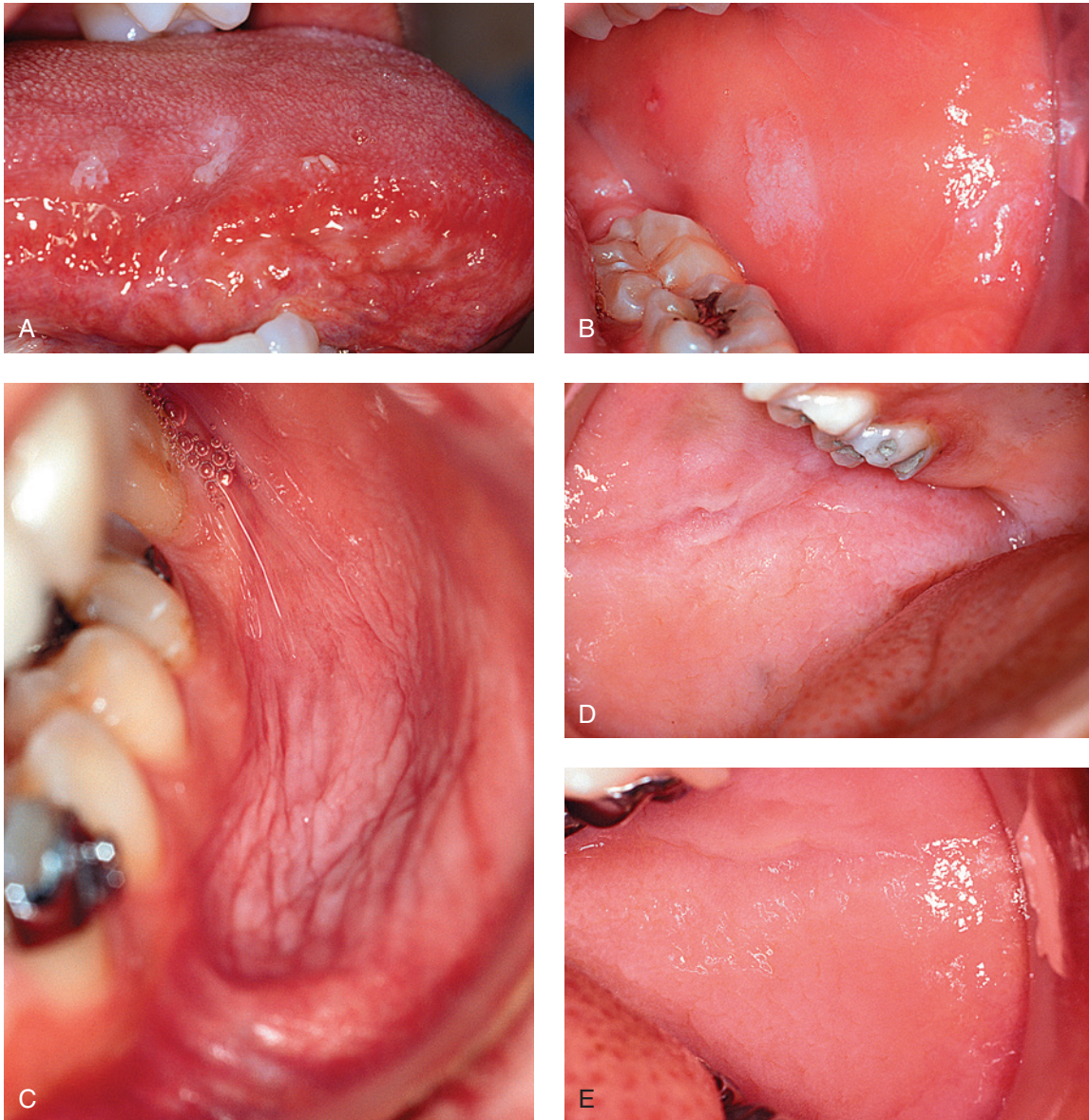
White Surface Material Lesions

Chemical burn	First and second decades No gender predilection	Localized or widespread, white nonadherent plaques, erosions or ulcers; tender to painful; sudden onset	Any site but common on lips, tongue, buccal mucosa, and gingiva	Multiple chemicals and drugs may cause this reaction, including those used in dentistry—inappropriate use of mouth rinses, topical anesthetics, phenol, formocresol	Identify and remove cause; ask about homeopathic remedies; symptomatic relief management	Thermal burn Pseudomembranous candidiasis Coated tongue Oral mucosal peeling Mucous patch of syphilis
Coated tongue (furred tongue)	First and second decades No gender predilection	White or yellow nonadherent coating on tongue; asymptomatic; may be source of halitosis	Dorsal tongue	Common condition associated with mouth breathing, febrile illnesses, dehydration, poor oral hygiene; source of halitosis	Brushing tongue and adequate hydration; tends to recur	Pseudomembranous candidiasis Hairy tongue White strawberry tongue
Oral mucosal peeling	Second decade No gender predilection	Translucent to white strips of mucosa that peel off; stringy and slimy in texture; may burn	Buccal and labial mucosa, tongue	Associated with detergents and other ingredients in toothpastes and mouth rinses	Identify and discontinue the oral hygiene product; resolves spontaneously	Plaque Pseudomembranous candidiasis Allergic contact stomatitis Thermal/chemical burn
White Subsurface Lesions						
Scar formation (cicatrix)	First and second decades No gender predilection	White or pale pink line or irregular patch with smooth surface; cross-hatch or starburst pattern; asymptomatic	Any site but common on labial mucosa, lip vermillion, tongue	History of oral trauma or surgery; may represent child abuse or self-mutilation	None required; scar revision if cosmetic concern or if restricts function	Linea alba Mucosal graft Lichen planus
Fordyce granules	Second decade Male predilection	Small, yellow-white, multifocal papules; discrete or clustered; asymptomatic	Bilateral buccal mucosa, retromolar pad and upper lip vermillion	Oral sebaceous glands occur in 20%–30% of children; puberty stimulates development	No treatment is necessary; may increase in size; laser treatment for cosmetics	Frictional keratosis Scar formation Pustules Milia

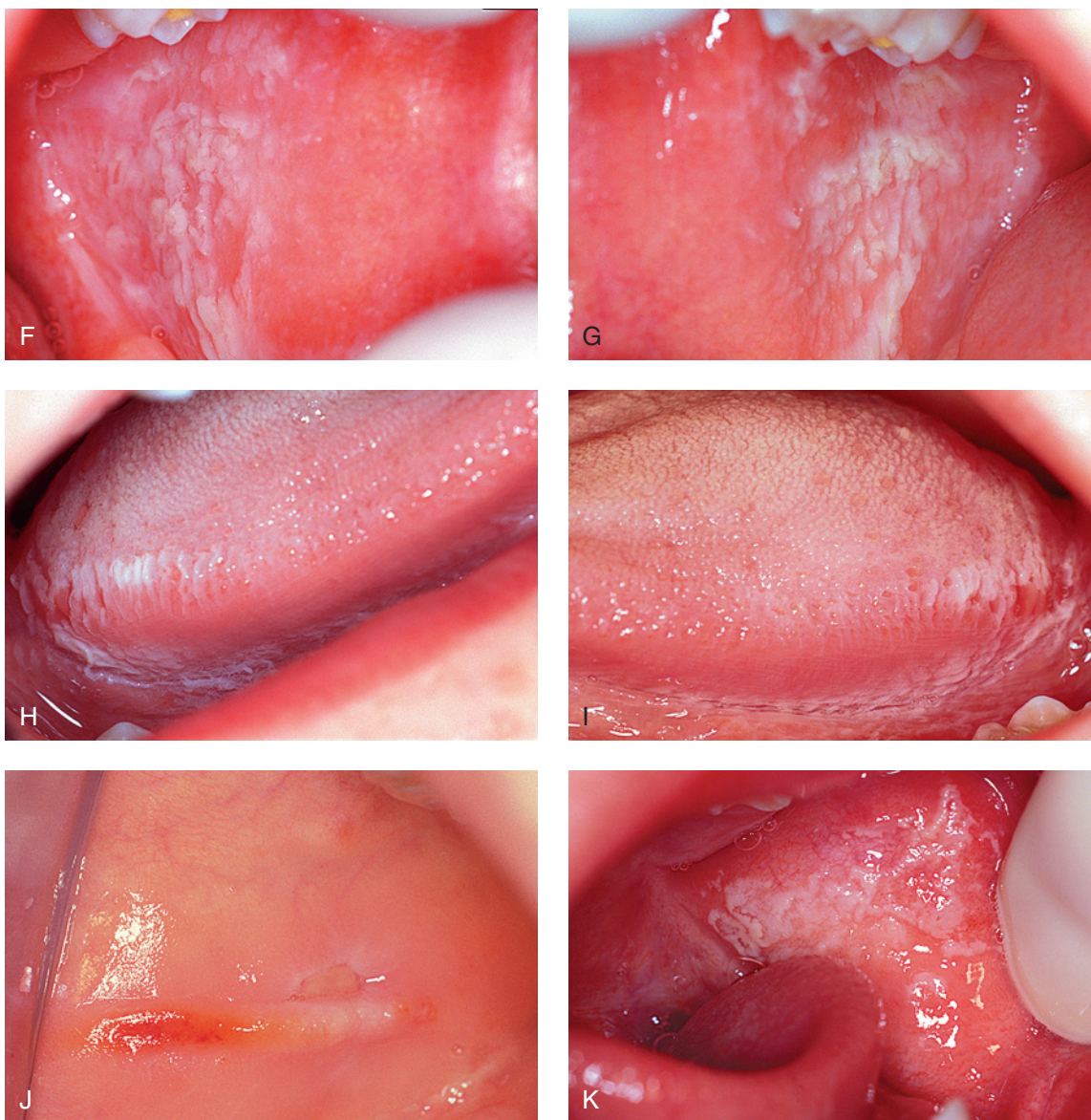
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TABLE 2.2 White Soft Tissue Lesions (see Fig. 2.2)—cont'd

Lesion	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
Oral lymphoepithelial cyst	Second decade No gender predilection	Solitary, soft, pinkish white nodule with superficial fine vascular pattern; usually nontender	Posterior lateral tongue, floor of mouth, soft palate	Mimics an abscess because it may fluctuate in size and discharge contents	Excisional biopsy; does not recur	Soft tissue abscess Lipoma Sialolith Tonsillolith Hyperplastic lymphoid aggregate
Sialolithiasis	Second decade No gender predilection	Solitary or multiple, hard, yellowish white globular mass; episodic pain and swelling when eating; obstructive disease of the duct	Usually floor of mouth within Wharton duct, submandibular gland	Occlusal or panoramic radiograph may assist with diagnosis; circular calcified mass	Massage of gland, surgical removal of stone and sometimes the gland; lithotripsy; stone may recur	Soft tissue abscess Oral lymphoepithelial cyst Epidermoid cyst Calcified lymph nodes
Palatal cysts of the newborn	Neonates No gender predilection	Solitary or multiple, discrete or clustered papules with a smooth pearly white surface; usually 1–3 mm in size, asymptomatic	<i>Epstein pearls</i> : median palatal raphe <i>Bohn nodules</i> : lateral hard and soft palate and junction	Cysts occur in up to 85% of neonates	None required; keratin-filled cysts that spontaneously rupture within first month	Soft tissue abscess Oral lymphoepithelial cyst
Gingival cysts of the newborn (dental lamina cysts)	Neonates No gender predilection	Solitary or multiple, discrete or clustered papules with a smooth translucent to pearly white surface; usually 1–3 mm in size, asymptomatic	Alveolar mucosa, especially maxillary mucosa	Cysts occur in up to 50% of neonates	None required; spontaneously rupture within first 3 months	Natal/neonatal teeth Soft tissue abscess Neonatal alveolar lymphangioma



• **Figure 2.2** White soft tissue lesions. (A and B) Frictional keratosis of the lateral tongue (A) and buccal mucosa (B) from chronic biting of the tissues. (C) Smokeless tobacco keratosis of the posterior mandibular vestibule. (D and E) Leukoedema of the buccal mucosa, bilaterally. *Continued*



• **Figure 2.2, cont'd** (F–I) White sponge nevus of the buccal mucosa (F and G) and lateral tongue (H and I). (J) Ulcerated linea alba from aggressive sucking habit. (K) Pseudomembranous candidiasis of the buccal mucosa.



• **Figure 2.2, cont'd** (L) Chemical burn from overuse of a topical anesthetic. (M) Coated tongue in a child who is mouth breathing. (N) Fan-shaped scar at the corners of the mouth due to an electrical burn. (O) Cluster of Fordyce granules of the anterior buccal mucosa. (P) Oral lymphoepithelial cyst of the posterior lateral tongue. (Q) Single palatal cyst of the newborn on the midline hard palate. (R) Cluster of gingival cysts of the newborn on the mandibular alveolar mucosa.

TABLE 2.3
Dark Soft Tissue Lesions (see Fig. 2.3)

Lesion	Pediatric Age and Gender	Clinical Findings	Location	Pediatric Significance	Treatment and Prognosis	Differential Diagnosis
Red or Purple-Blue Lesions						
Port-wine stain (capillary vascular malformation)	Infancy No gender predilection	Localized to diffuse, red to purple macular lesions; variable blanching; bleeds freely; gingival and bony enlargement; grows with child	Face, along distribution of trigeminal nerve, is most common site; may have lip and oral mucosal involvement	Occurs in approximately 1% of newborns; may be sign of <i>Sturge-Weber syndrome</i> ; bleeding is complication; possible neurologic disease; gingival lesion mimics <i>pyogenic granuloma</i>	Laser treatment; persistent lesion that may become darker in color and nodular with age	Hemangioma Venous and arteriovenous malformation Ecchymosis Hereditary hemorrhagic telangiectasia
Submucosal hemorrhage, including petechiae, ecchymosis, and hematoma	First and second decades No gender predilection	Localized to diffuse, pinpoint spots, patches or swellings with smooth surface; early lesions are red; late lesions are blue-black; may be tender	Buccal mucosa, lips, lateral tongue, and soft palate; may develop concurrently on skin	If multiple lesions, need to exclude child abuse, facial injury, infectious diseases, such as infectious mononucleosis, and blood disorders including leukemias, thrombocytopenia, anemia, and hemophilia	Identify the cause; no treatment for lesions; spontaneously resolve	Amalgam/graphite tattoo Blue nevus Hemangioma Vascular malformation Erythematous candidiasis Blood dyscrasia
Erythematous candidiasis	First and second decades No gender predilection	Multiple red macules to diffuse red patches; depapillation of tongue; burning sensation; may have <i>angular cheilitis</i>	Palate, buccal mucosa, dorsal tongue	Caused by <i>Candida albicans</i> and other species; contributing factors are antibiotics, immunosuppression, xerostomia, pacifier, and palatal coverage appliances	Antifungal medication and proper oral hygiene; may recur if cause is not eliminated or managed	Contact allergy Traumatic erythema Erythema migrans Thermal burn Palatal petechiae Anemia Scarlet fever (strawberry tongue)
Median rhomboid glossitis	First and second decades No gender predilection	Localized red, depapillated patch; oval to rhomboid in shape with smooth or lobulated surface; asymptomatic	Midline posterior dorsal tongue	Caused by candidal infection; localized palatal erythema or "kissing lesion" may be present	Antifungal medication and proper oral hygiene	Erythema migrans Traumatic erosion Contact allergy Hemangioma Vascular malformation Lingual thyroid
Erythema migrans (benign migratory glossitis)	First and second decades Female predilection	Multiple oval or circular red patches with white scalloped borders; loss of filiform papillae; pattern changes; may burn	Dorsal and ventrolateral tongue; rarely at other mucosal sites	More common in children than adults; increased risk in atopic children; may occur with <i>fissured tongue</i> and <i>transient lingual papillitis</i>	None required; avoidance of hot, spicy, or acidic foods; topical coating agents or steroids in symptomatic cases	Median rhomboid glossitis Contact allergy Erythematous candidiasis Transient lingual papillitis Lichen planus