Oral-Systemic Health Education for Non-Dental Healthcare Providers

University of Manitoba | Faculty of Health Sciences

An initiative of the International Centre for Oral-Systemic Health of the College of Dentistry in collaboration with the College of Medicine

Empowering Physicians, Nurses, Pharmacists and Other Non-Dental Healthcare Providers to Care for the Oral Health of Children and Adolescents

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Approved for CME credit
(in Canada and the United States)

Introduction

Every healthy newborn has the potential for success and good health. However, profound disparities in access to basic dental care very often have a devastating impact on the health, education, and well-being of children and adolescents.* In fact, dental caries (tooth decay) may serve as a sentinel disease for other pediatric conditions that are related to inadequate diet, poor oral hygiene and lack of dental care in childhood. Oral pain causes children to lose sleep and compromises growth. Oral health problems are also associated with a substantial reduction in school attendance, consequently diminishing learning potential. The reality for many underserved children and adolescents is that persistent oral pain, the inability to comfortably chew, and the embarrassment of discoloured and damaged teeth undermine the socialization process. As a result, unmet dental needs perpetuate low self-esteem and over time can wear down a child's stamina—ultimately hampering the child's dreams and ambitions. The most vulnerable are children and adolescents in populations of lower socioeconomic status, those in indigenous communities, immigrant and migrant populations, homeless families, and children with disabilities. All children and adolescents should have access to basic dental care.

(Introduction continued on page 4)

KEYWORDS: early childhood caries (ECC); fluoride; gingivitis; infective endocarditis (IE); knee-to-knee exam; oral dental screening; oral developmental abnormalities; oral health anticipatory guidance; oral health literacy; oral hygiene; oral dental trauma; pediatric dentistry; periodontal diseases; teething; tooth avulsion; tooth development.

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*For the purposes of this course: **infancy** is defined as birth-11 months of age; **childhood** is defined as 12 months-12 years of age; **adolescence** is defined as age 13-19 years of age.

Learning Objectives

Upon completion of this course, participants will be able to do the following:

1. Describe the role of the primary care provider (PCP; e.g., physician, physician assistant or nurse) in ensuring the oral health of children and adolescents, and support the concept of the dental home.
2. Describe the prevalence, etiology, clinical presentations and prevention and management of the most common dental diseases (i.e., caries and periodontal disease) in children and adolescents.
3. Provide anticipatory guidance to parents regarding oral health during infancy, childhood and adolescence.
4. Identify common oral abnormalities found in children and adolescents and treat or refer patients to appropriate HCPs as necessary.
5. Manage oral trauma from accidents.
6. Prevent infective endocarditis resulting from dental procedures in children and adolescents.
7. Provide supportive care for acute dental conditions of children and adolescents living in areas underserved by dentists and dental hygienists.
8. Describe successful programs that have provided access to basic dental care for children and adolescents from underserved populations.

Accreditation

Committee on Accreditation of Continuing Medical Education (CACME)
The University of Manitoba CPD Medicine Program is fully accredited by the Committee on Accreditation of Continuing Medical Education (CACME). This event was co-developed with the CPD Medicine Program, University of Manitoba and was planned to achieve scientific integrity, objectivity and balance.

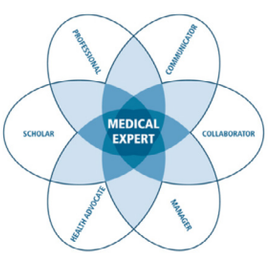
RCPSC Maintenance of Certification Section 3
This activity is an Accredited Self-Assessment Program (Section 3) as defined by the Maintenance of Certification Program of The Royal College of Physicians & Surgeons of Canada, and approved by the CPD Medicine Program, University of Manitoba on February 10, 2015 and expires February 10, 2018. Remember to visit MAINPORT to record your learning and outcomes. You may claim a maximum of 4.0 hours (credits are automatically calculated). Participants should only claim credit for the actual number of hours attended.

AMA PRA Category 1 Credit™
Through an agreement between the Royal College of Physicians and Surgeons of Canada and the American Medical Association, physicians may convert Royal College MOC credits to AMA PRA Category 1 Credits™. Information on the process to convert Royal College MOC credit to AMA credit can be found at ama-assn.org/go/internationalcme.

College of Family Physicians of Canada Mainpro-M1
This online program meets the accreditation criteria of the College of Family Physicians of Canada and has been accredited by the CPD Medicine Program of the University of Manitoba for up to 4.0 Mainpro-M1 credits.

CanMEDS Roles

As Medical Experts, physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills and professional attitudes in their provision of patient-centered care. The following CanMEDS Roles are addressed in this educational activity:



ROYAL COLLEGE OF PHYSICIANS AND SURGEONS OF CANADA | CANMEDS

- **Medical Expert** is the central physician role in the CanMEDS framework.
- **Communicator**: Physicians effectively facilitate the doctor-patient relationship and the dynamic exchanges that occur before, during and after the medical encounter.
- **Collaborator**: Physicians effectively work with patients, families and the healthcare team to achieve optimal patient care.
- **Health Advocate**: Physicians responsibly use their expertise and influence to advance the health and well-being of individual patients, communities and populations.
- **Scholar**: Physicians demonstrate a lifelong commitment to reflective learning, as well as the creation, dissemination, application and translation of medical knowledge.
- **Professional**: Physicians are committed to the health and well-being of individuals and society through ethical practice, professional-led regulation and high personal standards of behaviour.

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Access this Course Online

All courses in the *Oral-Systemic Health for Non-Dental Healthcare Providers* curriculum are available free of charge in web format at oralhealthed.com. The online version of this course covers the same learning objectives and learning material as the corresponding print/PDF format, and is enhanced with additional photos, illustrations and animations to help reinforce concepts. Visit oralhealthed.com to access the online version of this course.

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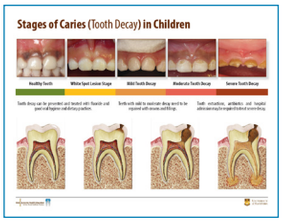
Supplemental Resources

To reinforce concepts taught in the *Oral-Systemic Health Education for Non-Dental Healthcare Providers* curriculum, supplemental resources are available for healthcare providers and their patients. In addition to links to helpful websites, a number of screening and diagnostic tools, referral forms, clinical posters and patient hand-outs are included with each course. Supplemental resources are available in print (inside the back cover of the print version of this course) and electronically (PDF format) at oralhealthed.com.

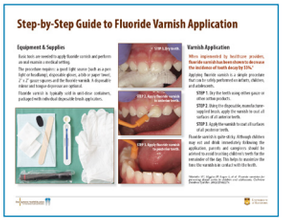
Stages of Caries (Tooth Decay) in Children

Use this curriculum resource to review and share images of visually-detectable caries with your patients.



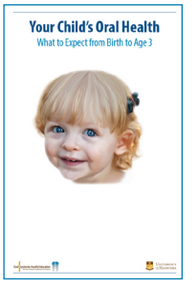
Step-by-Step Guide to Fluoride Varnish Application

Use this curriculum resource to train your clinical staff on fluoride varnish application.



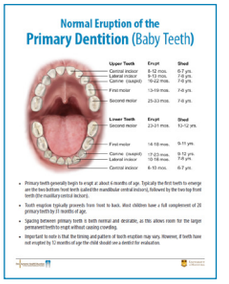
Anticipatory Guidance Sheets

Print these curriculum resources and distribute to your patients to help manage their expectations about the development of the oral cavity. Four handouts are available as attachments to this course; one for each age group from birth to19 years of age.



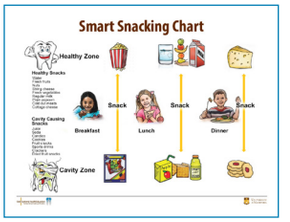
Eruption Charts

Use these curriculum resources to educate your colleagues and patients about the eruption sequence and pattern of primary and permanent teeth.



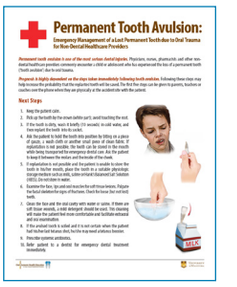
Smart Snacking Chart

Encourage young patients to hang this chart on the refrigerator as a reminder of the difference between healthy and decay-causing snacks.



Permanent Tooth Avulsion: Emergency Management of a Lost Permanent Tooth due to Oral Trauma for Non-Dental Healthcare Providers

Use this curriculum resource to help train your staff to care for patients who have experienced permanent tooth avulsion as a result of oral trauma.

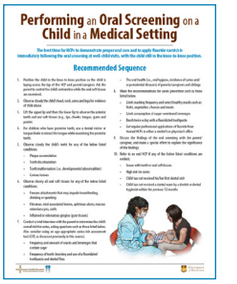


First Aid for a Lost Adult Tooth

Print this curriculum resource and distribute to parents, coaches and teachers to help ensure that best practices are followed at the accident site when an adult tooth is lost due to oral trauma.

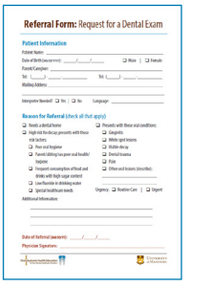
Performing an Oral Screening on a Child in a Medical Setting

Use this curriculum resource as a checklist when performing an oral exam.



Referral Form: Request for a Dental Examination

Use this University of Manitoba curriculum resource as a referral tool. Print and keep copies of this form in your clinic to assist with making timely and appropriate referrals of children to oral HCPs.



Introduction *(continued from cover page)*

Although the majority of infants and toddlers have not seen a dentist, most see physicians, nurses, pharmacists and other non-dental healthcare providers (HCPs) on a regular basis. Each of these visits is an opportunity to screen for caries and periodontal diseases (e.g., gum disease), and provide preventive services that may limit exposure to oral disease. Physicians, nurses and other non-dental HCPs also have an important role in advocating for more comprehensive and universal dental care for children.

This course provides information and ideas that will empower non-dental HCPs to care for the oral health of children and adolescents. The importance of establishing a dental home will be discussed. Overviews of the clinical presentation of the most common oral diseases and abnormalities in children and adolescents will be presented, along with strategies to prevent caries and gingivitis. This course provides key information for non-dental HCPs to incorporate into anticipatory guidance to help parents understand the importance of oral health during infancy, childhood and adolescence. In addition, this course offers recommendations for preventing and managing oral trauma, and preventing infective endocarditis following dental procedures. The course concludes by illuminating a number of programs that have successfully provided children and adolescents from underserved populations with access to basic dental care.

University of Manitoba Wins Gies Award

Outstanding Innovation - Academic Dental Institution

Winning the 2015 Gies Award for Outstanding Innovation - Academic Dental Institution, the University of Manitoba has stepped up as a leader in health sciences education for its *Oral-Systemic Health Education for Non-Dental Healthcare Providers* curriculum.

Created by dental experts for non-dental healthcare providers, this professional development curriculum explicitly identifies oral-systemic interrelationships and moves toward medical-dental curriculum reform. The courses provide interprofessional education and encourage collaborative, patient-centered care targeting comorbidities associated with oral diseases and conditions.

The curriculum is being recognized as the very first evidence-based, interprofessionally-peer-reviewed, multi-platform collection of accredited continuing education courses to successfully engage dental and medical professionals as peers and bridge the knowledge gap between dentistry and medicine.

Special Thanks

The Colleges of Medicine and Dentistry at the University of Manitoba want to thank the Manitoba Government for providing an educational grant to support the development of the *Oral-Systemic Health Education for Non-Dental Healthcare Providers* curriculum.

Scientific investigation conducted over the last several decades has provided compelling evidence that diseases and conditions of the oral cavity can have a profound and pervasive impact on overall health, especially in high-risk populations where access to care may be limited. With this emerging body of knowledge has come increased awareness that among non-dental healthcare providers (e.g., physicians, nurses, pharmacists and the greater healthcare community) there is a significant gap in knowledge concerning the interrelationships between oral and systemic health, or recognition of the significance of oral health in achieving and sustaining general health outcomes.

With appropriate education and training, physicians, nurses, pharmacists, dieticians, speech pathologists and other non-dental healthcare providers can significantly affect the epidemiologic trends in serious and often debilitating oral diseases and conditions. This innovative curriculum is the first comprehensive plan to fill the gaps in oral health knowledge and its application to practice in medicine, nursing and other healthcare disciplines.

Table of Contents

Table of Contents *(continued from previous)*

Table of Contents *(continued from previous)*

Case Study 1: Case in Point

This case study demonstrates a lost opportunity to identify **early childhood caries (ECC)** at the incipient **white spot lesion** stage and subsequently prevent the progression of the disease. Had this child received oral screening at an earlier age, and had the parent been counseled regarding healthy diet and good oral hygiene practices, the outcome may have been different.

Unfortunately, cases like this are common, resulting in pain, tooth loss, and heavy use of public health resources, such as dental treatment provided in the hospital under general anesthesia (GA).

DAY 1: A 4-year, 1-month-old girl presented to her primary care provider (PCP) for a routine pediatric examination. She had seen the same PCP since she was 18-months-old, but she had never seen a dentist or dental hygienist.

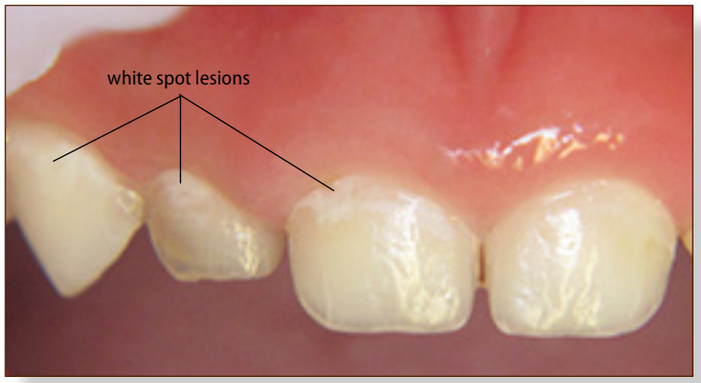


Figure 1. White spot lesions. These areas of demineralization are readily visible on the labial (lip-side) aspects of the child's maxillary central incisors. White spots are precursors to caries. Photo source: Travis Nelson. Used with permission.

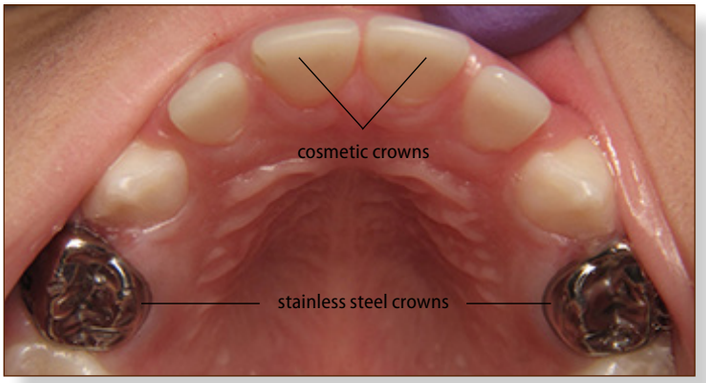


Figure 3. Crowns. Visible on these maxillary primary incisor teeth are the lingual aspects of cosmetic crowns created from white dental composite material. Stainless steel crowns are visible on the maxillary primary molars. Photo source: Travis Nelson. Used with permission.

Figure 2. Caries. Cavitated lesions (frank caries) are readily visible on the lingual (tongue-side) aspects of the same teeth shown in Figure 1. Photo source: Travis Nelson. Used with permission.

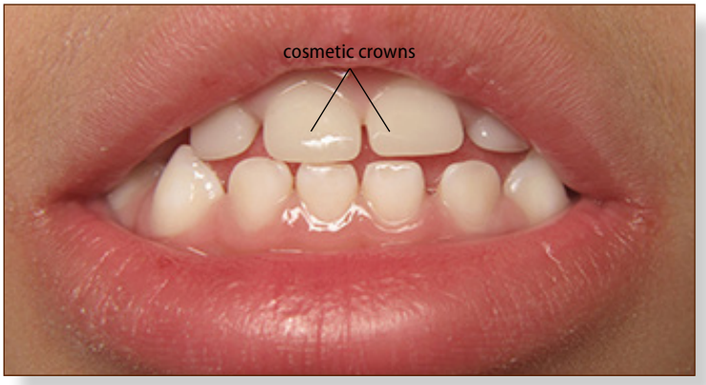


Figure 4. Crowns. Visible here is the labial aspect of the same cosmetic crowns on the maxillary primary incisor teeth shown above. Photo source: Travis Nelson. Used with permission.

The child was in good health, took daily multivitamins and had no known allergies. At this visit, her mother explained that recently her daughter had been fussy and reluctant to eat cold and sweet foods. The PCP had not previously performed an oral examination on this patient, nor had he discussed aspects of oral health with the parent.

Upon visual examination of the child's mouth, the PCP found white spot lesions on the **labial** aspects of her **maxillary** anterior teeth (*Figure 1*) and visible **caries** on the **lingual** aspects of these teeth (*Figure 2*). The PCP referred the child to a local dentist, where she had an initial examination the following week.

DAY 9: The dentist diagnosed decay in all 4 maxillary incisors as well as deep caries into the **dental pulp** of both maxillary and **mandibular** primary molars. Given the extent of the child's treatment needs, the dentist recommended that she be treated under GA.

The backlog of other children requiring GA services for dental care was so great that it was not possible to treat this child for three months. During this long waiting period, the child experienced several episodes of tooth pain that interfered with her ability to eat and sleep.

DAY 111: After waiting more than 100 days, the child's dental treatment was completed in one hour under GA. Treatment consisted of extracting an abscessed mandibular molar, root canal treatment (**pulpotomy**) on three teeth, stainless steel crowns on five primary maxillary and mandibular molar teeth (*Figure 3*) and cosmetic crowns on four maxillary anterior teeth (*Figure 4*).

CONCLUSION: If caries in this child's mouth had been diagnosed earlier she may have been treated with **minimally invasive dental procedures**, such as **remineralization**. Delayed diagnosis precipitated severe **carious lesions** that required more invasive dental treatment, necessitating GA for this child.

Earlier diagnosis and treatment would have substantially decreased the child's pain, possibly eliminating the need for **invasive dental procedures** and significantly reduced the treatment expense.

Role of the Primary Care Provider in Ensuring the Oral Health of Children and Adolescents

For most children the entry point into the healthcare system is through primary care providers (PCPs). Recognizing this fact, the Canadian Dental Association (CDA), the Canadian Academy of Pediatric Dentistry (CAPD), the American Academy of Pediatrics (AAP) and the American Academy of Pediatric Dentistry (AAPD) now recommend that children receive an oral health screening by a dental or medical provider by 1 year of age.[1]

PCPs are experts at screening for and diagnosing disease. With respect to oral health, the role of the PCP is to screen for caries, gingival inflammation, and abnormalities of the oral cavity, determine caries risk, provide **anticipatory guidance** and refer at-risk children and adolescents to oral HCPs (e.g., dentists and dental hygienists) when indicated. Physicians, nurses, pharmacists and other non-dental HCPs should recognize that they are already communicating many of the messages that promote oral health to their patients, such as educating them about food selection and eating behaviours that help reduce obesity. Simply stating, "and this will also help reduce cavities and make your gums healthier" helps influence positive oral health behaviours.

To encourage habits that promote a lifetime of oral health, a dental home should be established for each child.[2] The notion of a dental home is derived from the AAP's concept of a medical home, which is where comprehensive, continuously-accessible, family-centred, coordinated, compassionate and culturally-effective care is provided.[3] This is best established by either a non-dental HCP's early referral to a dentist, or a parent/caregiver's selection of a dentist.[4] The dental home should be established either within 6 months of the eruption of the first tooth, or by 12 months of age.[2] The dental home promotes continuity of care, and is associated with fewer emergency visits and reduced treatment costs.[5] There are also long-term psychological benefits that accrue to children and adolescents who receive routine dental care.

When a dental home does not exist, tooth decay may go untreated until a child reaches school age. This often results in extensive interventions to restore or extract damaged teeth, which may be invasive and traumatic for the child. Employing early and continuous prevention strategies reduces the need for invasive procedures and the risk of serious dental problems in the future.[6]

Pearls to Practice

Role of the PCP in Ensuring the Oral Health of Children and Adolescents

1. **All HCPs should encourage parents and caregivers to ensure that their children receive an oral health exam by a dental or medical provider by 1 year of age.**
2. The dental home is best established through early referral to a dentist. **Non-dental HCPs can play a vital role by screening for oral disease early and facilitating referral to a dentist for all pediatric patients.**

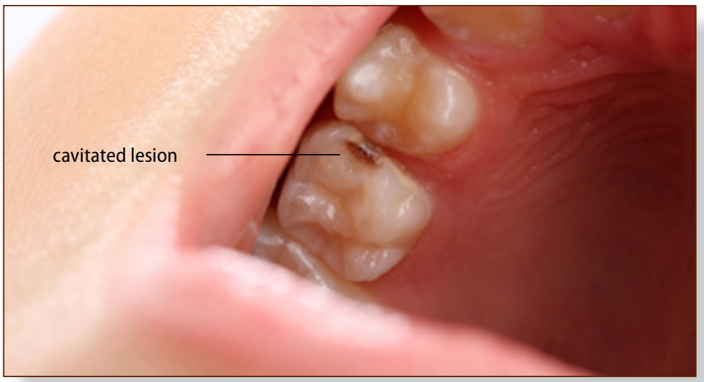


Figure 5. Tooth decay. This cavitated lesion represents tooth decay in a molar that has advanced beyond the white spot lesion stage. Photo source: © iStockphoto.com/kgfoto. Used with permission.

Figure 6. Rampant dental caries. Severe tooth decay can be seen in several teeth in this 5-year-old girl. (This photograph is for illustrative purposes only). Photo source: phetsamay philavanh/Shutterstock.com. Used with permission.

Most Common Oral Health Problems of Children and Adolescents

The two most-common oral health problems that children and adolescents encounter are tooth decay (*Figure 5*) and **periodontal disease**. Pain, suffering and eventual tooth loss from untreated caries and/or periodontal disease may interfere with breathing, tasting, eating, swallowing, sleeping, speaking and language development—all of which are vital to the health and development of children and adolescents.

Early Childhood Caries (ECC)

Prevalence of Dental Caries in Children and Adolescents

While many North Americans have experienced improved oral status over the past 20 years, prevalence of caries in children aged 2-6 years has actually increased.[7] A recent national survey showed that 57% of Canadian children aged 6-11 years have had tooth decay.[8] Alarmingly, in some Canadian indigenous populations the prevalence of decay may exceed 90%.[9,10] More alarming still is the fact that dental caries in these groups is on the rise. Similar statistics have been reported in the United States. According to recent reports from the Centers for Disease Control and Prevention (CDC), more than one-quarter (27.9%) of all American children aged 2-6 years have experienced dental decay and nearly three-quarters (73.4%) of these affected children have unrepaired teeth.[11] This equates to 4.5 million toddlers in the United States who are affected, of which 3 million need dental restoration before kindergarten.

Dental caries remains the single-most common disease of childhood. Caries is not self-limiting like the common cold; and, unlike an ear infection, caries does not respond to a simple course of antibiotics.[12] Early childhood caries (ECC) is an aggressive disease process that can result in severe destruction of the primary dentition (**rampant dental caries**; *Figure 6*). Children who suffer from this condition may experience pain and tooth loss, which can impair sleep, normal growth, nutrition and school performance.[13,14] Historically, dental caries in young children was described as 'baby bottle tooth decay' and 'nursing bottle caries'.[15] Over time, our understanding of this condition as a disease process has improved. We now recognize that many factors other than bottle use may contribute to a child's caries experience. Children under 6 years of age are now considered to have ECC if the child has one or more decayed teeth (**noncavitated lesions** or **cavitated lesions**), missing teeth (due to caries), or filled tooth surfaces in any **primary teeth**.[16,17]

The consequences of dental disease are cumulative, and children who have experienced decay often develop more decayed teeth as they grow older. Indeed, roughly two-thirds of American children between the ages of 12-19 years who come from lower-income families have experienced dental decay.[18] When left unchecked, the disease process often continues into adulthood. For instance, premature loss of primary teeth or loss of **permanent teeth** often results in

malocclusion, periodontal disease and temporomandibular joint disturbances (TMJ) among other dental problems in adulthood. Unhealthy practices that begin in childhood may contribute to lifelong dental problems. As evidence of this, statistics currently show that more than one-quarter of American adults aged 65 years or older have lost all their teeth.[18] The factors contributing to tooth loss in older adults are largely avoidable if children begin life with a healthy mouth and good oral habits.

Etiology of Dental Caries

Teeth consist of a calcified exterior with an interior network containing rich vasculature and innervation (*Figure 7*). The **crown** of each tooth consists of two laminated layers—**enamel** and **dentin**. Enamel is composed of a highly mineralized crystalline structure. Similar to porcelain, enamel is extremely hard yet brittle. Structurally, dentin is more organic and contains a series of channels, called **dentinal tubules**. These tubules are permeable, and will produce a sensation of pain when exposed. The root of the tooth is covered in a dentin-like substance called **cementum**. Cementum couples with the tooth's anchor, the **periodontal ligament (PDL)**. Periodontal ligament fibres are integrated with the cementum and **alveolar bone** of the jaw. They provide firm yet flexible attachment and **proprioception**.[19]

Dental caries occurs as a result of the confluence of four key elements: a host (tooth in the oral environment), fermentable substrate (dietary carbohydrates), acid-producing bacteria and time (*Figure 8*). Bacteria form a **plaque biofilm**, which adheres to the tooth surface. As we eat, bacteria consume the foods we ingest to produce a lactic-acid by-product. This, in turn, causes a reduction in the mouth's pH level from near neutral to around pH 5, which is mildly acidic. This persists for 20-40 minutes, during which time minerals are leached from the tooth.[20] This process is known as **demineralization**. Ideally, after demineralization the oral pH returns to a neutral state and the tooth undergoes remineralization—the process by which saliva redistributes minerals to the tooth. If a tooth is subjected to repeated incidences of demineralization without adequate periods of remineralization, it will become fragile and break down. The result is dental caries.[21]

The key to controlling dental caries lies in maintaining healthy oral chemistry, a process conceptualized as the **caries balance**.[22] This model recognizes the dynamic balance that is responsible for the prevention or development of caries. By managing the four key variables of host, diet, bacteria and time, pathologic factors are kept under control and the balance is tipped toward optimal mineralization of teeth.[23] *Figure 9* illustrates both the risk and protective factors that determine whether dental caries progresses, arrests, or reverses. The balance shifts according to increases in either risk factors and disease indicators or protective factors.

SUPPLEMENTAL RESOURCE

Stages of Caries (Tooth Decay) in Children

Use this curriculum resource to review and share images of visually-detectable caries with your patients.

Factors that Place a Child at Risk for ECC

Like many diseases, management of ECC is based upon individual risk. Nearly all children start life with healthy primary teeth, yet within just a few years some children develop caries. The interplay of behavioural, environmental and biological risk factors determines which children will develop decay.

Developmental Risk Factors

Before a child is even born, factors exist that may alter his/her risk for tooth decay. Primary teeth begin developing in utero. Therefore, the makeup and quality of primary teeth can be affected by both pre- and perinatal factors.

Teeth that do not form properly are at increased risk for caries.[24-26] Poor tooth quality, known as **hypoplasia** and/or

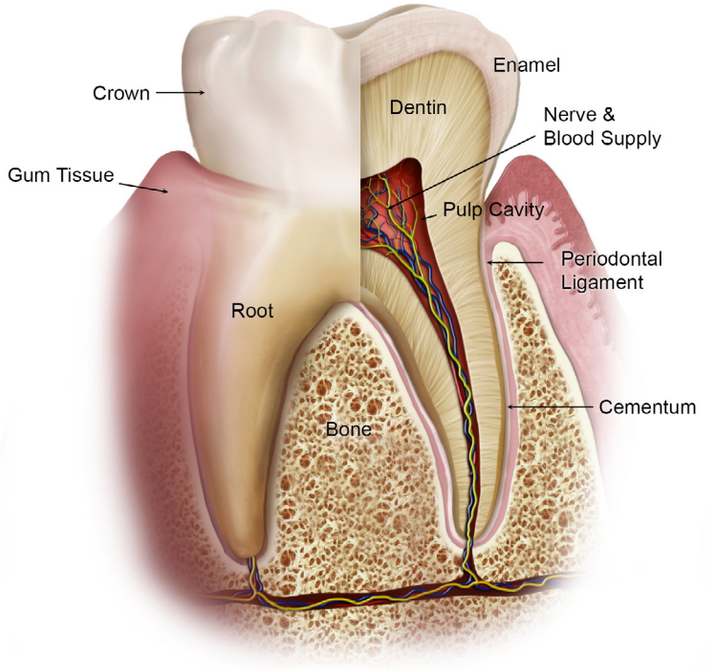


Figure 7. Anatomical cross section of a human tooth. The crown of healthy teeth is covered by enamel, a highly mineralized, crystalline structure. The root is covered by a porous structure called cementum, which is much more susceptible to decay. The pulp chamber houses the vascular and nerve supply of the tooth.

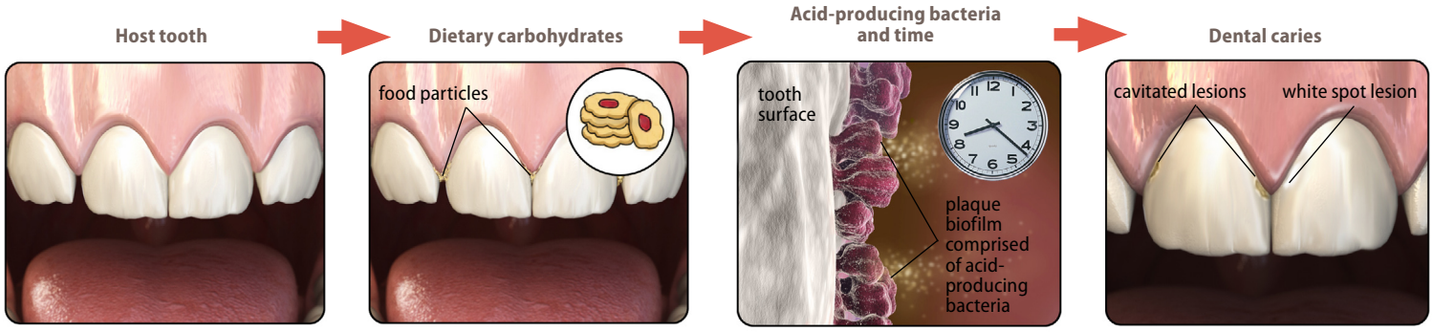


Figure 8. Four key elements cause dental caries: host tooth; dietary carbohydrates; acid-producing bacteria; time. Bacteria form a plaque biofilm, which adheres to the tooth surface. As we eat, bacteria consume the foods we ingest to produce a lactic acid by-product, leaving the oral cavity slightly acidic. These acidic conditions persist for about 20–40 minutes, during which time minerals are leached from the tooth in a process called demineralization. The key to controlling dental caries lies in maintaining healthy oral chemistry, a process conceptualized as the caries balance (see Figure 9, below). This image is available as an animation in the online version of this course. © 2014 University of Manitoba. All rights reserved.

hypomineralization, is often due to these factors.[24]

- Poor maternal nutrition
- Low birth weight
- Prematurity
- **Hypocalcemic** conditions (e.g., vitamin D deficiency, chronic renal failure, **hypoparathyroidism**)
- **Hyperbilirubinemia**
- Infections during fetal life and the neonatal period
- Local traumatic injury from laryngoscopy and endotracheal intubation

Risk Factors Related to Oral Chemistry

An individual's unique oral chemistry, including his/her ability to buffer an acid challenge, also affects caries risk. The principal intrinsic oral pH buffer is saliva. Saliva bathes the teeth in minerals necessary for remineralization, and has the capacity to neutralize acidic challenges. Saliva quantity and quality is highly individualized. Children who are exposed to high-dose radiation to the head and neck experience extremely inadequate salivary function. These patients may have little or no salivary flow and/or altered salivary composition. As a result they often develop severe caries (*Figure 10*) even when good oral hygiene and healthy diet habits are practiced.[27]

While radiation-induced **hyposalivation** is rare in children, hyposalivation related to medication use is not. **Xerostomia** (dry mouth) is a common side effect of over 400 medications (*Figure 11*). Medications that commonly cause xerostomia include cardiovascular medications, antidepressants, sedatives, centrally-acting analgesics, anti-allergy medications and behavioural stimulants.[28-30] Many of these medications are only administered to children with uncommon health conditions. However, stimulants are regularly prescribed for children with attention deficit hyperactivity disorder (ADHD). These children experience more caries, which may be attributed to altered quality and quantity of saliva as well as high amounts of dental plaque.[31,32]

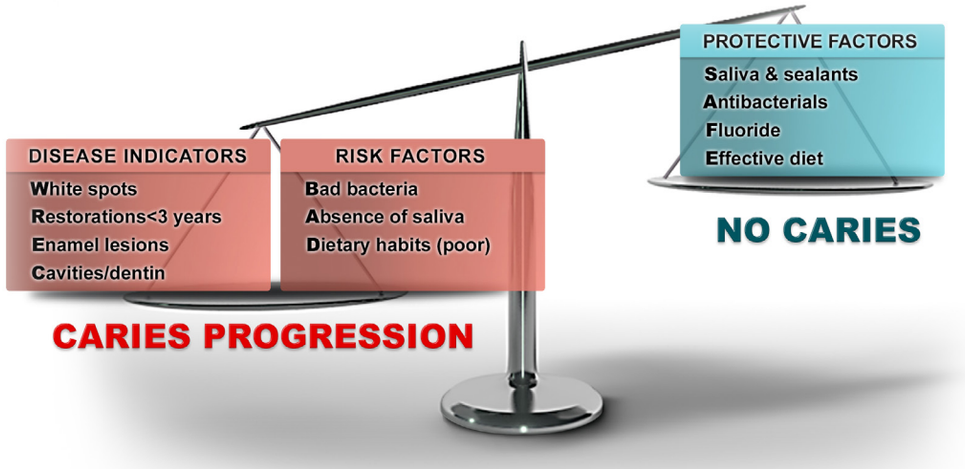


Figure 9. The caries balance. The balance shifts toward/away from caries progression according to changes in disease indicators, risk factors and protective factors. Disease indicators include: presence of white spot lesions, restorations (tooth fillings) within the last 3 years, presence of enamel lesions indicating enamel breakdown and visible cavities with exposed dentin. Risk factors for dental caries include: acid-producing bacteria, poor saliva quantity and/or quality and poor dietary habits. Protective factors include: sufficient saliva quantity and quality, prophylactic use of sealants on teeth with deep grooves and/or fissures, regular use of antibacterial agents (toothpaste and mouth rinses), sufficient fluoride exposure and healthy dietary practices. Redrawn with permission from the Journal of the California Dental Association.

SUPPLEMENTAL RESOURCES

Xerostomia (Dry Mouth)

Use these online resources to educate yourself and your patients about the causes and management of xerostomia.

Drymouth Info (Practitioner Portal):
drymouth.info/practitioner/default.asp

Drymouth Info (Patient Portal):
drymouth.info/consumer/default.asp

National Institute of Dental and Craniofacial Research:
nidcr.nih.gov/OralHealth/Topics/DryMouth/

Bacterial Risk Factors

Researchers have identified over 700 bacterial species in the human oral cavity.[33] Of these, mutans streptococci (MS) is strongly associated with dental caries.[34,35] The **virulence** of these bacteria is related to their ability to adhere to a tooth, produce acid and survive in an acidic environment.[36,37] Infants acquire MS bacteria at the time of birth, but significant colonization and proliferation of MS does not usually occur until tooth eruption as teeth provide a hard surface onto which the bacteria can adhere.[38-40]

We now know that MS bacteria colonize through **vertical transmission** from mother to infant.[41-43] Therefore, infants typically have the same strain of MS as their mothers. Additionally, mothers with high levels of MS have greater chances of colonizing their babies with these bacteria.[44] This means that when a mother kisses her baby, she could translocate these virulent bacteria to her infant's mouth. Non-dental HCPs can help decrease the chances of children becoming colonized with MS by encouraging mothers to practice excellent personal oral hygiene and seek routine dental care. Regularly brushing the infant's teeth as soon as they erupt may also help reduce the risk of early bacterial acquisition and proliferation.[45]

Environmental, Social and Behavioural Risk Factors

In a conceptual model for dental caries, Fisher-Owens and colleagues described the four key factors of host, diet, bacteria and time within a global framework (*Figure 12*).[46] They demonstrated that to fully comprehend and address the factors that contribute to dental caries, the disease must be viewed within a much broader context. In this model, oral health is affected by environmental/community, family and individual influences. Though not among the four key factors previously discussed, these variables have been shown to be very predictive of dental caries.[47]

Like obesity, dental caries is mediated by human behaviour. Human behaviour both affects and is affected by all of the variables found within this framework, and dictates how each individual will experience a disease. Perhaps the most broad-reaching and profound environmental influence is poverty.

Poverty exerts pressure on individuals that can adversely affect their health-related behaviours, including factors relating to the development of dental caries. Not surprisingly, children of low socioeconomic status (SES) experience the majority of tooth decay.[11] For example, approximately 40% of children enrolled in social programs in the United States (e.g., Women Infants and Children,WIC; Head Start) have tooth decay, compared with only about 20% of their more affluent peers.[7,48,49] Although Canadian data is currently unavailable, a number of reports indicate that caries patterns in Canadian preschool children follow the same trends.[50] A recent Canadian study showed that 5-year-olds who had experienced maltreatment (e.g., neglect and/or physical and/or psychological abuse) were almost twice as likely to have experienced ECC. Therefore, clinicians should consider the child's environment when seeking to identify children at high risk for decay.

Figure 10. Rampant dental caries. This 16-year-old boy received chemotherapy and radiation therapy for treatment of Hodgkin's lymphoma at 6 years of age. Radiation-induced hyposalivation led to rampant dental caries. Photo source: Travis Nelson. Used with permission.

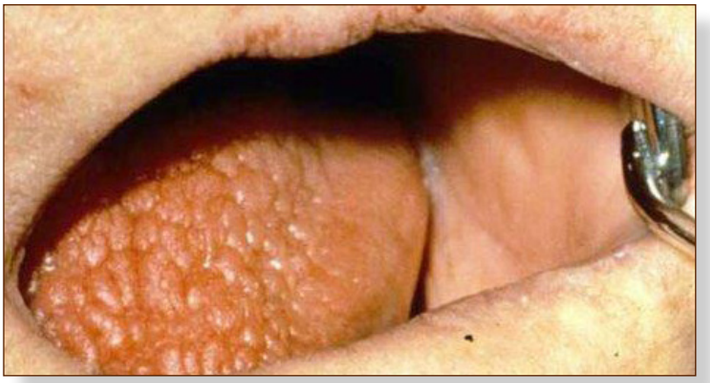


Figure 11. Xerostomia. Dry oral soft tissues and a rough tongue are signs of inadequate saliva flow, causing severe dry mouth. Photo source: Anthony Iacopino. Used with permission.

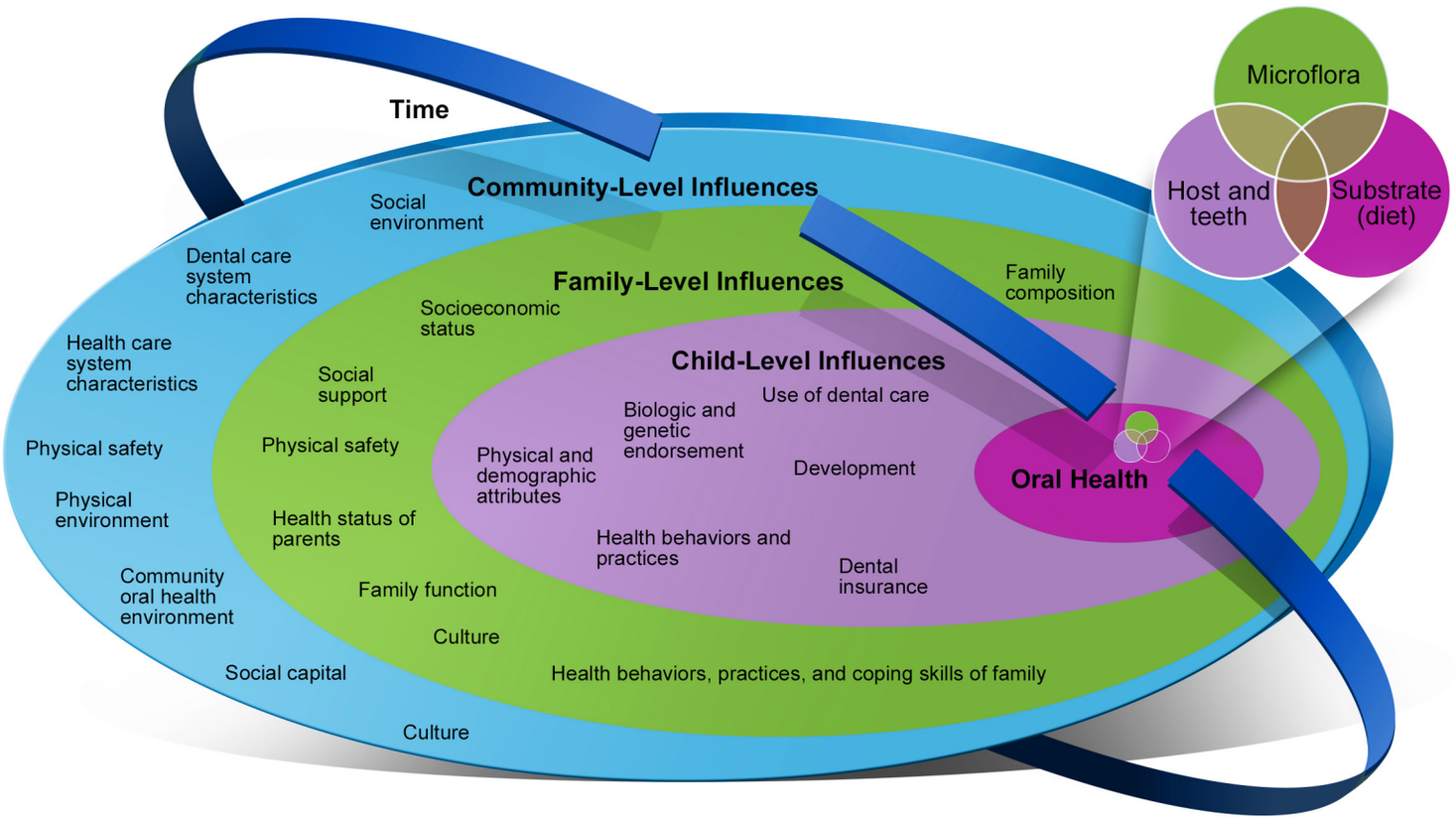


Figure 12. Fisher-Owens model of the social influences on dental health. This ecologic model demonstrates the local and global factors responsible for oral health, recognizing that a child's disease experience is affected by factors beyond the individual. Like other chronic diseases, dental caries is mediated by human behaviour, which has an affect on and is affected by a variety of environmental, social and biological risk factors. Adapted from: Fisher-Owens SA, et al. Influences on children's oral health: a conceptual model. Pediatrics. 2007; 120(3):e510-20. Original image adapted from: (A) Keyes PH. Bateriological findings and biological implications. International Dental Journal. 1962; 12:443-64. (B) National Committee on Vital Health Statistics. Shaping a health statistics vision for the 21st century. Washington, DC: Department of Health and Human Services Data Council, Centres for Disease Control and Prevention, National Center for Health Statistics, 2020: viii. Redrawn with permission.

Caries Risk Assessment

Risk assessment is the cornerstone of preventive medicine. By assessing factors that affect individual risk, preventive resources can be effectively allocated to those who need them most. Low SES is one factor that may help alert medical and nursing professionals to be more vigilant in assessing a child's caries risk. However, other factors that may affect an individual's susceptibility to dental caries are often more difficult to determine. A number of age-based **caries risk assessment tools (CATs)** have been developed to help determine an individual's risk for disease.

A CAT tailored to the specific needs of medical providers is also available through the California Dental Association.[51,52] This 1-page tool utilizes caries management by risk assessment (CAMBRA), a methodology that provides clinicians with a framework for identifying the cause of caries in individual patients by assessing their specific caries risk factors (*Figure 13*). The form also provides a checklist of concrete caries intervention strategies that all HCPs can either recommend or perform.

When using the form, the HCP will first determine caries risk indicators based upon an interview with the parent (e.g., whether the child has a sibling with a history of dental decay, sleeps with a bottle or nurses on demand, takes saliva-reducing medications, etc.). Next, any protective factors will be accounted for (e.g., child drinks fluoridated water, brushes teeth daily with fluoridated toothpaste, receives regular professional fluoride treatment, etc.). Collection of this information allows all HCPs to modify or manage any risk factors using specific treatment recommendations. This could include behavioural modification, the use of chemicals and antibiotics and **minimally invasive dental procedures**. Risk assessment and interventions are based on the concept of altering the caries balance, discussed previously. The HCP should then examine the child's dentition. Steps to performing a dental screening are discussed later in this course.

The form facilitates decision-making by offering three disease categories: 1) no visible ECC; 2) non-cavitated ECC (white spots); and 3) cavitated ECC (**frank caries**). Following the examination a diagnosis of 'low' or 'high' caries risk is selected. Once risk has been determined, the provider

CAMBRA Form for Medical Providers (0-5 year patients), Assessment Tool

(Adapted from UCSF/San Francisco General Hospital Department of Family and Community Medicine.)

Name

DOB

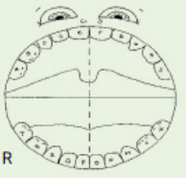
Community Health Network
San Francisco General Hospital
Medical Center

Family Health Center
Pediatric Oral Health Screening
Progress Notes

MRN
PCP
Patient ID/Addressograph

MEDICAL CAMBRA RISK ASSESSMENT FORM 0 TO 5 INFANTS & TODDLERS

Chief complaint or reason for referral ❑ Initial ❑ Follow-up

Caries risk indicators — based on parent interview	Y	N	Notes
(a) Mother/ primary caregiver has had active dental decay in past 12 months			
(b) Older siblings with history of dental decay			
(c) Continual use of bottle containing beverages other than water/milk. Bottle use > 24 months old.			
(d) Child sleeps with a bottle or nurses on demand			
(e) Frequent (greater 3x/day total) candy, carbohydrate snacks (junk food), soda, sugared beverages (including processed juice)			
(f) Medical Issues 1. Saliva-reducing meds (asthma, seizure, hyperactivity etc.) 2. Developmental problems etc. 3. H/O anemia or Fe+ Rx:			
Protective factors — based on parent interview	Y	N	Notes
(a) Child lives in fluoridated community AND drinks tap water daily			
(b) Teeth cleaned with fluoride toothpaste (pea-size) daily			
(c) Fluoride varnish applied to child's teeth in last 6 months			
Oral examination	Y	N	
Obvious white spots (decalcifications), or obvious decay present on the child's teeth: NOTE ON DIAGRAM			
(b) Plaque is obvious on the teeth and/or gums bleed easily **ECC (Early Childhood Caries) Diagnosis:** ❑ No visible Early Childhood Caries (ECC) ❑ Non-cavitated ECC ❑ Cavitated ECC			
Assessment: Child's caries risk status (cavities in the mother/caregiver, white spots or cavities in the child indicate high caries risk. The balance between the checked shaded areas (risk indicators) and the checked un-shaded areas (protective factors) provides the risk status as high or low): ❑ LOW ❑ HIGH			
Plan: ❑ Health education handouts ❑ Self-management Goals 1._____			
❑ Dispense fluoride toothpaste and toothbrush ❑ Prophylaxis and fluoride varnish ❑ FHC Oral Health Clinic follow-up appointment (high risk) ____ months ❑ Urgent outside dental referral (high risk, needs tracking) ❑ Routine dental referral for dental home (all others)			

Signature of Rendering Provider: _____ Name: _____ CHN # _____

Supervising Attending: _____ CHN # _____ Date of Service: _____

Figure 13. CAMBRA Form for Medical Providers (0-5 year patients), Assessment Tool. This age-specific caries-risk assessment tool was designed to increase awareness of the risk factors for early childhood caries and to help non-dental healthcare providers develop a care plan tailored to an individual's age and risk. Image source: Ramos-Gomez FJ, et al.

can choose from a list of preventive options. Individual circumstances and clinical judgment will help determine treatment options to reduce risk, such as dispensing fluoride toothpaste, recommending that toothbrushes be replaced once a month, applying fluoride varnish, referring patients to dentists for urgent care (e.g., tooth abscess) or routine care (e.g., prophylaxis and fluoride treatment) and/or establishing a dental home.[51]

The HCP may also suggest more frequent dental visits, recommend the use of sealants on teeth with deep grooves and/or fissures (*Figure 14*) or recommend/prescribe alternative caries prevention strategies. Fluoride and alternative caries prevention strategies are discussed later in this course.

SUPPLEMENTAL RESOURCES

Caries-Risk Assessment Tools (CAT)

Read these two CAMBRA resources to improve your understanding of current caries-risk assessment and management protocols.

Caries Management by Risk Assessment: A Practitioner's Guide: cda.org/Portals/0/journal/journal_102007.pdf

Guideline on Caries-risk Assessment and Management for Infants, Children and Adolescents: aapd.org/media/Policies_Guidelines/G_CariesRiskAssessment.pdf

Presentation of ECC

Teeth are the hardest substance in the human body. Their durable crystalline structure is evidenced in their pearl-like translucence (*Figure 15*). Yet, when continuously subjected to acid, teeth weaken and lose their pearl-like appearance. Early in the caries process, there are no visible signs that the teeth are demineralized because the mineral loss has occurred only on a microscopic level. As demineralization increases, the first signs of decay become visible to the human eye. In areas of decreased mineral content the natural translucence of the tooth is altered, and the eye recognizes a chalky matte lesion. This white spot lesion is the most important caries lesion for HCPs to recognize because it is at this stage that prevention is most effective. Once a white spot lesion (*Figure 16*) is detected, preventive interventions can be implemented and the tooth's integrity maintained.

If decay is not arrested at the white-spot-lesion stage, it will progress to become **frank decay** (a cavitated lesion; *Figure 17*). When local factors such as poor oral hygiene and diet are left unchecked, acid gradually leaches more and more mineral content from the tooth. Eventually the tooth becomes weakened and the outer surface fractures, revealing a visible hole in the tooth. At this stage, the caries lesion is typically a brownish-yellow colour due to exposure of the naturally-yellow dentin. Over time, foods, beverages and oxidation will stain the dentin, causing dark discolouration that we recognize as dental decay. If left unchecked, the depth of the lesion will increase. Eventually decay will erode the entire thickness of the dentin, allowing bacteria to enter the dental pulp, causing inflammation within this enclosed space. The pulp is highly innervated and vascular. Therefore, the resulting pressure may be extremely painful. Ultimately the pulpal infection progressively expands out of the tooth root and into the surrounding bone, creating a dental abscess or **odontogenic infection**. *Figure 18* describes the progression of caries.

Odontogenic infections are uncomfortable and extremely dangerous. They typically present in any of the following three ways: 1) draining **parulis** (*Figure 19*); 2) localized **abscess** (*Figure 20*); or 3) facial **cellulitis** (*Figure 21*). Infections arising from both primary and permanent teeth can invade **fascial spaces**, resulting in rapidly growing cellulitis. Signs of this serious infection include elevated temperature (>38.9°C/102°F) and difficulty swallowing and breathing. Swelling below

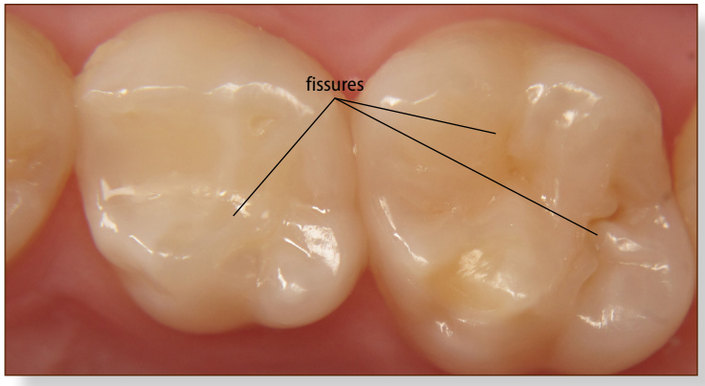


Figure 14. Fissures. Deep fissures can be seen on the occlusal (chewing) surface of these molar teeth. Fissures increase susceptibility to dental caries, and are often treated prophylactically with dental sealants. Photo source: Travis Nelson. Used with permission.

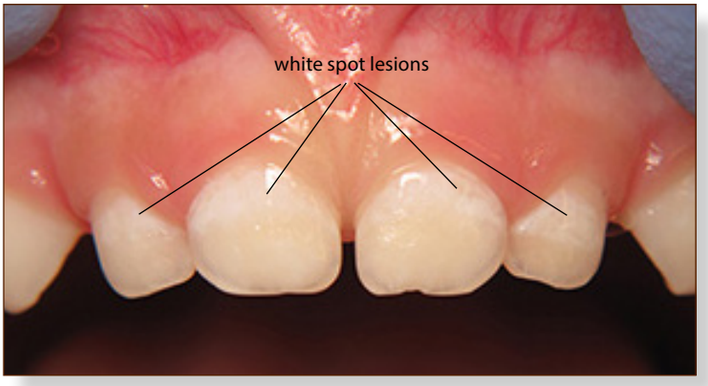


Figure 16. White spot lesions. White spot lesions are the first visible sign of the caries process. When identified and treated early, caries can be stopped before it progresses to cavitation. Photo source: Travis Nelson. Used with permission.

Figure 15. Healthy teeth with intact enamel. The crystalline structure of healthy, intact enamel gives teeth their pearl-like translucence. Photo source: Travis Nelson. Used with permission.

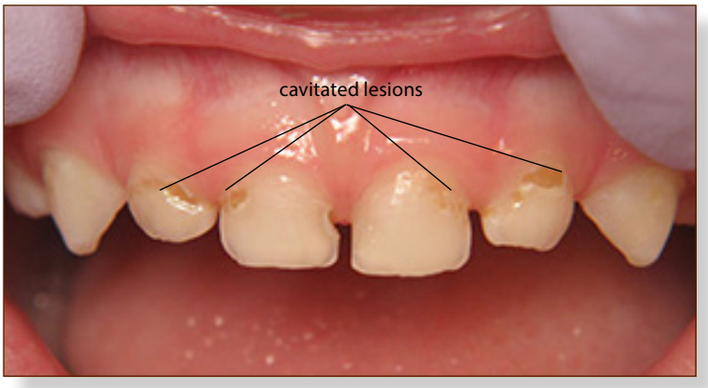


Figure 17. Frank decay. Cavitated lesions on the labial surfaces of a young child's maxillary anterior teeth. Caries has progressed to the point where tooth structure is visibly lost and requires restoration. Photo source: Travis Nelson. Used with permission.

the inferior border of the mandible into the neck, **trismus** and floor of mouth swelling are indications of impending airway compromise and must be treated as life-threatening emergencies. Swelling of the mid-face, especially the bridge of the nose and lower eyelid, should also be immediately evaluated and managed definitively (i.e., **definitive care**) due to risk of periorbital involvement and meningitis. In circumstances involving acute dental conditions, timely referral to oral health colleagues is usually the treatment of choice. For patients with limited access to dental care due to logistical and/or financial constraints, physicians and nurses are well-positioned to alleviate emergent needs by providing oral health services.

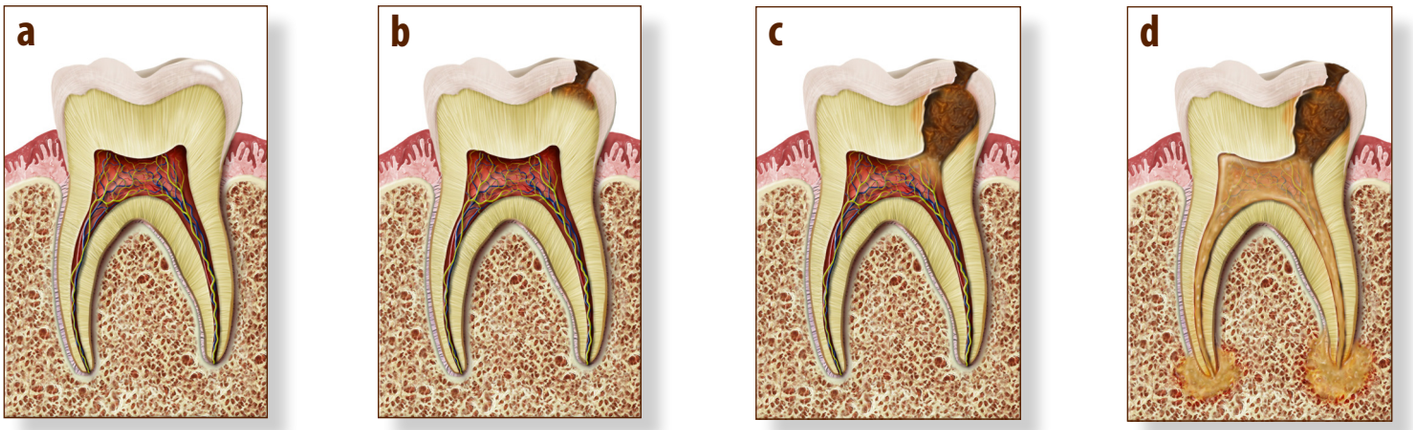


Figure 18. Progression of caries destruction. (a) At the white spot lesion stage, tooth decay can be halted by treatment of fluoride and maintenance of good oral hygiene including fluoridated toothpaste, and sound dietary practice; (b) when decay has demineralized the enamel it then penetrates to the dentin which is much less demineralized than the enamel; (c) when decay has progressed through the entire dentin it breaches the pulp chamber where nerves and blood supply of the tooth are located, resulting in pressure and pain in the localized area; d) when infection in the pulp chamber expands out through the root tips and into surrounding bone, this creates a dental abscess. © 2014 University of Manitoba. All rights reserved.

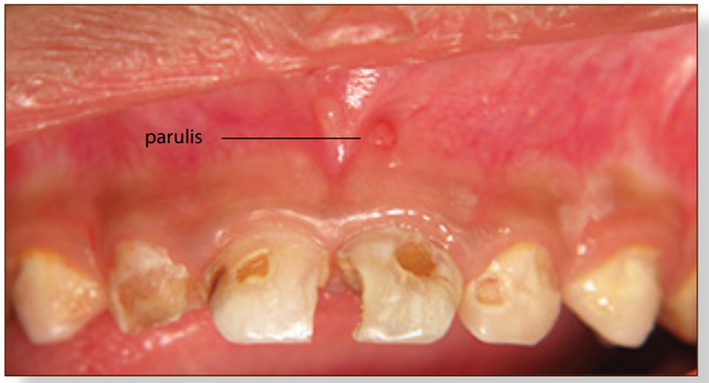


Figure 19. Draining parulis. Odontogenic infection begins in the tooth crown and progresses out the root tip, sometimes resulting in a parulis (gumboil) that drains pus into the oral cavity. Photo source: Travis Nelson. Used with permission.

Figure 21. Facial cellulitis. This child had an odontogenic abscess that gave rise to facial cellulitis, which is a serious medical and dental emergency that requires immediate treatment. Photo source: Travis Nelson. Used with permission.

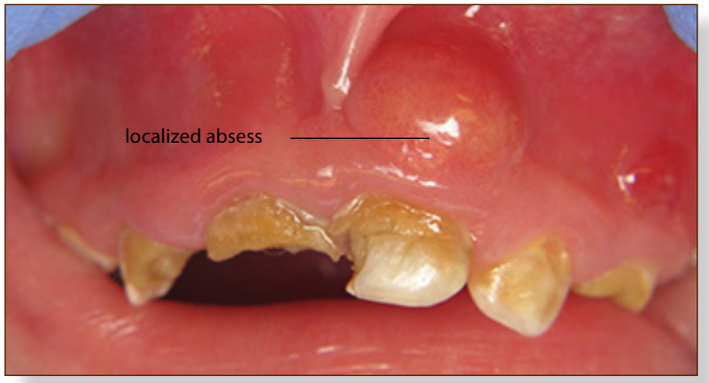


Figure 20. Localized abscess. A localized abscess results when an odontogenic infection is bound by the oral soft tissues. Photo source: Travis Nelson. Used with permission.

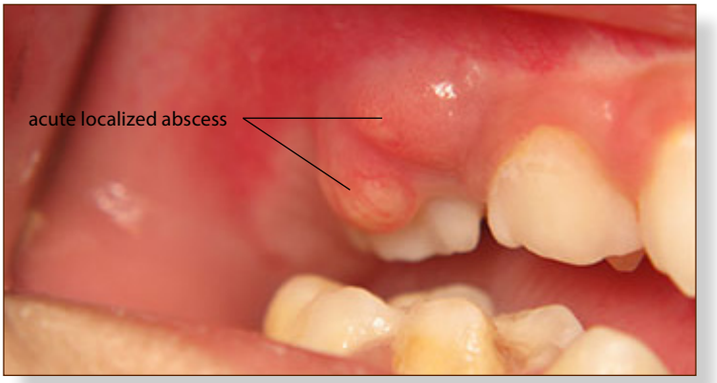


Figure 22. Acute localized abscess. Pus collects at the infection site, causing it to become increasingly more painful until the abscess either spontaneously ruptures or is surgically drained. Definitive care is necessary. Photo source: Travis Nelson. Used with permission.

Tooth Abscess

The treatment of choice for cases of acute localized tooth abscess (i.e., without systemic signs of fever or generalized swelling; *Figure 22*) is definitive care. This typically involves extraction or **endodontic therapy** (i.e., partial or complete root canal treatment) of the offending tooth. Antibiotic coverage is generally not required when definitive care is provided expeditiously. In cases when dental treatment may be delayed, non-dental HCPs can either prescribe an oral antibiotic or administer intramuscular/intravenous (IM/IV) antibiotics depending on the severity of the infection. *Table 1* provides more detail about the oral antibiotics used to treat odontogenic infections in pediatric patients.

Additionally, placement of a drain within the body of the infection may facilitate drainage of **purulent exudate** and decrease proliferation of anaerobic bacteria. General guidelines to place an intraoral drain (*Figure 23a-f*) are as follows.

1. Administer a local anesthetic to the area.
2. Create an incision over the affected area using a sterile blade.
3. With an instrument such as a hemostat, enter through the incision, break up the loculations of infection and decontaminate the affected area.
4. Insert a sterile drain through the incision.
5. Suture the drain in place securely.
6. Trim the drain with scissors a few millimetres past the beginning of the incision. Within the next several days, follow-up to remove the drain and refer the patient to a dentist for definitive treatment of the offending tooth.

In cases when a drain is placed emergently, it is important to schedule a follow-up appointment to remove the drain within the next several days and make arrangements for definitive treatment of the offending tooth. In such cases, administration

Table 1. Oral Antibiotics for Odontogenic Infections in Pediatric Patients

Amoxicillin	25-50 mg/kg/day in divided doses every 8 hours; maximum dose: 500 mg/daily
Clindamycin	**Mild to moderate infection:** 10-25 mg/kg/day divided every 8 hours; maximum daily dose: 1,800 mg/day,
	Severe infection: 30-40 mg/kg/day divided every 6-8 hours; maximum daily dose: 1800 mg/day,
Penicillin V Potassium	25-50 mg/kg/day in divided doses every 6-8 hours; maximum daily dose: 2000 mg/day
Amoxicillin/Clavulanate	25-45 mg/kg/day, divided every 12 hours; maximum single dose: 875 mg amoxicillin

Adapted from: American Academy of Pediatrics, Committee on Infectious Diseases. *Red Book: Report on the Committee on Infectious Diseases.* 29th ed. Elk Grove Village: American Academy of Pediatrics; 2012.

Table 2. Intravenous Antibiotics for Odontogenic Infections in Pediatric Patients

Ampicillin-Sulbactam (Unasyn®)	**Mild to moderate infection:** 100-200 mg/kg/day divided every 6 hours; maximum daily dose: 1,000 mg
	Severe infection: 200 mg/kg/day divided every 6 hours; maximum daily dose: 2,000 mg; higher doses up to 400 mg/kg/day may be required for some infections
Clindamycin (Cleocin HCl®)	**Mild to moderate infection:** 20 mg/kg/day divided every 8 hours; maximum daily dose: 1,800 mg/day
	Severe infection: 40 mg/kg/day divided every 6-8 hours; maximum daily dose: 2,700 mg/day
Penicillin G (Crystapen™) + **Metronidazole (Flagyl®)**	**Mild to moderate infection:** 1.0-1.5 million IU/kg/day/kg/day in divided doses every 6 hours; maximum daily dose: 8.0 million IU/day
	Severe infection: 2.0-3.0 IU/kg/day in divided doses every 6 hours; maximum daily dose: 24 million IU/day + 22.5-40 mg/kg/day in divided doses 3 times daily; maximum daily dose: 1,500 mg/day

Adapted from: American Academy of Pediatrics, Committee on Infectious Diseases. *Red Book: Report on the Committee on Infectious Diseases.* 29th ed. Elk Grove Village: American Academy of Pediatrics; 2012.

of antibiotics and removal of the source of infection (i.e., either by extraction or root canal treatment) is indicated.

When infection is severe, hospital admission to give IV antibiotics and maintain fluid balance is often required. In these situations, antibiotic selection is usually empirical, employing agents such as clindamycin (Cleocin HCL®) or ampicillin-sulbactam (Unasyn®).[53-56] A list of intravenous antibiotics that are used to treat more severe odontogenic infections in pediatric patients is detailed in *Table 2*.

In select cases, a **fluctuant lesion** may be drained by perforating the body of the lesion with a sharp instrument, such as a sterile blade. Although the abscess will generally recur, this procedure may provide temporary relief from pressure-related pain until the patient can access care from a dentist.

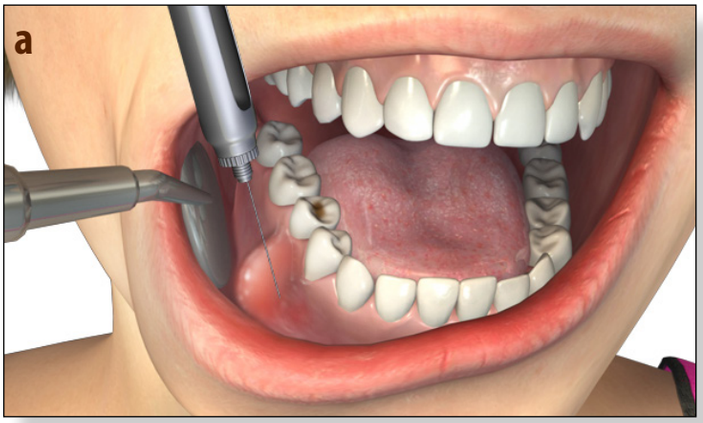


Figure 23. a. Placement of an intraoral drain. STEP 1: Administer a local anesthetic to the area. © 2014 University of Manitoba. All rights reserved.

Figure 23. b. Placement of an intraoral drain. STEP 2: Create an incision over the affected area using a sterile blade. © 2014 University of Manitoba. All rights reserved.

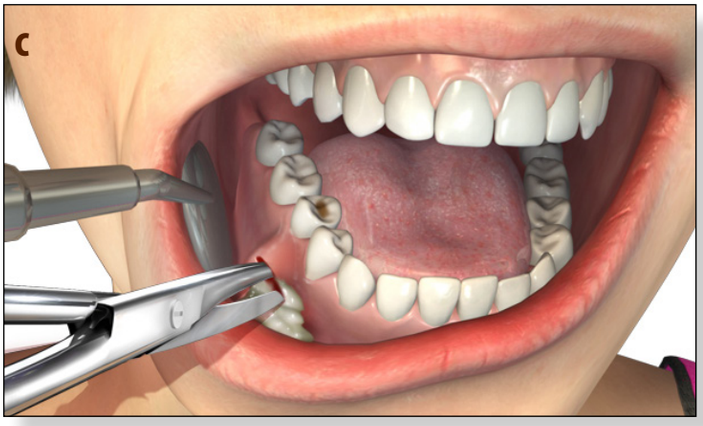


Figure 23. c. Placement of an intraoral drain. STEP 3: With an instrument such as a hemostat, enter through the incision, break up the loculations of infection and decontaminate the affected area. © 2014 University of Manitoba. All rights reserved.

Figure 23. e. Placement of an intraoral drain. STEP 4: Insert a sterile drain through the incision. © 2014 University of Manitoba. All rights reserved.

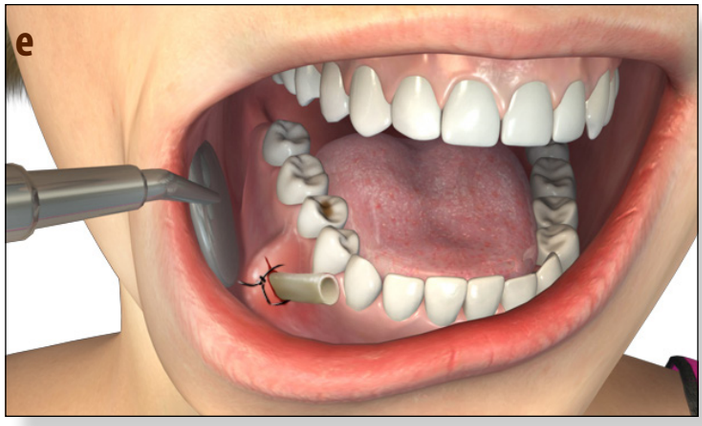


Figure 23. f. Placement of an intraoral drain. STEP 5: Suture the drain in place securely. © 2014 University of Manitoba. All rights reserved.

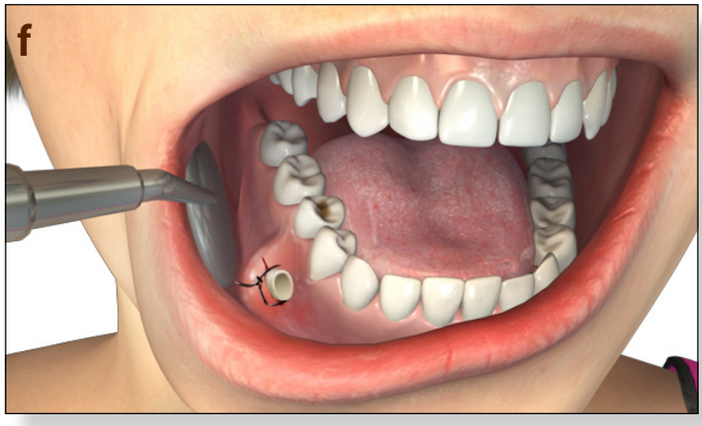


Figure 23. g. Placement of an intraoral drain. STEP 6: Trim the drain with scissors a few millimetres past the beginning of the incision. © 2014 University of Manitoba. All rights reserved.

Toothache

Patients who present with a toothache should first be evaluated for signs of infection. Signs generally include oral swelling and fever. When no signs of systemic infection exist, the toothache may be related to **pulpitis** of the offending tooth (*Figure 24*). Definitive care of this condition generally includes dental intervention to extract, fill, or perform root canal treatment. When urgent dental services are not available, systemic pain medications are indicated. For children and adolescents, **scheduled dosing** of non-narcotic pain relievers such as acetaminophen and/or ibuprofen will often effectively alleviate symptoms. A systematic review of the literature suggests that, in the absence of swelling or fever, administration of antibiotics does not decrease pain, and therefore cannot be recommended.[14]

Broken Fillings

Patients with broken fillings (*Figure 25*) may occasionally present to non-dental HCPs for evaluation. The treatment of choice is referral to a dentist. When a dental visit is not immediately possible, patient discomfort may be relieved with temporary over-the-counter (OTC) tooth filling materials. OTC tooth filling materials, which often contain **eugenol** to help relieve tooth sensitivity, may be mixed and applied to the tooth surface according to manufacturer directions. This treatment strategy is intended to provide patients with temporary relief and additional time to obtain much-needed dental care.

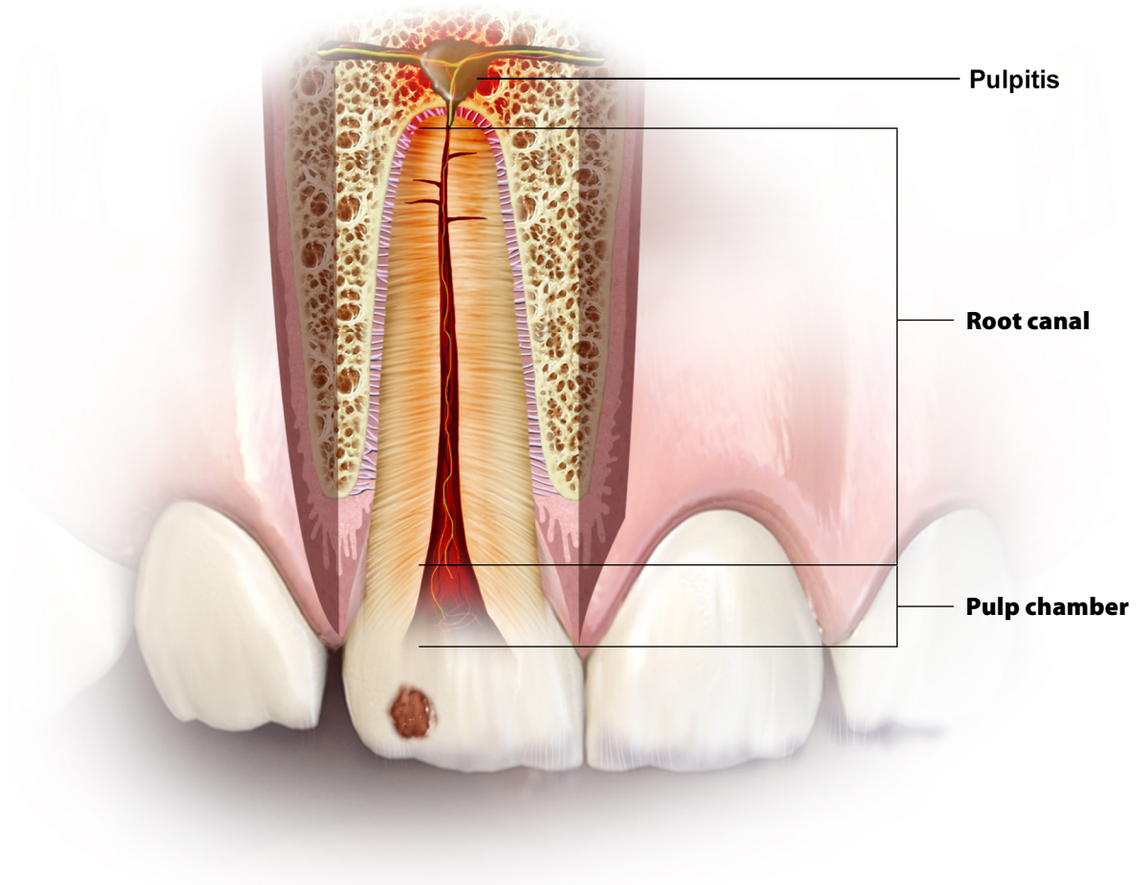


Figure 24. Pulpitis. Note how infection can expand beyond the pulp chamber and root canal into the surrounding bone.

Challenges Associated with Treating ECC

The biological costs of untreated dental caries in children are significant. In one study,[13] 86% of families reported that decayed teeth interfered with their child's ability to eat; 50% reported that their child's ability to sleep was affected; 32% reported an impact on school attendance and their child's ability to participate in school activities. Pain from untreated dental caries may also impact the physical growth and cognitive development of young children.[14,57-59] The monetary cost of treating dental diseases (i.e., caries and **gingivitis**) also places a great financial burden on families and society. For instance, children with extensive decay are often treated under GA (*Figure 26*), which can drive the cost of care up to several thousand dollars per child.[59] For children living in remote communities, costs may rise even further to cover travel and lodging.[60]

Most treatments used to repair pediatric dental decay are relatively simple. However, delivering high-quality care to young children often requires the use of GA (*Figure 27*). Restoration of ECC under GA accounts for one-third of all day surgeries for preschoolers in Canada, making it the most common surgical procedure performed on Canadian preschool children.[61] Failure to provide preventive dentistry for children who have already received dental care under GA may result in repeated dental treatment under GA.[62] In one report, 76% of First Nations children living in Alberta experienced caries relapse following the first comprehensive dental rehabilitation procedure, and were consequently treated under GA on two separate occasions.[63] This is consistent with the finding that 20-60% of children have new tooth decay within two years of tooth restoration under GA,[64-66] which provides compelling rationale for identifying children at moderate to high risk for caries.

When diagnosed early, the pain, infection, biological and monetary cost of caries can be prevented or at least limited through improved dietary practices, good oral hygiene, increased fluoride exposure, the use of antimicrobial agents and simple **restorative dental procedures**.

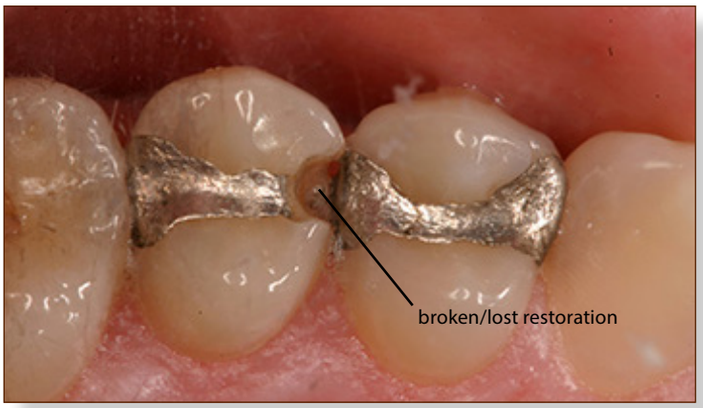


Figure 25. Broken filling. A patient with a lost restoration (filling), such as the one seen here in the left maxillary second bicuspid, should be referred to a dentist. Photo source: Matt McGee. Used with permission.

Figure 26. Treatment under general anesthesia. Here a child with extensive dental decay receives treatment under GA. Photo source: Travis Nelson. Used with permission.

Figure 27. Treatment under general anesthesia. Here a child is prepared to receive full mouth rehabilitation under GA. Photo source: Travis Nelson. Used with permission.

Pearls to Practice

Most Common Oral Health Problems of Children and Adolescents

1. Dental caries is common in children. Of Canadian children aged 6-11 years, 57% have had decayed teeth. **Non-dental HCPs should carefully screen children and adolescents for tooth decay, paying special attention to those of low SES where the risk for caries is greatest.**
2. Untreated dental caries causes pain that affects a child's ability to eat, sleep and attend school, which negatively impacts physical growth and cognitive development. **Non-dental HCPs should recognize that diagnosis and effective management of caries can have numerous important, positive effects on a child's life.**
3. **Non-dental HCPs can best help children control dental caries by educating them about the importance of managing the oral environment.** Specifically, children and their parents should be taught that reducing the time and frequency that teeth are exposed to fermentable carbohydrates will decrease the risk for dental decay.
4. Teeth are repeatedly subjected to periods of demineralization followed by remineralization. To promote adequate remineralization, **non-dental HCPs should encourage parents to allow breaks of several hours between meals, snacks and sugared beverages.**
5. **Non-dental HCPs should educate patients that the key to controlling dental caries lies within the caries balance.** This intervention strategy is aimed at optimizing tooth remineralization through the management of four key variables: host tooth, diet, acid-producing bacteria and time.
6. Primary teeth form in utero. Factors that occur during pregnancy (e.g., poor maternal nutrition, hypocalcemia, infections) can affect the structure and quality of a child's teeth. **Non-dental HCPs should be aware that primary teeth that are hypoplastic or hypomineralized may be at higher caries risk.**
7. Saliva has the capacity to neutralize oral acids. People with inadequate salivary flow or altered salivary composition are at high risk for caries. Many common medications can cause xerostomia. **Non-dental HCPs should identify children and adolescents who have special healthcare needs and/or who may be taking medications that cause dry mouth, which places them at greater risk for dental caries.**
8. Mutans streptococci (MS), the bacteria associated with dental caries, is transmitted vertically from mother to infant. Children who are colonized by this bacteria early in life are at higher risk for decay. To limit the potential for transfer of pathologic bacteria, **non-dental HCPs should encourage mothers to practice excellent personal oral hygiene and seek routine dental care.**
9. Children of low SES experience the majority of tooth decay. **Non-dental HCPs who see high numbers of children of low SES should be particularly vigilant in oral health screening.**
10. White spot lesions signify the earliest stage of the caries process. They appear when enamel is over-exposed to acid-containing dental plaque. **Non-dental HCPs should recognize white spot lesions and recommend intervention with such measures as fluoride varnish and improved oral hygiene.** Adequate preventive measures may prevent progression to more advanced decay.
11. Cavitated lesions result when caries progresses beyond the white spot stage, and typically require restorative dental procedures. To reduce the risk of carious lesions becoming more advanced and the possible need for GA; **non-dental HCPs should identify caries in its earliest stage (white spots) and refer these patients to dentists as soon as possible.** Delayed referral may lead to pain, infection and tooth extraction.
12. Definitive care for tooth abscesses generally involves extraction or endodontic root canal therapy. When access to dental services is not readily available, **non-dental HCPs may prescribe an antibiotic to decrease infection severity and/or place a drain within the body of the infection to facilitate drainage.**
13. Toothaches generally require the intervention of a dentist. However, **non-dental HCPs can provide temporary relief by recommending scheduled dosing of a non-narcotic pain reliever.**
14. In North America, GA is often administered to children with extensive tooth decay. **Non-dental HCPs should be aware of the large number of children who receive dental services in this way, and develop professional networks with dentists who are able to offer GA services when needed.**
15. Caries relapse following procedures rendered under GA is quite common, with 20-60% of children experiencing new decay after the initial procedure. **Non-dental HCPs should provide preventive treatments such as fluoride varnish, and offer dietary and hygiene recommendations to high-risk patients who have received extensive dental care.**

Importance of Fluoride and Alternative Caries Prevention Strategies

Helping prevent tooth decay in three ways, fluoride: 1) decreases the acid solubility of enamel; 2) decreases the rate of demineralization; and 3) increases the rate of remineralization.[67-71] These dynamic biochemical processes depend on the composition of both tooth enamel and the surrounding plaque biofilm, which is influenced by frequency of sugar consumption and oral hygiene.

In the absence of dietary calcium, which binds and removes free fluoride ions, roughly 80% of fluoride is absorbed from the gastrointestinal tract. Nearly all absorbed fluoride is bound reversibly to calcified tissues (bones and teeth). In healthy young or middle-aged adults, approximately 50% of absorbed fluoride is retained in calcified tissues and 50% is excreted in the urine. For young children, as much as 80% may be retained due to increased uptake by developing teeth and bones.[67]

Fluoride, like many other substances to which humans are exposed, has benefits in appropriate doses but may become harmful in quantities that are too great. Therefore, many parents are concerned about systemic overexposure to fluoride. Overexposure to fluoride may result in **fluorosis**, a condition that results in cosmetic defects of the permanent teeth (*Figure 28, Figure 29 and Figure 30*).

Recently, the United States Department of Health and Human Services recommended lowering the optimal level of water fluoridation to 0.7ppm, which is consistent with Health Canada recommendations.[68,72] The first eight years of life are the period during which teeth are at highest risk for fluorosis because they are calcifying. Therefore, this is a period in a child's life when fluoride consumption must be carefully monitored to ensure that the child receives enough to prevent caries, but not excessive amounts that will cause esthetic problems.[73]

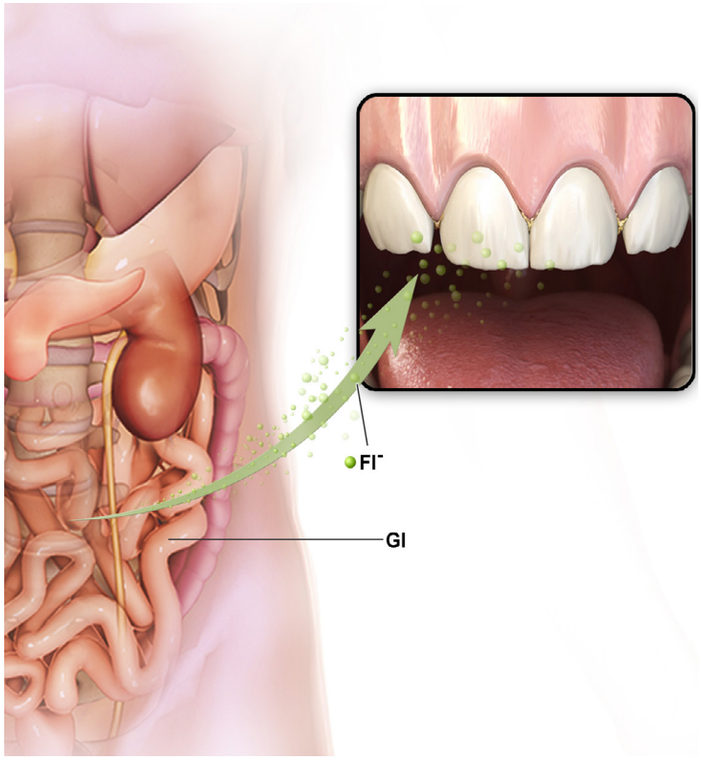


Figure 28. Fluoride absorption. Among the most soluble fluoride compounds is sodium fluoride, which is found in water and toothpaste. When swallowed, approximately 80% of fluoride is absorbed by the stomach and intestines and then transported throughout the body via the blood. Fluoride ions are gradually removed from the blood by two mechanisms: reversible uptake in calcified tissues and excretion in the urine. Over the long term, the blood-fluoride level is influenced by daily exposure and uptake by the bones and teeth. Children and adolescents tend to retain more fluoride in their bones and teeth than adults because these tissues are still developing.

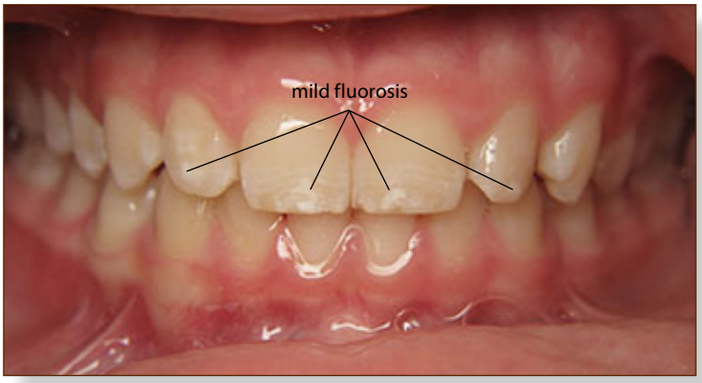


Figure 29. Mild fluorosis. Dental fluorosis is graded from mild to severe using a tooth surface index. This case of mild fluorosis is characterized by chalky, white discolouration affecting up to one third of the tooth surface. This results when excess fluoride is over-ingested during the calcification stage of tooth development. Photo source: Travis Nelson. Used with permission.

Figure 30. Severe fluorosis. This case of severe dental fluorosis is characterized by brownish discolouration of tooth surfaces, corrosion causing pitting and grooves and areas of missing enamel, resulting in altered tooth anatomy and increased susceptibility to decay. Photo source: Travis Nelson. Used with permission.

Systemic Fluoride

Systemic exposure to fluoride occurs when fluoride is ingested. Approximately 50-90% of the average individual's total fluoride exposure is from drinking water.[74] The remainder comes from fluoride ingested in dental products (i.e., toothpaste and mouth rinses) and in foods that are processed in fluoridated communities. Fluoride was first introduced into United States public water supplies in the 1940s. Historically, caries prevalence in fluoridated communities was 40-60% lower than in non-fluoridated communities.[75] During the early years of fluoridation, water was a community's only source of fluoride. Because fluoride is now more widely available in various forms (e.g., toothpaste, gels and foams), it is more difficult to determine the exact benefit of fluoridated water. Current figures estimate caries reduction in fluoridated communities throughout the world to be approximately 18%.[66]

In Canada, the decision to fluoridate water is made by local governments with federal, provincial and territorial governments setting the guidelines.[72] Fluoridation practices have been challenged in many areas, and currently there is a wide variation in fluoridation practices among Canadian provinces. Similar to the United States where approximately 70% of communities are fluoridated, Alberta, Manitoba and Ontario have the highest rates of fluoridation.[72,75] In contrast, British Columbia, Newfoundland and Labrador, Nunavut and Yukon are almost completely non-fluoridated.[72]

In our society, we have seen a clear upward trend in the consumption of bottled and filtered water products.[76] The majority of these products contain lower levels of fluoride than is currently recommended.[77] Furthermore, a high degree of variability in fluoride concentration exists between different batches of the same brand of bottled water.[77,78] This is largely because of the variability in the content of commercially-available bottled water, with some products using municipally-sourced water and others using water that has been purified using sophisticated industrial processes. Reverse osmosis and distillation purification processes remove fluoride from water. However, charcoal/carbon filters (present in the majority of commercially-available home-filtration systems) do not.[79] Because these types of filtered water usually do not contain the recommended levels of fluoride, patients who drink them may not be receiving the same anti-caries benefits as those who consume fluoridated tap water.

While Health Canada does not recommend general fluoride supplementation, recommendations by the CDA support the use of supplementation in select cases.[80] The CDA generally does not recommend supplementation before the eruption of the first permanent tooth.[81] Fluoride supplements are only recommended for children at high risk for dental caries, and who consume the majority of their water from non-fluoridated sources.

Due to the nearly ubiquitous nature of fluoride, a child's exposure from all sources of fluoride (not only water) should be considered before prescribing a supplement. The child's age and the level of fluoride in the water must also be taken into account. Before prescribing fluoride to children who drink well water, non-dental HCPs should recommend that parents have the water source tested for fluoride levels, as some wells contain fluoride. The CDA suggests that if fluoride supplements are deemed appropriate for a child, dosing should reflect total daily fluoride intake from all sources. In order to minimize the risk of dental fluorosis, the daily total should not exceed 0.05-0.07mg F/kg body weight.[81] When supplements are indicated, parents should be advised to place the supplement in the child's mouth and encourage the child to

Table 3. U.S. Recommended Dosing for Fluoride Supplementation

Age	Fluoride Ion Level In Drinking Water (ppm)*		
	<0.3	0.3-0.6	>0.6
Birth-6 months	None	None	None
6 months-3 years	0.25 mg/day**	None	None
3-6 years	0.50 mg/day	0.25 mg/day	None
6-16 years	1.0 mg/day	0.5 mg/day	None

*1 part per million (ppm) = 1 milligram per liter (mg/l)
**2.2 mg sodium fluoride contains 1 mg fluoride ion

Adapted from: (A) American Academy of Pediatric Dentistry, Liaison with Other Groups Committee. Guideline on fluoride therapy. *Pediatr Dent.* 2008; 30:121-124. (B) Rozier RG, et al. Evidence-based clinical recommendations on the prescription of dietary fluoride supplements for caries prevention: a report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc.* 2010; 141(12):1480-9.

chew or suck the tablet/lozenge prior to swallowing. This will ensure the supplement contacts the teeth, maximizing both the topical and systemic effects.[80-84] Although Health Canada does not recommend general fluoride supplementation, *Table 3* provides recommendations for fluoride dosing in the United States. A parallel table for Canada does not currently exist.

Topical Fluoride

Topical fluoride is the easiest and most effective type of fluoride for PCPs to provide. Topical fluoride agents include toothpastes, rinses, gels, foams and varnish. The percentage of fluoride in each product varies. However, fluoride products can easily be compared using the parts per million (PPM) scale. The new recommended level for water fluoridation in communities in Canada and the United States (0.7ppm fluoride ion) provides an effective reference point for fluoride concentration.[68] *Table 4* is a guide to the average fluoride concentration of topical products.

Fluoride Toothpaste

Fluoride is most effective when applied frequently and in low concentrations, which is why fluoridated toothpaste provides an ideal vehicle for regular low-dose exposure.[85] Because fluoridated toothpaste is typically well-perceived by the public and is among the most important preventive therapies, HCPs should emphasize its regular use. The effect of fluoride toothpaste can be maximized if patients do not rinse their mouths after use, allowing the fluoride to remain in the mouth for a longer period of time.[73,86] While OTC toothpaste is effective, a very strong preventive effect has been shown when toothpaste with fluoride at 5,000ppm is used in populations at high risk for caries. Colgate® PreviDent® 5000 and 3M Clinpro™ 5000 are available in Canada and the United States. One study demonstrated that adolescent subjects who used a toothpaste with fluoride at 5,000ppm had 40% less caries than those who used a conventional fluoride toothpaste.[87] Children who cannot adequately spit after brushing should not use toothpaste with fluoride at 5,000ppm. However, this option may be reasonable for older children and adolescents at high risk for decay.

Fluoridated Mouth Rinses

Many dentists routinely recommend OTC fluoride mouth rinses to their patients. Recent systematic reviews of published research on the effect of fluoridated mouth rinses suggest that although rinses may be beneficial in children who have limited exposure to fluoride sources, the benefits are questionable in those who brush daily with fluoride toothpaste.[88-91]

Professional Application of Fluoride

Acidulated Phosphofluoride

Many dental practices routinely apply topical products containing acidulated phosphofluoride (APF) in trays that adapt to the maxillary and mandibular dental arches. Because children tend to swallow fluoride applied in this manner, this practice is most commonly used for adolescents and adults. Research suggests that APF can impart a 20% reduction in caries if applied annually; 25% if performed twice per year.[92]

Sodium Fluoride Varnish

Sodium fluoride varnish is the most convenient and effective fluoride for non-dental HCPs to apply. Studies show that sodium fluoride varnish has a reduced ingestion rate, and provides up to a 46% reduction in caries of the permanent dentition.[93] Sodium fluoride varnish has also been shown to

Table 4. Fluoride Concentration of Common Topical Products

Product	Concentration (ppm fluoride ion)
Daily Mouth Rinses	225
Regular Concentration Toothpaste	1,000-1,100
Gel	5,000
High Concentration Toothpaste	5,000
Acidulated Phosphate Fluoride (APF) Foam	9,000 or 12,500
Varnish	22,600

Adapted from: Nelson T. The key to caries prevention. *Dimens Dent Hyg.* 2011 Jul: 48-53.

reduce caries more than any other topical fluoride products, and is often the preferred fluoride treatment.[86] According to the ADA guideline on fluoride therapy, children at moderate caries risk should receive professionally-applied fluoride two times per year, and those at high caries risk may benefit from receiving treatment up to four times annually.[83]

Application of fluoride varnish in medical settings is becoming increasingly common. A 2009 report[95] stated that 4% of surveyed American pediatricians regularly applied fluoride varnish. Following the 2011 adoption of a policy encouraging non-dental HCPs to apply fluoride varnish in the United States, practitioners in 42 of 50 states began offering this intervention, which is usually reimbursable for American medical providers.[96,97]

When implemented by HCPs, fluoride varnish has been shown to decrease the incidence of decay by one-third.[96] Those medical practices with the most successfully-implemented fluoride varnish programs typically have trained clinical staff apply the product on patients. Successful clinics also have systems in place to identify patients who would benefit from fluoride varnish application. Fluoride varnish not only provides a valuable preventive treatment, but it affords HCPs an opportunity to discuss preventive oral health with families.[97]

Canada has implemented a national program called the Children's Oral Health Initiative (COHI),[98] which was designed to improve and maintain the oral health of both First Nations populations living on reserves, and Inuit populations living in remote communities. Twice-a-year fluoride varnish application is an essential component of this program.

Basic tools are needed to apply fluoride varnish in a medical setting. The procedure requires a good light source, such as a pen light or headlamp, disposable gloves, a bib or paper towel, 2" x 2" gauze squares and the fluoride varnish (*Figure 31*). Varnish is typically sold in unit-dose containers, packaged with individual disposable brush applicators. Applying fluoride varnish is a simple procedure that can be performed on infants, children and adolescents. The steps to applying fluoride varnish are described in *Figure 32, a-c*.

In contrast to APF, which does not adhere to the teeth, fluoride varnish is quite sticky. Although children may eat and drink immediately following the application, parents/caregivers should be advised to avoid brushing the child's teeth for the remainder of the day in order to increase contact time.

SUPPLEMENTAL RESOURCE

Step-by-Step Guide to Fluoride Varnish Application

Use this curriculum resource to train your clinical staff on fluoride varnish application.

Figure 31. Basic tools needed to apply sodium fluoride varnish in a medical setting. The procedure requires a good light source, disposable gloves, a bib or paper towel, 2" x 2" gauze squares and the fluoride varnish. Disposable mouth mirror and tongue depressor are optional. © 2014 University of Manitoba. All rights reserved.

Figure 32. a. Application of sodium fluoride varnish in a medical setting. STEP 1: Dry the teeth with gauze to increase the amount of sodium fluoride varnish that adheres to the teeth. Photo source: Travis Nelson. Used with permission.

Figure 32. b. Application of sodium fluoride varnish in a medical setting. STEP 2: Apply sodium fluoride varnish to anterior teeth. Photo source: Travis Nelson. Used with permission.

Figure 32. c. Application of sodium fluoride varnish in a medical setting. STEP 3: Apply sodium fluoride varnish to posterior teeth. Keeping the teeth dry is more challenging in the posterior area. However, varnish will still adhere to teeth even when moist with saliva. Photo source: Travis Nelson. Used with permission.

Alternative Caries-Prevention Strategies

Children and adolescents at high caries risk may benefit from application of antimicrobial agents that target caries-causing bacteria. Agents that are commonly available and have been shown to reduce caries are xylitol, **chlorhexidine** and **povidone-iodine**.

Xylitol

Xylitol is a non-nutritive sweetener that is widely available in a number of OTC products including foods, syrups, candies and chewing gum (e.g., Clorets® Pure™, Icebreakers™, Stride™, Trident®). Xylitol reduces caries by decreasing bacterial acid production and enhancing remineralization. Research indicates that xylitol is effective in preventing caries when 4-10g are consumed three to seven times per day.[99] Because young children typically acquire Mutans streptococci (MS) from their mothers,[42] maternal use of xylitol can reduce the transfer of these pathogenic bacteria. In one study,[100] a 70% caries reduction was seen in 6-year-olds whose mothers regularly chewed xylitol gum compared with those who had only received chlorhexidine rinse and fluoride varnish.

Commercially available xylitol-containing wipes have recently come on the market (e.g., Spiffies™, Tooth Tissues™). These portable products can be used anywhere to wipe a baby's teeth after feeding. One study[101] showed that among children under 3 years of age whose mothers used wipes three times per day (4.2g/day total) in addition to tooth brushing, the incidence of caries was significantly lower.

Chlorhexidine Gluconate

A rinse with chlorhexidine gluconate (CHX; e.g., Peridex™) has been the gold standard for antimicrobial plaque control. Early research findings indicated that CHX was effective when used for caries control. However, a recent analysis[102] indicated that the caries-preventive effect of CHX products may be more limited (10-26% decrease). Due to contradicting evidence, CHX rinses currently are not recommended for primary caries prevention. However, CHX rinses may prove to be effective and may be recommended on a case-by-case basis by using professional judgement.[102]

Povidone-iodine

Povidone-iodine (e.g., Betadine™) is an antimicrobial agent used widely in medicine as a surgical scrub, a skin disinfectant, and for the treatment of wounds. When topically applied in small doses (0.2ml) in the mouth it has also been shown to suppress Mutans streptococci counts for at least 90 days.[103] Children who were treated with povidone-iodine demonstrated a nearly 50% reduction in white spot caries lesions over a 12-month period.[104] These findings indicate that this agent has strong potential for prevention and treatment of ECC, yet additional research is warranted before it can be conclusively recommended.

Silver Diamine Fluoride and Silver Nitrate

A growing body of evidence now supports the topical application of silver diamine fluoride (SDF),[105] which is indicated as a preventative product. Though not yet available for use in North America and Europe, SDF has been recognized for topical use by the Central Pharmaceutical Council of the Ministry of Health and Welfare in Japan for over 40 years, and its use as an anti-caries agent is now widespread in locations such as Spain, Brazil, Argentina and throughout Africa.

SDF is an alkaline solution that acts on caries in two ways: 1) by killing caries-causing bacteria such as Mutans streptococci; and 2) by remineralizing decayed tooth structure.[105] When a drop of SDF is placed on an active caries lesion with a small brush, SDF stains the lesion black and arrests the decay (*Figure 33*). The efficacy of this product appears to be greater than any other topical preventive agent. One study[105] showed that after 36 months of use, 77% of active caries became inactive and 80% of new caries was prevented in primary teeth.

Silver nitrate is currently available in many industrialized nations, but there is limited contemporary scientific evidence to support its success in preventing dental caries. Future research on the safety and efficacy of these agents is required for their recommended use as antimicrobials that reduce and treat caries.[106]

Figure 33. Silver diamine fluoride. Two teeth with varying stages of decay have been treated with silver diamine fluoride, arresting progression of the disease. Photo source: Steven Duffin. Used with permission.

Probiotics

Regular intake of probiotics is classified as safe by food and drug agencies around the world,[107] and their medical uses have increased in recent years. Probiotics, as defined by the World Health Organization (WHO), are "live microorganisms which, when administered in adequate amounts, confer a health benefit to the host." Probiotic bacteria may work through direct action against pathogens or through competition for nutrients or ecological niches.[108] In dentistry, recent research findings[102,109] suggest probiotics may become an important area of future intervention.

The *Lactobacillus* species are currently the most commonly-used probiotic agents in dentistry. In one well-designed study,[110] children were given one serving of milk supplemented with *Lactobacillus rhamnosus* daily for 21 months. At conclusion, the study showed a 75% decrease in caries in the treatment group. Those children who received probiotic milk also experienced 60% fewer days that required antibiotic therapy and 50% fewer days with **otitis media** as compared to those who did not receive probiotic milk.

Pearls to Practice

Importance of Fluoride and Alternative Caries Prevention Strategies

1. **Non-dental HCPs should be familiar with the recommendation of health authorities regarding water fluoridation, which is currently 0.7ppm**. Before prescribing a fluoride supplement, the child's age and total fluoride exposure from all sources should be considered. For children who consume well water, HCPs should have the water tested before prescribing a supplement. The Canadian Dental Association suggests that for children who need supplements, total daily dosing should not exceed 0.05-0.07mg F/kg body weight in order to minimize the risk of dental fluorosis. The United States has recommended basing fluoride supplementation on fluoride levels in drinking water.
2. Fluoridated toothpaste is one of the most readily available caries-prevention products that is familiar to patients and can be easily incorporated into an oral hygiene routine. **Non-dental HCPs should emphasize the importance of regular brushing with fluoridated toothpaste**.
3. Sodium fluoride varnish is currently the best professionally-available topical fluoride agent. **Non-dental HCPs should consider incorporating a fluoride varnish application program into their practice**. Successful sodium fluoride varnish programs require staff involvement, as well as tracking and billing systems. To facilitate the implementation of a sodium fluoride varnish program, **non-dental HCPs should train clinical staff in varnish application, and deploy a system to identify patients who may benefit most from these treatments**.
4. Xylitol has been shown to decrease the acquisition of Mutans streptococci in young children, which is frequently transmitted vertically from mother to baby. **Non-dental HCPs should recommend that mothers of young children use xylitol-containing products and receive routine dental care**.
5. Although not yet available for use in North America and Europe, antimicrobial agents such as silver diamine fluoride and silver nitrate are being used in pediatric populations at high risk for caries. **Non-dental HCPs should be aware of antimicrobial therapies that control caries, as they may one day be asked to provide these treatments in their offices**.
6. Probiotics are an emerging therapy in dentistry. Results of recent trials show promising oral and general health effects. **Non-dental HCPs may consider recommending that patients at risk for caries use probiotics**.

Periodontal Diseases in Childhood and Adolescence

Periodontal Diseases Affecting Children and Adolescents

Periodontal disease encompasses a continuum of conditions involving varying levels of inflammation of the gingiva, the connective tissue that attaches tooth roots and bone (i.e., attachment apparatus) and the bone that supports teeth. A number of clinically distinct periodontal diseases can affect children and adolescents, including those listed below.[111]

- Gingivitis
- Chronic periodontitis
- Aggressive periodontitis
- Periodontitis as a manifestation of systemic diseases
- Necrotizing ulcerative gingivitis/periodontitis

Presentation of Healthy Gingiva

Recognizing the presentation of healthy gingiva (gum tissue) is an important first step in recognizing the presentation of periodontal diseases.

In young children, the colour of healthy gingiva is pink, coral or slightly red (*Figure 34*), and the shape is thick, rounded or rolled. Because it is less fibrous than the gingiva of adults, it is not as tightly adapted to the teeth. Also in contrast to healthy gingival tissues in adults, healthy gingiva in children tends to have a shiny rather than matte appearance.

In adolescents, healthy gingiva is flat and fits snugly around teeth; the **papilla** are pointed and pyramidal, filling the interproximal area between teeth; **stippling** is evident on the gingival surface (*Figure 35*). Clinical markers of mild gingivitis (*Figure 36*) in adolescents include inflammation of the marginal gingiva, which becomes red or bluish pink in colour, resulting in a smooth, shiny surface that is absent of stippling. Moderate gingivitis (*Figure 37*) is marked by inflammation and the gingiva bleeds easily during tooth brushing and flossing—when a patient reports seeing 'pink in the sink', a diagnosis of gingivitis should be considered. Severe gingivitis (*Figure 38*) is characterized by a distinct change in gingiva colour to red or magenta, edema, loss of stippling, spongy consistency, spontaneous bleeding and ulceration. Braces (*Figure 39*) increase the risk of gingivitis because the brackets that retain the wires accumulate hard-to-remove plaque.

Gingivitis

Gingivitis of varying severity is nearly universal in children;[112] it is the mildest form of periodontal disease, and the most prevalent in childhood. Gingivitis is initiated by the bacteria within plaque biofilm that collects around teeth contiguous to the gingiva (gum tissue). The incidence and severity of gingivitis increase throughout childhood, peaking at 80% prevalence in those aged 11-13 years.[113] Fluctuations in hormone levels during the onset of puberty can modify the inflammatory response to dental plaque, thus increasing the risk for gingivitis in this age group. People with diabetes may also be at increased risk due to altered insulin levels, which also amplifies the gingival inflammatory response to microorganisms within the biofilm.[112]

Because gingivitis does not affect the connective tissue attachment and bone that support teeth, the condition is both preventable and reversible with good daily oral hygiene.[112] For physicians, nurses and other non-dental HCPs who encounter cases of gingivitis in children or adolescents, giving patients instructions on how to perform thorough tooth brushing and dental flossing is essential. The use of **disclosing agents** to demonstrate areas in the mouth where plaque has not been removed is especially helpful. Patients with inflamed gingiva should be advised that there may be slight bleeding and

Figure 34. Healthy gingiva in a young child. The tissue is uniformly pink/coral in colour, shiny in appearance and rounded or rolled where it adapts to the teeth. Photo source: Travis Nelson. Used with permission.

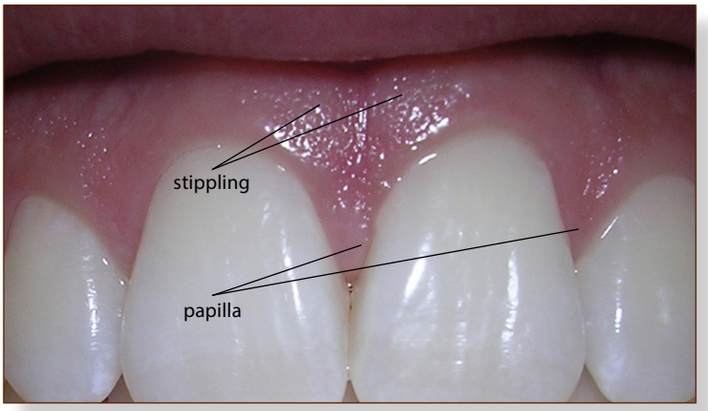


Figure 35. Healthy gingiva in an adolescent. The tissue is uniformly pink, stippled in appearance, flat and fits snugly around teeth; papilla are pointed and pyramidal, filling the interproximal space between teeth. Photo source: Wikimedia Commons/Dozenist. Used with permission.

Figure 36. Mild gingivitis. Characterized by slight changes in colour and mild inflammation, mild gingivitis may result in a smooth, shiny surface that is absent of stippling. Photo source: Travis Nelson. Used with permission.

Figure 37. Moderate gingivitis. Gum tissue with moderate gingivitis appears red and edematous, stippling is absent and the tissue bleeds easily. Photo source: Dreasmtime.com/ Zsolt Bota Finna. Used with permission.

Figure 38. Severe gingivitis with evident plaque. Severe gingivitis is characterized by a distinct colour change in gum tissue to red or magenta, edema, loss of stippling, spongy consistency, ulceration and the tissue bleeds easily. Photo source: Travis Nelson. Used with permission.

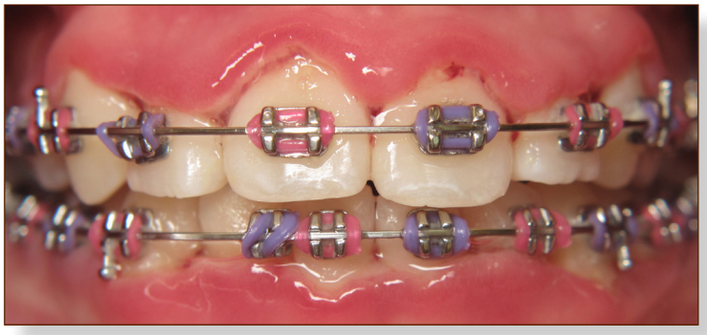


Figure 39. Moderate gingivitis with braces. Braces increase the risk of gingivitis because the brackets that hold the wires accumulate hard-to-remove plaque. Photo source: Travis Nelson. Used with permission.

gingival tenderness when a more vigorous regimen of oral hygiene is begun. Once thorough plaque removal is initiated, bleeding and tenderness will discontinue. Warm salt water rinses may help shrink edematous tissue. Patients and their caregivers should be advised that gingival inflammation in the affected areas disappears approximately one week after thorough removal of plaque, and that gingival health can be maintained by effective daily brushing and flossing.

Periodontitis

Periodontitis is a major cause of tooth loss in older patients. Surveys of young people from around the world indicate that the incidence of periodontitis increases in adolescents aged 12-17 years, compared to children aged 5-11 years.[112] While chronic periodontitis is more common in adults, aggressive periodontitis may be more common in children and adolescents.[111] The two most prominent types of periodontitis seen in children and adolescents are discussed in more detail: chronic periodontitis and aggressive periodontitis.

Chronic Periodontitis

Chronic periodontitis is often the result of untreated gingivitis. The accumulation of dental plaque evokes a host response that perpetuates destruction of the supporting tissues. This disease process is characterized by a chronic state of infection and inflammation, which causes formation of soft gingival tissue pockets or crevices surrounding the root of the tooth (*Figure 40*). If left unchecked, these will continue to deepen, resulting in destruction of the connective tissue apparatus that supports teeth, including gingival tissues, periodontal ligaments and alveolar bone (*Figure 41*). The disease has varying degrees of severity, from mild to advanced, which is determined by measuring millimetres of attachment loss with a specialized dental instrument called a periodontal probe (*Figure 42*).[112]

Periodontitis is uncommon in young children,[112] but the incidence increases in the adolescent population,[114] which is at greater risk for gingivitis. In addition to the bacterial components of the biofilm, genetic and environmental risk factors influence the initiation and progression of the disease.

The clinical signs and symptoms of chronic periodontitis include gingival swelling, redness, bleeding (often but not always), pocketing of gingiva surrounding teeth, tooth mobility and/or **suppuration** (discharge of pus; *Figure 43*). Since periodontitis is a disease affecting the deeper tissues (e.g., periodontal ligament and alveolar bone), the appearance of surface tissues is not a reliable way to detect disease severity. Radiographic evidence of bone loss (*Figure 44*) may or may not be present. Usually there is no pain associated with chronic periodontitis until the disease has significantly advanced. Comprehensive clinical examination is the gold standard for diagnosis.

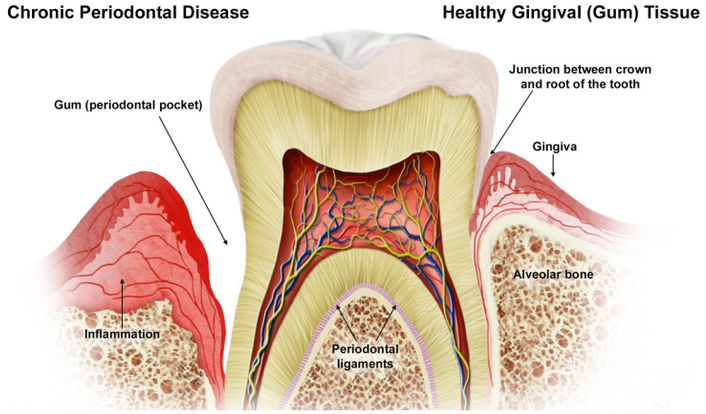


Figure 40. Healthy versus diseased gums. The right side of this illustration depicts healthy gum (periodontal) tissue. Note that the height of the attached gum tissue is adjacent to the junction where the crown and the root of the teeth meet. The left side of the illustration shows chronic periodontitis caused by infection and inflammation. The resultant host response eventuates a loss of the collagen content of the soft tissue that comprises the gum tissue. This triggers an increase in the depth of periodontal (gum) pockets that surround the tooth. If left untreated, these pockets continue to deepen resulting in destruction of the connective tissue apparatus that supports the tooth, including gingival tissues, periodontal ligaments and alveolar bone. © 2014 University of Manitoba. All rights reserved.

Figure 41. Chronic periodontitis. Note the gingival recession (receding gums), exposing the roots of the teeth. Photo source: © iStock/watanyou. Used with permission.

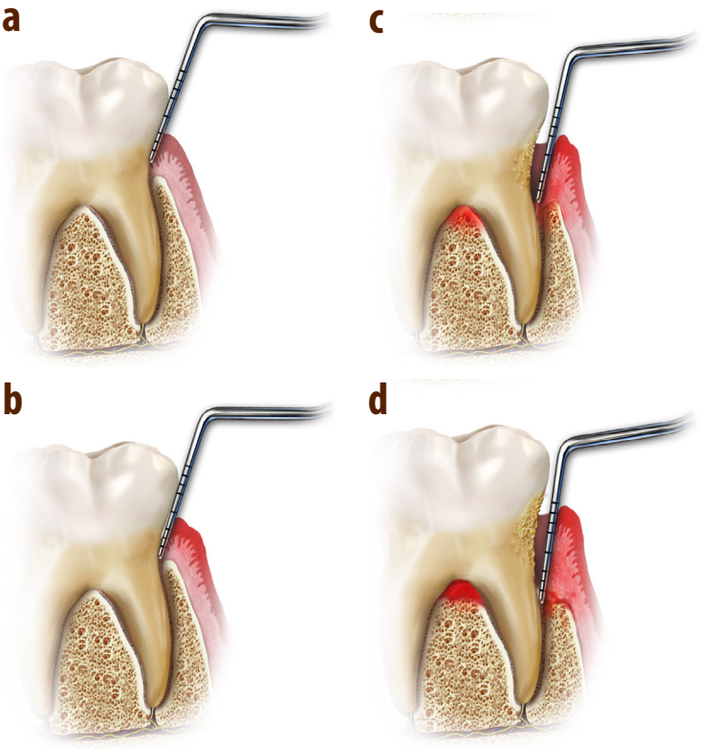


Figure 42. Loss of periodontal attachment. Periodontal disease has varying degrees of severity, from mild to advanced, which is determined by measuring millimetres of attachment loss with a specialized dental instrument called a periodontal probe. (a) healthy gums fit snugly to the tooth-alveolar bone complex, firmly anchoring the teeth in place; (b) in mild or early-stage periodontitis, gums are slightly inflamed in response to plaque bacteria accumulation, creating small pockets between the teeth and gums; (c) in moderate periodontitis, pockets between the teeth and gums extend to the alveolar bone, allowing more plaque and calculus to collect below the gumline, sometimes resulting in loose teeth; (d) in advanced periodontitis, pockets become very deep, resulting in advanced alveolar bone loss due to accumulation of virulent bacteria and their by-products. Teeth become loose and sometimes fall out or require extraction. © 2014 University of Manitoba. All rights reserved.

Aggressive Periodontitis

Aggressive periodontitis is characterized by a history of rapid bone loss around most teeth, loss of alveolar attachment and marked gingival inflammation in the absence of heavy dental plaque or **calculus** (tartar) in an otherwise healthy individual (*Figure 45*). This disease is usually localized to the first permanent molars and incisors in young individuals. However, it can affect the entire dentition.

Generalized aggressive periodontitis exhibits varying severities of gingival colour and contour changes. However, the distinguishing radiographic feature of aggressive periodontitis is severe alveolar bone loss (*Figure 46*).

The onset of aggressive periodontitis is usually around puberty. The disease often occurs in adolescents and young adults, with greater prevalence in the female population. The prevalence of generalized aggressive periodontitis in American adolescents (aged 14-17 years) is reported to be 0.13%.[112] In geographically diverse adolescent populations, the prevalence of localized aggressive periodontitis ranges from 0.1-15%. However, most studies report 0.2%, with a significantly higher prevalence in African American populations.[112] At the time this course was developed, no such statistics were available for Canadian adolescents.

Aggressive periodontitis is thought to have a genetic link, as it most often occurs within families. Evidence suggests that **neutrophil defects** and alterations in immunologic function increase susceptibility to the disease, and may play a role in its progression.[112] In young patients with neutrophil deficiency, permanent teeth may exfoliate as soon as they erupt, sometimes simultaneous with loss of primary teeth.[115] Although localized aggressive periodontitis can be treated successfully, the success rate of generalized aggressive periodontitis treatment is low in patients with systemic diseases.[112] Sometimes the only option is full mouth extraction.

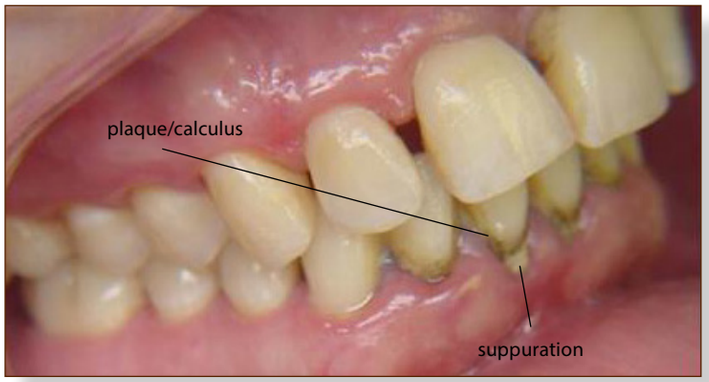


Figure 43. Chronic periodontitis. In this patient, notice the accumulation of plaque/calculus above and below the gum line as well as suppuration (pus). Photo source: Casey Hein. Used with permission.

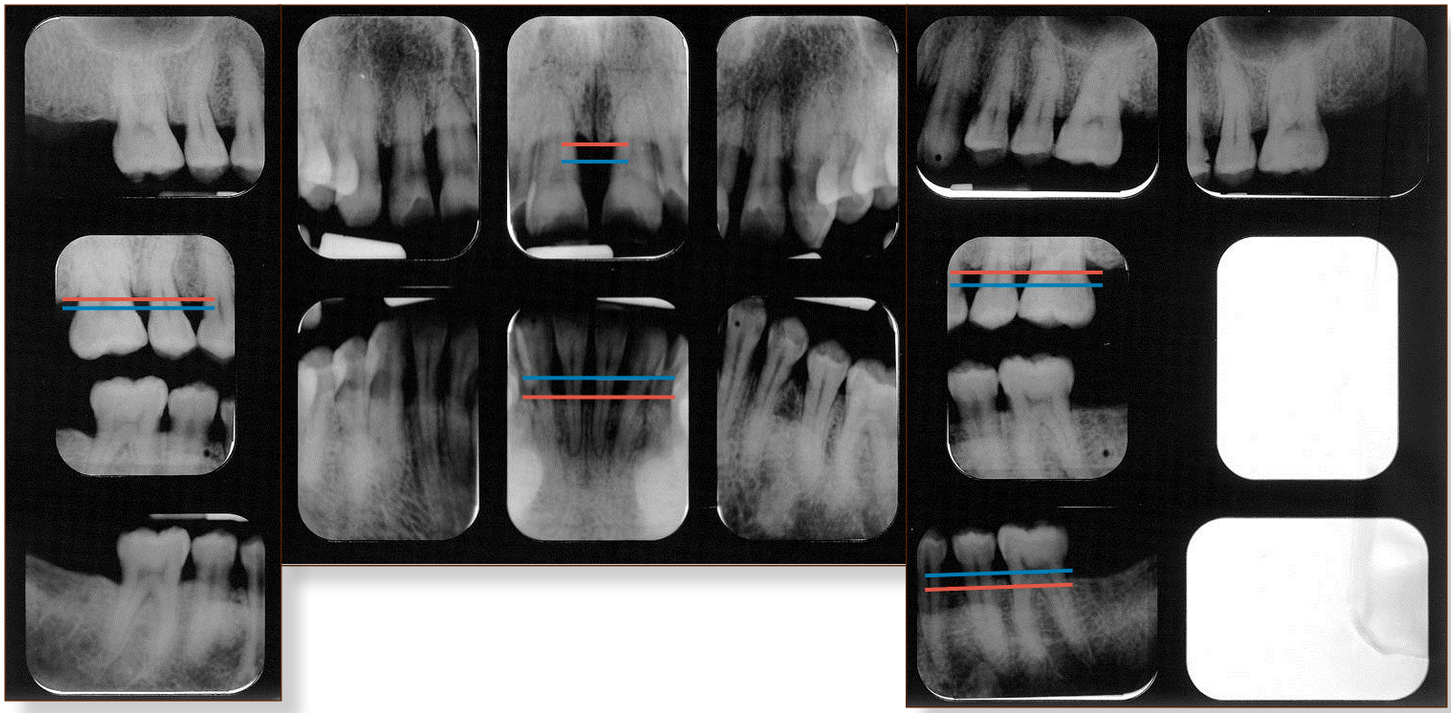


Figure 44. Chronic periodontitis. Full mouth radiographic survey of the patient above, showing evidence of bone loss. The space between the blue and red lines demonstrates the amount of alveolar bone loss that has occurred. Photo source: Casey Hein. Used with permission.

Periodontitis as a Manifestation of Systemic Diseases

In children and adolescents who may suffer from systemic diseases that predispose the primary or permanent dentition to periodontal destruction, the diagnosis is periodontitis as a manifestation of systemic disease. This includes systemic diseases and disorders associated with neutrophil defects or immunologic deficiency, such as **Papillon-Lefèvre syndrome**, **Cyclic neutropenia**, **Agranulocytosis**, **Down's syndrome**, **Hypophosphatasia**, **Leukocyte adhesion deficiency**, **Acrodynia**, **Leukemia**, **Chédiak-Higashi syndrome** and **Histiocytosis-X**.[113,116]

Studies have shown that children with Type 2 diabetes experience significantly higher plaque scores, gingival inflammation and loss of periodontal attachment.[117,118] These clinical parametres generally worsen in adolescence and adulthood. Evidence also suggests that children with diabetes are at a significantly higher risk for gingival bleeding and diabetes-related oral complications affecting the primary periodontium as early as 6 years of age and possibly earlier.[119] Other studies have demonstrated an association between diabetes and increased risk for periodontal destruction early in life.[120] This provides a compelling rationale for medical and nursing professionals to screen for gingivitis as a standard of care in children and adolescents with diabetes.

A number of studies have also brought to light the significance of the relationship between obesity and periodontal disease in children. A recent study[121] demonstrated that obese children (mean age: 9 years) showed significantly higher plaque deposits and gingival bleeding. These are both risk indicators

Figure 45. Aggressive periodontitis. This clinical presentation is a case of aggressive periodontitis in a 13-year-old patient. He presented with a complaint that the space between his two front teeth had increased within the last year. This is a chief complaint reported in cases of aggressive periodontitis. Note that the teeth appear relatively plaque free and the gum tissue does not appear as inflamed as in cases of chronic periodontitis. The minimal amount of plaque on the teeth is disproportionate to the amount of bone loss in this case. Photo source: Bruce Mandel. Used with permission.

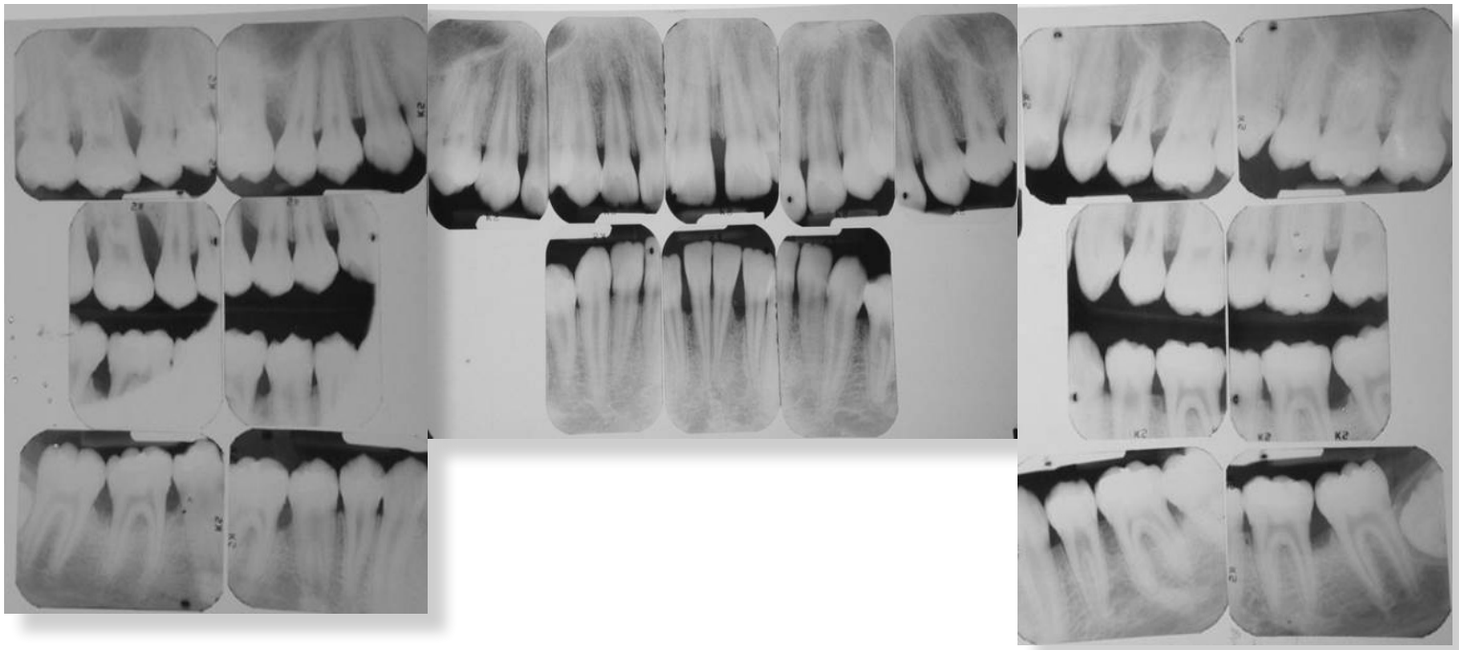


Figure 46. Aggressive periodontitis. Full mouth radiographic survey of the 13-year-old patient above shows a significant loss of alveolar bone around the maxillary and mandibular incisors (anterior), and the molar teeth (specifically the first molars in both the maxilla and mandible). This is a distinguishing feature of aggressive periodontitis. The loss of bone in the anterior maxilla explains why the patient experienced drifting between his incisor teeth. Aggressive cases of periodontitis usually have marked familial aggregation. Photo source: Bruce Mandel. Used with permission.

of future periodontal destruction. Other research[122] suggests an early life association between **metabolic syndrome** and gingival inflammation, which may start in early childhood.

Non-dental HCPs such as physicians and nurses routinely recommend lifestyle choices that encourage promotion of healthy weight and lower risk for chronic disease conditions. These recommendations also decrease the risk for periodontal diseases. Physicians, nurses and diabetes educators who emphasize good oral hygiene can help prevent future periodontal complications in patients with diabetes.

Necrotizing Ulcerative Gingivitis/Periodontitis

The most common clinical characteristics of necrotizing periodontal disease include: necrosis and ulceration of the **interproximal gingiva** (*Figure 47*), rapid onset of gingival pain, fiery red gingival tissues, spontaneous bleeding of the gingiva, the presence of a grey pseudomembrane (*Figure 48*), excessive salivation, **fetid** (bad) breath, swollen lymph nodes and fever.[112,115]

Viral infections (including HIV), malnutrition, emotional stress, lack of sleep and a range of systemic diseases predispose children to necrotizing periodontal disease.[112] Necrotizing ulcerative gingivitis/periodontitis is much more prevalent in developing countries.[123-125]

Since necrotizing ulcerative gingivitis is an infectious disease, the signs and symptoms begin to diminish when the microbial concentration is reduced. The recommended treatment involves administration of systemic antibiotics and

mechanical debridement using either manual or ultrasonic dental instruments.[126]

Non-dental HCPs have not yet been trained to perform **debridement** of oral soft tissues, although this may be a skill that is someday included in their scope of practice. In the meantime, there are a number of palliative procedures that physicians, nurses and other non-dental HCPs can perform to provide temporary relief of necrotizing ulcerative gingivitis, including those listed below.[126]

- Prescribe systemic antibiotics if there are signs of systemic involvement, such as fever, **lymphadenopathy**, or malaise.
  - Metronidazole is the drug of choice. However, other antibiotics can be combined or used instead, such as penicillin or erythromycin.
  - Dosages should be prescribed with regard to the child or adolescent's body weight (e.g., Metronidazole, 30 mg/kg divided in four daily doses up to a maximum 2 g/day; Penicillin V Potassium, 25-50 mg/kg divided in four daily doses up to a maximum 2 g/day).
  - Antibiotics should be continued until systemic complications or local lymphadenopathy has subsided.
- Prescribe an analgesic such as ibuprofen to help alleviate pain.
- Instruct the patient to rinse with either an equal mixture of 3% hydrogen peroxide and warm water every two hours, or 0.12% chlorhexidine gluconate solution twice daily.
- Instruct the patient to avoid excessive physical activity or prolonged exposure to the sun.
- Instruct the patient to brush with bland toothpaste (e.g., baking soda), restrict tooth brushing to the removal of gross debris and refrain from flossing or overzealous brushing that provokes pain/discomfort.
- Refer the patient to a periodontist for further treatment.

Prevention of Periodontal Diseases in Children and Adolescents

Gingivitis is an important risk factor for development of periodontal diseases later in life.[123,127,128] Intervention at a young age may reduce the risk of developing periodontitis in adulthood. Recent studies have shown that inadequate maternal oral hygiene may also be a risk factor, and may predict the incidence of periodontitis in children and adolescents.[129]

The cornerstone of periodontal disease prevention is thorough removal of the bacterial plaque that collects around teeth contiguous to the gingiva. Individual patient counseling on

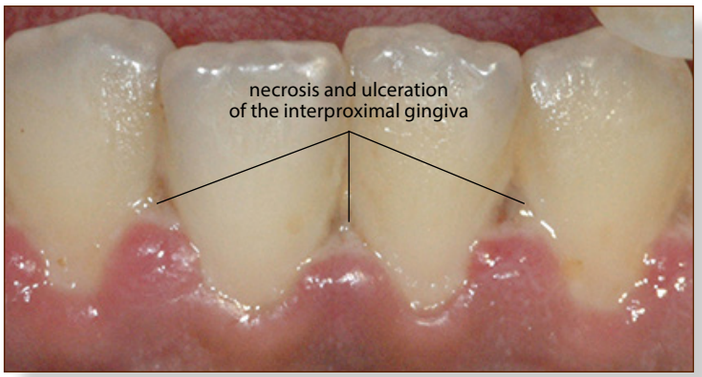


Figure 47. Necrotizing ulcerative gingivitis. This acute condition of the gingiva is caused by bacterial infection and characterized by interdental gingival necrosis, bleeding and pain. Photo source: Wikimedia Commons/Modteque; Mohammed Hamze. Used with permission.

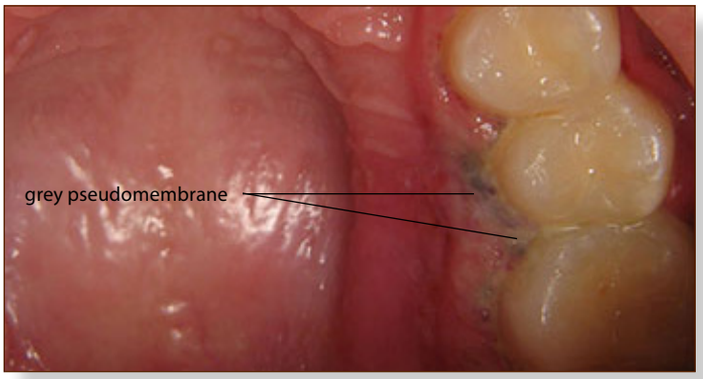


Figure 48. Necrotizing ulcerative gingivitis. Necrosis and sloughing of interdental papillae and marginal gingiva give rise to a grey pseudomembrane in cases of necrotizing ulcerative gingivitis. Photo source: Travis Nelson. Used with permission.

Figure 49. Disclosing agents. Available in liquid and tablet formats, disclosing agents show patients where they are failing to remove dental plaque, which helps improve compliance to oral hygiene instructions. © 2014 University of Manitoba. All rights reserved.

how to maintain good oral hygiene should be matched with the patient's needs, as well as cognitive and physical abilities.

On the most basic level, oral hygiene regimens should include brushing teeth at least twice a day with a soft bristled toothbrush, which should be replaced on a monthly basis. Patients and their caregivers should be advised against sharing toothbrushes. Interdental cleaning with dental floss at least once a day is also recommended. Irrigation devices (e.g., Waterpik™) are particularly helpful for adolescents undergoing orthodontic treatment. As an adjunct to oral hygiene, mouthwash containing essential oil (e.g., Listerine®) may also reduce biofilm and the risk for gingivitis.[130] Important to note is that mouth rinses of any kind are not indicated for children who cannot spit (i.e., children generally under 6 years of age). Primary prevention of periodontal disease is achieved through good oral hygiene practices.

Dental biofilm is not readily visualized on most teeth because it is often white or cream coloured. For children and adolescents at high risk for periodontal diseases; non-dental HCPs may consider using a plaque-disclosing agent to clearly show to the patient where dental biofilm retained after brushing and flossing still needs to be removed (*Figure 49*). Showing patients the stained plaque is a dramatic way to demonstrate the multitudes of microorganisms that live on teeth and can initiate periodontal disease. Disclosing agents are readily available in liquid and tablet form at drug stores and dental supply companies.

Successful treatment of periodontal diseases in children and adolescents relies largely on early diagnosis. Secondary prevention is essential, and may be accomplished through early identification of high-risk patients during routine oral screening and aggressive intervention.

Periodontitis in childhood and adolescence is not highly prevalent. However, routine screening is recommended in patients who present with any of the conditions listed below.

- Overweight, obesity or metabolic syndrome
- Diabetes (Type 1 or Type 2)
- Parents who have lost their teeth or who have reported having periodontal disease
- Viral infections (including HIV)
- Malnutrition
- Emotional stress
- Lack of sleep
- Systemic diseases and disorders associated with neutrophil defects or immunologic deficiency (as discussed previously in this course)

Pearls to Practice

Periodontal Diseases in Children and Adolescence

1. **Non-dental HCPs should be aware of the clinically-distinct periodontal diseases that can affect children and adolescents, and educate young patients and their caregivers about the importance of maintaining good oral hygiene.**

2. Gingivitis is the mildest form of periodontal disease. Nearly universal in children and adolescents, it is an important risk factor for the development of periodontal disease later in life. To prevent gingivitis, **non-dental HCPs should encourage good oral hygiene, and be aware that both fluctuations in hormone levels around puberty and diabetes-associated hyperglycemia may amplify the gingival inflammatory response to microorganisms in dental plaque. Patients who are bacterially hypersensitive should be carefully screened for inflammation of the gums.**

3. Although chronic periodontitis is more common in adults, aggressive periodontitis is more common in children and adolescents. **Non-dental HCPs should screen children and adolescents who have diseases or conditions associated with either neutrophil defects or impaired immune function for aggressive periodontitis.** These patients may present with loosened teeth and gingival inflammation in the absence of heavy dental plaque, and should immediately be referred to a periodontist.

4. Because children and adolescents who suffer from systemic diseases are predisposed to periodontal diseases, **non-dental HCPs should carefully screen for gingival inflammation, and co-manage these patients with medical experts and a periodontist.**

5. **Non-dental HCPs should screen for oral inflammation in children and adolescents who have diabetes, are overweight or obese, or have metabolic syndrome**. The importance of routine dental examinations and good oral hygiene should be recommended to these patients and their caregivers. Children with diabetes are at increased risk for periodontitis; therefore, oral health recommendations should be emphasized for all pediatric patients with diabetes.

6. **Non-dental HCPs are often the first professional to see a child or adolescent who has ulcerative necrotizing gingivitis and should therefore recognize the signs and symptoms and refer these cases to a dentist**. A patient with this condition may present with any of the following: necrosis and ulceration of the interproximal gingiva, rapid onset of gingival pain, fiery red gingiva, spontaneous bleeding, grey pseudomembrane, excessive salivation, fetid breath, swollen lymph nodes and/or fever.

Figure 50. Primary teeth. The first teeth to emerge in infancy are typically the mandibular central incisors (bottom front teeth). Photo source: Wikimedia Commons/Chrisbwah. Used with permission.

Oral Health Anticipatory Guidance During Infancy, Childhood and Adolescence

Non-dental HCPs have a unique opportunity to provide anticipatory guidance to children and their parents or caregivers. Simple explanations at routine pediatric visits regarding what to expect often allay parents' concerns and provide valuable information.

SUPPLEMENTAL RESOURCES

Anticipatory Guidance Sheets

Print these curriculum resources and distribute to your patients to help manage their expectations about the development of the oral cavity. Four handouts are available as attachments to this course; one for each age group from birth to19 years of age.

Development of the Primary, Mixed and Permanent Dentition

The timing and pattern of tooth eruption may vary, but generally baby teeth begin to erupt at around 6 months of age. Typically the first teeth to emerge are the mandibular central incisors (*Figure 50*). Shortly thereafter, the maxillary anterior teeth follow. Generally the process proceeds from anterior to posterior, with most children having a full complement of 20 primary (baby) teeth by 31 months of age. *Figure 51* provides a chart that details the timing of the normal eruption of the primary dentition.

In some cases there is a significant delay in eruption of the primary dentition. This is often a source of concern for parents. If teeth have not erupted by 12 months of age, non-dental HCPs should refer the child to a dentist for evaluation. In rare cases, delay in tooth eruption may be associated with systemic or genetic conditions. Many craniofacial syndromes and conditions, such as cerebral palsy, malnutrition and anemia, can result in delayed eruption. While uncommon, these syndromes and conditions should be considered in cases of delayed dental development. An oral radiograph taken at the dental clinic can reveal the presence of developing teeth, allaying parental fears and providing important diagnostic information.[45] Spacing between primary teeth allows room for the larger permanent teeth to erupt without causing crowding. Accordingly, parents should be advised that spaces between primary teeth are both normal and desirable.

For most children, permanent teeth begin to emerge around 6-7 years of age. *Figure 52* provides a chart that details the timing of the normal eruption of the permanent dentition. The mandibular incisors are usually first to appear. These permanent teeth develop lingual to the primary teeth, and as a result both primary and permanent mandibular anterior teeth may be present as they emerge (*Figure 53*). Typically the primary teeth are shed naturally. However, in some cases the permanent successors do not adequately dissolve the roots of the primary teeth and, as a result, the primary teeth do not become loose. In such situations, referral to a dentist for extraction is indicated.

Around this same time, the first permanent molar will begin to erupt. This tooth is located posterior to the primary dentition, and is often known as the 'six-year molar' because of the age at which it emerges (*Figure 54*). During this phase, the child has a mix of primary and permanent teeth, known as a mixed dentition (*Figure 55*). Dental development remains relatively stable during the early mixed-dentition phase, and the child will not begin losing teeth again until late mixed dentition (around 10 years of age). At this time, the primary cuspids (canines) and molars are lost, giving way to the permanent cuspids and premolar teeth. Permanent second molars also erupt at this time and are commonly known as the '12-year molars.' By the early teen years most adolescents have a full complement of permanent teeth. This phase is known as the 'adolescent dentition' or 'early permanent dentition'. During this time period, the periodontal attachments for new permanent teeth mature. However, there are very few noticeable changes in the developing teeth. Because a full complement of permanent teeth is now present, many teens will undergo definitive orthodontic treatment at this phase.

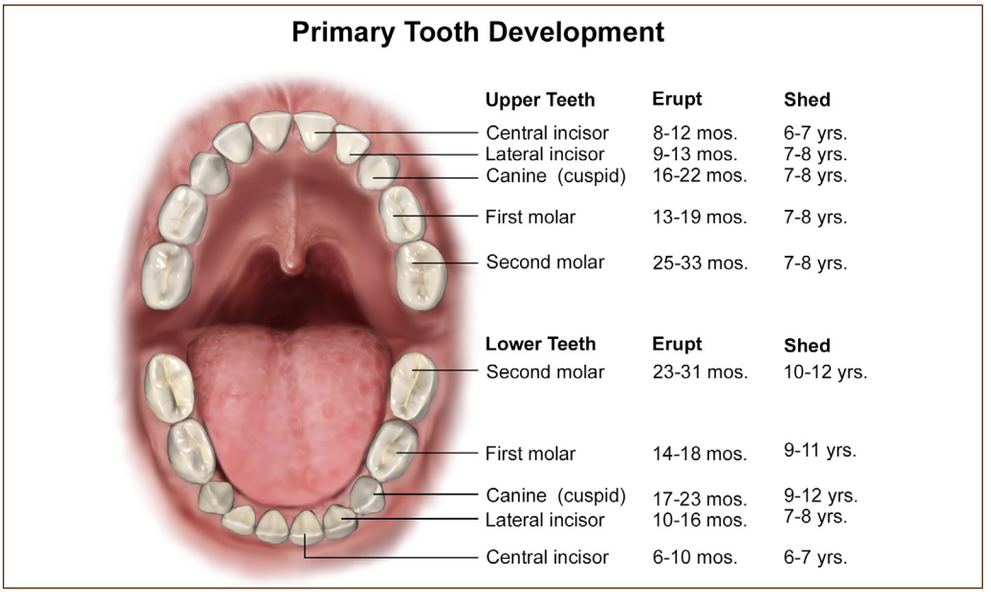


Figure 51. This chart details the timing of normal eruption of the primary dentition. Baby teeth typically start erupting at around 6 months of age, beginning with the mandibular central incisors, followed by the maxillary anterior teeth. Generally the process proceeds from anterior to posterior, with most children having a full complement of 20 primary teeth by 31 months of age. © 2014 University of Manitoba. All rights reserved.

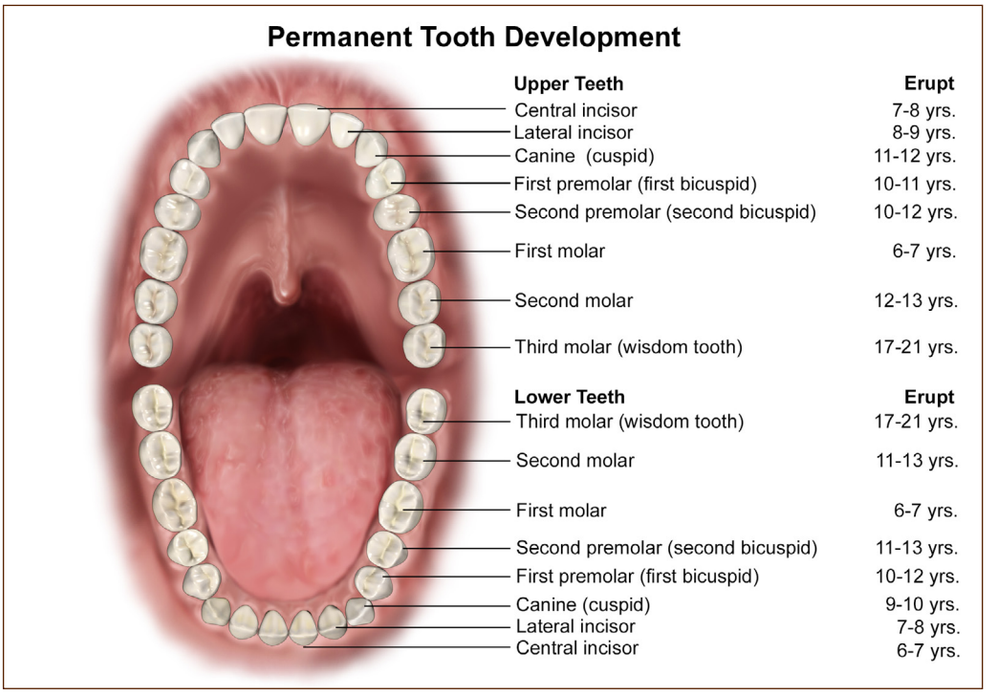


Figure 52. This chart details the typical eruption pattern of the permanent dentition. At 5-6 years of age, the first permanent teeth emerge, beginning with the mandibular incisors. At about the same time, the first permanent molars erupt. Located posterior to the primary dentition, this tooth is commonly referred to as the 'six-year-molar' because of the age at which it emerges. © 2014 University of Manitoba. All rights reserved.

The last major change in dental development involves the third molars (wisdom teeth). Third molars are the most common congenitally-absent teeth. If present, they will erupt without incident in the majority of people.[131] However, they can become impacted in ways that do not allow them to erupt properly into the mouth (*Figure 56*). When this occurs a dentist can determine whether it is best to observe third molars for pathologic changes or extract them. Adolescents and young adults commonly complain of pain and pressure associated with third molars. Depending on the severity of discomfort, this may be an indication for removal.

Pericoronitis is another relatively common yet painful condition that results when the gingival tissue overlying the erupting tooth becomes infected (*Figure 57*). When this occurs, antibacterial irrigation and/or antibiotic administration usually allows the infection to resolve.[132] Pericoronitis and its treatment will be discussed later in this course.

SUPPLEMENTAL RESOURCES

Eruption Charts

Use these curriculum resources to educate your colleagues and patients about the eruption sequence and pattern of primary and permanent teeth.

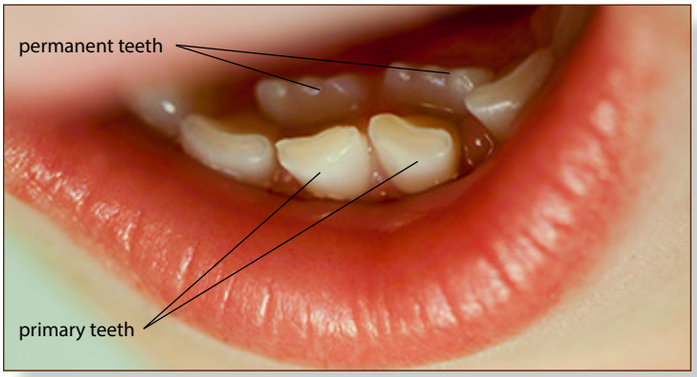


Figure 53. Permanent teeth. The mandibular incisors are usually the first permanent teeth to appear. They develop lingual to the primary teeth; both sets of teeth may be present as they emerge. Photo source: Wikimedia Commons/Milchzahn Haifischgebiss. Used with permission.

Figure 54. Six-year-molar. This photograph shows the first permanent molar beginning to erupt posterior to the primary dentition. Photo source: Zenmindphotopgraphy by Valeria Pereira-Howell. Used with permission.

Optimal Breastfeeding/Bottle Feeding and Weaning

When a child's primary teeth are erupting, medical and nursing professionals can play an important role in promoting healthy feeding practices. Breastfeeding has well-established short- and long-term medical and neurodevelopmental advantages for young children. Therefore, the American Academy of Pediatrics (AAP) and the Canadian Paediatric Society (CPS) recommend exclusive breastfeeding for the first six months of a child's life.[133,134] As the child grows older, complementary foods should be introduced. Although breastfeeding can be encouraged after the introduction of solid foods, continuous or frequent breastfeeding may put the child at higher risk for dental caries. This is particularly true when children nurse throughout the night.[135-137] Parents who wish to breastfeed after the child's teeth have emerged should be counseled to regard breastfeeding as a meal. This practice is healthy and does not pose a risk to the teeth. Parents who insist on co-sleeping or continuous feeding should be advised of the oral health risks, and they should be provided with additional preventive advice including optimal oral hygiene and fluoride exposure.[153] HCPs should encourage parents to

Figure 55. Mixed dentition. Between 6-13 years of age children have a mix of both primary and permanent teeth, as can be seen in this 7-year-old with two fully-erupted permanent mandibular central incisors, an erupting permanent maxillary central incisor and primary teeth. Photo source: Jasmin Merdan - Fotolia.com. Used with permission.

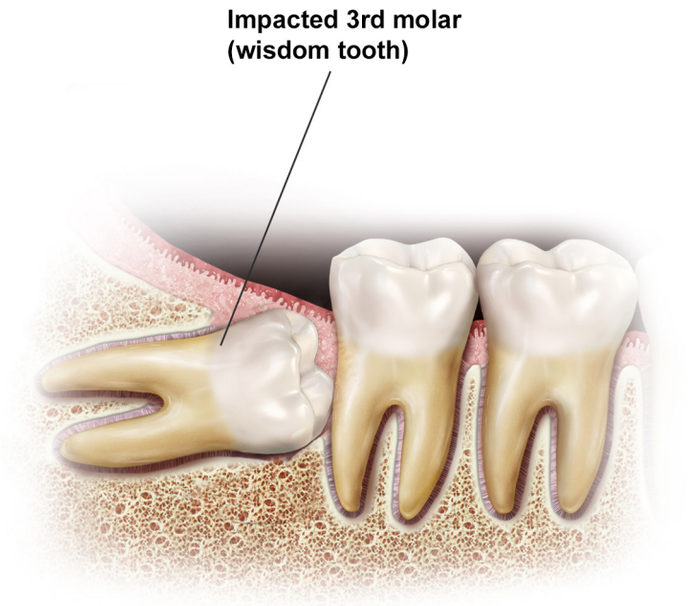


Figure 56. Impacted wisdom tooth. Impacted wisdom teeth are third molars that do not have enough room to erupt, often causing pain. Difficult to sufficiently clean, impacted wisdom teeth and neighboring structures are more vulnerable to decay and periodontal disease. Depending on the severity of discomfort and/or risk for other dental problems, impacted wisdom teeth may require extraction. © 2014 University of Manitoba. All rights reserved.

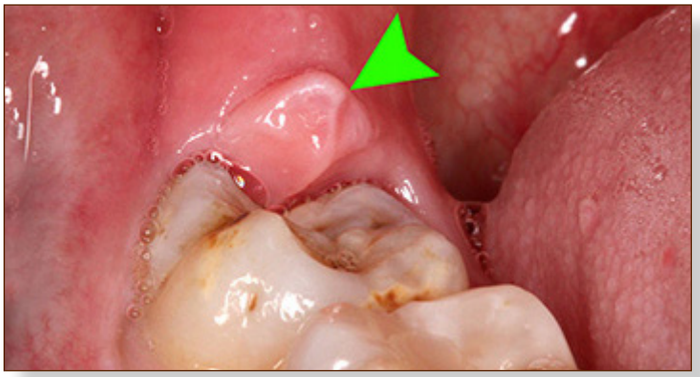


Figure 57. Pericoronitis. This condition results when the gingival tissue overlying an erupting tooth becomes infected. Photo source: Wikimedia Commons/Coronation Dental Specialty Group. Used with permission.

hold infants while bottle feeding. The bottle should never be propped on pillows or other objects so that it stays in the infant's mouth. This practice may be harmful because it encourages prolonged exposure to the contents of the bottle. Infants should not be allowed to fall asleep with a bottle that contains milk, formula, juice or other sweetened liquids due to their potential to cause tooth decay.[138] The AAP recommends weaning a child from the bottle by 18 months of age.[139] To smooth this transition, it may be helpful for parents to introduce a cup around age one.

Normal Sucking and Safe Use of Pacifiers

Thumb-sucking and the use of pacifiers are common in infants and young children, and they may have important soothing properties. Prior to 3 years of age these sucking habits should be considered normal. However, while helpful and comforting, non-nutritive sucking behaviours may compromise normal craniofacial and dental development. When sucking is frequent and/or vigorous, the mouth may conform to the shape of the pacifier, increasing the space between the maxillary and mandibular anterior teeth, narrowing the maxillary dental arch, and contributing to long-term orthodontic problems (*Figure 58*).[140,141] For these reasons, the AAPD recommends that parents wean children from pacifiers by 36 months of age.[142]

Cessation strategies for pacifiers may include behavioural conditioning, modification of the pacifier (e.g., cutting off the tip) to make it less appealing for the child, or simply discarding all available pacifiers and not purchasing more.

Recommended cessation strategies for digit sucking are varied and include reward and reminder therapy, such as placing a bandage on the child's finger, taping a mitten to a child's hand, or placing an ace bandage on the child's elbow during the night. Bitter flavouring agents, a dental appliance and other behavioural conditioning techniques may also be employed along with positive reinforcement.[142-146] Many of these approaches are best suited for older children who wish to stop, but are having a difficult time doing so. With young children, positive reinforcement and social pressures such as starting kindergarten often provide sufficient motivation. While similarly harmful to the developing dentition, a pacifier habit may be easier to break than a digit-sucking habit.[147]

Normal Teething and Palliative Care During Teething

Eruption of primary teeth is often preceded by increased salivation. Children may become fussy or restless and want to put their fingers in their mouths. Conditions like fever, seizures, bronchitis and diarrhea have all been erroneously attributed to teething. While daytime restlessness, finger sucking, drooling and loss of appetite are normal during teething, other systemic symptoms should be attributed to coincidence.[21] As teeth begin to erupt, the tissues surrounding the area commonly become swollen and sensitive. Cold washcloths or chilled teething rings may help. The use of systemic pain medications such as acetaminophen is also indicated for children who are experiencing discomfort. Benzocaine topical anesthetic marketed as teething pain relievers, (such as Orajel™ and Anbesol™) should be discouraged, as cases of **methemoglobinemia** have been reported following administration of these products.[148] There is such concern over this practice that the United States Food and Drug Administration (FDA) has now issued a warning stating that children under 2 years of age should not use teething gels that contain benzocaine except under the advice and supervision of a healthcare professional.[149]

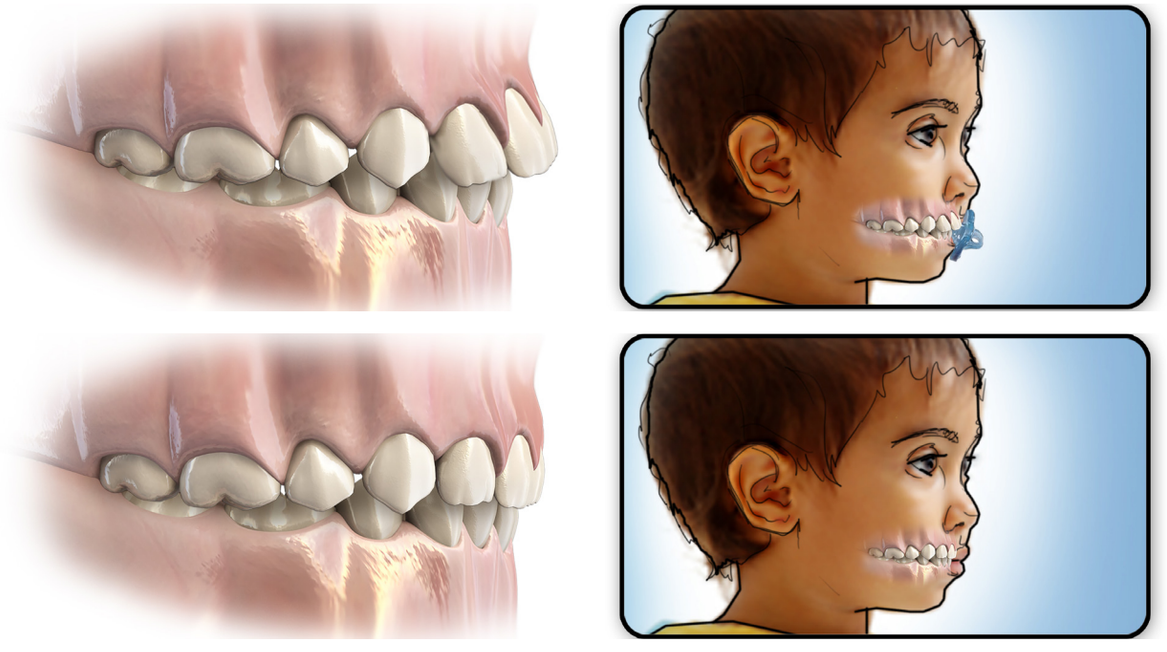


Figure 58. Mouth conformed to pacifier. When sucking is frequent and/or vigorous, the mouth may conform to the shape of the pacifier, resulting in increased space between the maxillary and mandibular anterior teeth, narrowing the maxillary dental arch and contributing to long-term orthodontic problems.

Preparing Children for First Dental Care Visit

In anticipation of a young child's first visit, having parents or caregivers explain to the child what he/she can expect is helpful. A large variety of children's books and educational materials describe the process of visiting the dentist. Many dental offices also have websites with photos of the office and office staff. Reviewing these resources may help the child become acquainted with the dental team before the first meeting.

Because anxious parents tend to make their children more nervous, parents who are very fearful about their own dental care should consider having another family member take the child to their first visit. Using a positive or neutral tone and words the child will understand can help send the right message when discussing the dental visit with older children. Terms like 'shot' and 'drill' should be avoided.

Children with special needs may benefit from additional accommodations. In these situations, parents should inform the clinic staff of the child's condition when making the appointment. The office may be able to accommodate the family by scheduling the visit in a private room or arranging a special tour of the office facilities before the dental visit.

SUPPLEMENTAL RESOURCES

Preparing Children for the First Dental Visit

Encourage parents/caregivers to use these online resources for advice on how best to prepare children for a first trip to the dentist.

EverydayHealth.com
everydayhealth.com/dental-health-specialist/kids-and-the-dentist.aspx

KidsHealth.org
kidshealth.org/parent/general/teeth/healthy.html

Canadian Dental Association
cda-adc.ca/en/oral_health/cfyt/dental_care_children/first_visit.asp

Pearls to Practice

Oral Health Anticipatory Guidance During Infancy, Childhood and Adolescence

1. Most children have a full complement of 20 primary teeth by 31 months of age. **Non-dental HCPs should be aware of tooth eruption chronology, advise parents when to expect that teeth will emerge, and refer patients to an oral HCP in cases where eruption is significantly delayed**.
2. Breastfeeding is a healthy practice that promotes optimal development. **Non-dental HCPs should promote breastfeeding, but encourage parents to treat each feeding as a meal.** Co-sleeping and continuous breastfeeding can put a child at high risk for decay.
3. **Non-dental HCPs should encourage parents to wean children from the bottle by 18 months of age**. Introducing a cup by 12 months can ease this transition.
4. Non-nutritive sucking is a normal part of infancy and early childhood that poses little risk of long-term orthodontic consequences in toddlers. However, after 3 years of age, sucking habits can promote unfavourable tooth-jaw relationships. **Non-dental HCPs should encourage cessation of sucking habits by 36 months of age**.
5. Chilled teething rings, cold washcloths and systemic pain medications such as acetaminophen are indicated for children who experience teething discomfort. **Non-dental HCPs should discourage use of benzocaine topical anesthetic marketed as teething pain relievers**, as cases of methemoglobinemia have been reported following administration of these products.
6. Early visits to the dentist provide the foundation for a lifetime of oral health. A child's first visits should help develop a positive impression of dental care. **Non-dental HCPs should establish relationships with oral HCPs who are accustomed to seeing young children, and who can best accommodate children with special healthcare needs**. Parents can help prepare children for dental visits using age-appropriate resources.

Oral Home Care and Dietary Practices

Importance of Positive Provider-Caregiver Relationships and Oral Health Literacy

People with low oral health literacy are often less likely to seek preventive care, comply with prescribed treatment and maintain their own self-care regimen. Individuals with low oral health-literacy commonly include those from low-income families, immigrants and refugees, those with language barriers and those with limited access to healthcare. In these populations, limited oral health literacy hinders prevention, diagnosis and treatment of oral diseases in children and adolescents. Children whose parents have low oral health-literacy often have worse health outcomes.[150-152]

Key components of an effective prevention program include educating parents and caregivers during routine medical examinations. These visits offer PCPs and other non-dental HCPs opportunities to provide individualized oral health counseling and educational resources that strengthen HCPs' relationships with parents and caregivers.

Many factors that contribute to caries are behavioural. Therefore, maintaining a positive relationship with the family and involving them in oral health decisions is vital to achieving preventive goals. This involves coaching parents and caregivers to guide children and adolescents to practice good oral hygiene, to use fluoridated toothpaste and to limit consumption of sweetened foods and beverages.[51]

Dietary Practices that Support Oral Health

Foods that contain large amounts of refined carbohydrates, such as crackers, candies, cookies and fruit snacks, are highly **cariogenic** when consumed frequently; other foods, such as cheese, meat, fresh fruits, vegetables and nuts, are much lower in carbohydrates, and present lower risk for decay (*Figure 63*).

For many children, beverages may actually present a greater caries risk than foods. Beverages often contain very high concentrations of sugars that contribute to decay. They are also portable, allowing them to be consumed in small amounts throughout the day. Infants may be exposed to liquid carbohydrates in the form of breast milk, formula or juices in baby bottles or training cups. Similarly, older children and adolescents may be exposed to beverages rich in carbohydrates such as sports drinks and/or soda.[153] To limit the adverse effects of sugary beverages, children should be encouraged to drink water. Water is a great substitute for sugared drinks, as it helps neutralize the oral environment and may contain fluoride to aid the remineralization process.

During routine pediatric visits PCPs should discuss the frequency with which a child consumes foods and beverages containing sugar. Parents may not be aware that feeding frequency is more critical than the types of foods that their child consumes. Breaks in between meals and snacks allow for remineralization of the tooth structures that are weakened by dietary acid challenges.[154] Children should not be expected to go without meals and snacks. However, snacking should be limited to defined periods and sweet beverages eliminated from young children's bottles and sippy cups.

SUPPLEMENTAL RESOURCE

Smart Snacking Chart

Encourage young patients to hang this chart on the refrigerator as a reminder of the difference between healthy and decay-causing snacks.

Daily Plaque Removal of Infant and Toddler Teeth

As part of an optimal doctor-patient visit, PCPs should assess children's oral hygiene. Children with visible dental plaque are at much higher risk for developing caries (*Figure 60*).[51] Providing caregivers with instructions about brushing with a fluoridated **dentifrice** (e.g., toothpaste) at home has been shown to significantly decrease caries in young children.[155-157]

As soon as primary teeth erupt, parents and caregivers should be instructed to brush their child's teeth twice daily with fluoridated toothpaste. Young children may swallow toothpaste, so parents must dispense a controlled amount. For children younger than 3 years of age, caregivers should apply no more than a 'grain-of-rice-sized' smear of fluoridated toothpaste to the child's brush. For children aged 3-6 years, caregivers should dispense no more than a 'pea-sized' amount of fluoride toothpaste (*Figure 61*).[158]

Primary teeth are considerably smaller and often have more space between them than their permanent counterparts. Spacing between teeth allows enough room for toothbrushes to cleanse the surfaces between teeth. As the child grows, the spaces between the molar teeth usually narrow, bringing the teeth into flat contact with each other. Once this happens, there is greater surface area for plaque to accumulate which can only be removed by flossing (*Figure 62*). Flossing is an important component of caries prevention, but research suggests the most effective preventive measure is brushing regularly with fluoride toothpaste.[159]

When performing daily oral hygiene, parents should be encouraged to position children in a way that facilitates a good view of the teeth. Although oral hygiene is often performed in front of the bathroom mirror, this may not necessarily be the best location to work with young children. Parents should consider alternative locations, such as the living room floor, the bathtub or even the child's bed.

There are two effective ways for caregivers to perform oral hygiene on a young child. The first method is for the adult to sit on the floor with his/her legs spread out. This allows the child to rest his/her head between the adult's legs (*Figure 63*). This position provides good access to the child's mouth for both brushing and flossing. The second method is for one adult to hold the child while another focuses on opening the child's mouth and cleaning the teeth. This method is particularly useful for uncooperative children.

Supervising Brushing and Flossing in Older Children and Adolescents

Parents and caregivers must perform oral hygiene for young children. However, as children age they become more capable of doing this themselves. Oral hygiene requires dexterity, intention and persistence. Thus, when considering the transition from actively performing oral hygiene to actively supervising oral hygiene, developmental stage is more critical than chronologic age. While younger children typically cannot be expected to brush their own teeth adequately, those between 6-9 years of age are typically ready for parents to begin coaching their oral hygiene techniques. Early training lays the foundation for a lifetime of proper oral hygiene practice.[21]

The teenage years are a time of great change for children and families alike. During this period, adolescents become increasingly independent, which may lead to increased consumption of cariogenic foods and beverages and inattention to oral hygiene.[160] As children enter their teenage years, the risk for periodontal diseases increases. Parents and non-dental HCPs must emphasize the importance of taking the time and effort to maintain good oral hygiene. To prevent gingivitis, flossing should be encouraged.[161,162] Professional removal of plaque and calculus is important in this population, so regular dental visits should be scheduled. Counseling adolescents on oral care and motivating them to practice adequate oral hygiene can be challenging for parents because of the power struggles that often occur in this age group, making the role of the HCP particularly important.

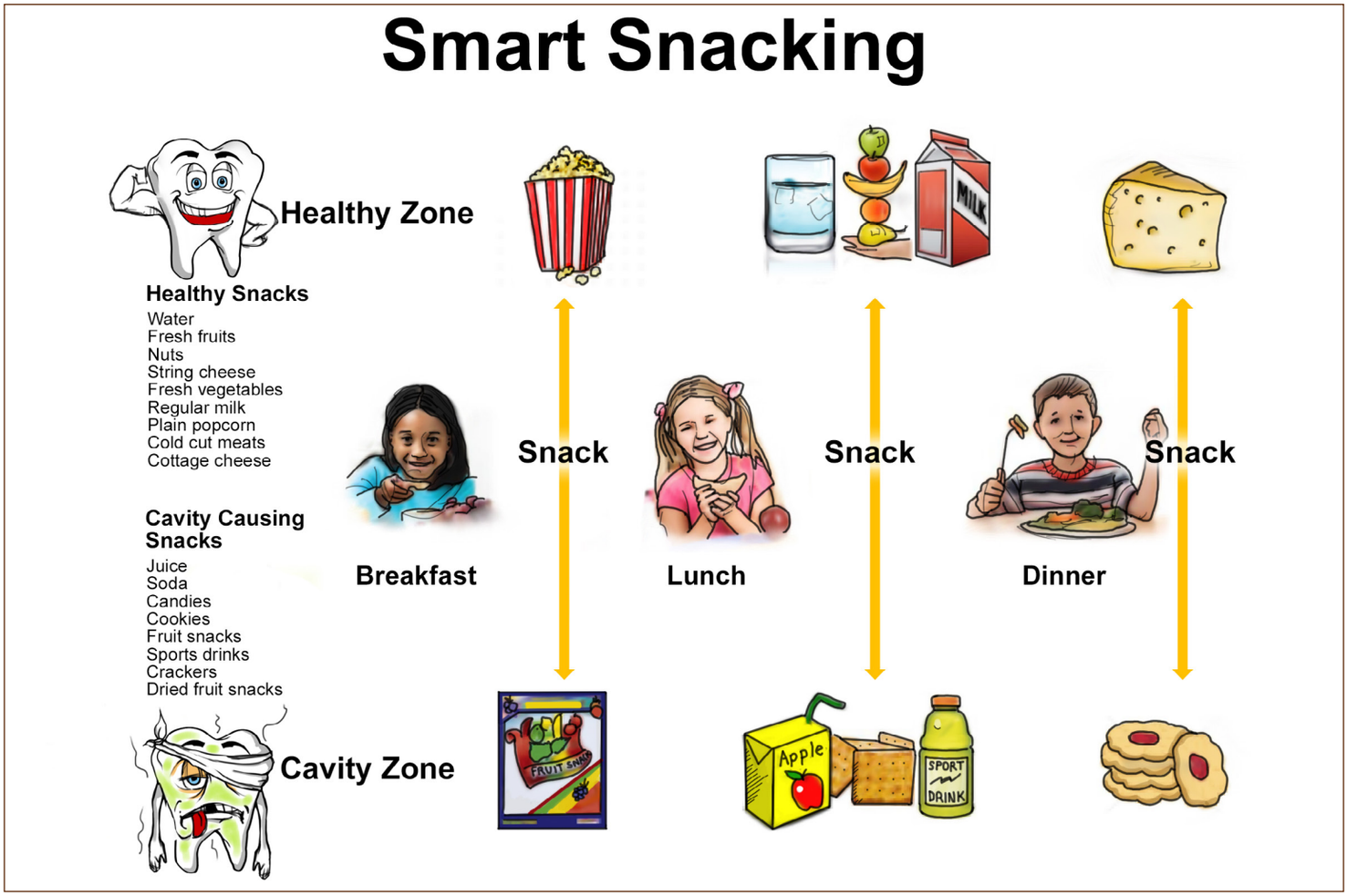


Figure 59. Smart Snacking chart. This chart offers a guide to healthy and cavity-causing snacks. Foods that contain large amounts of refined carbohydrates, such as crackers, candies, cookies and fruit snacks, are highly cariogenic when consumed frequently. Foods that are much lower in carbohydrates, such as cheese, meat, fresh fruits, vegetables and nuts present lower risk for decay. Beverages may present a greater caries risk than foods because of their portable format, allowing them to be consumed frequently throughout the day. Feeding frequency has a greater impact on oral health than food selection. A copy of this chart is available as a supplemental resource to this course.

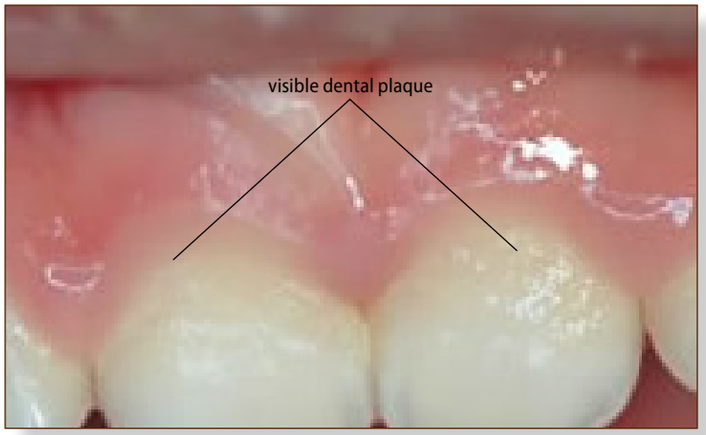


Figure 60. Visible dental plaque. Children with visible dental plaque are at higher risk of developing caries. Photo source: Norman Tinanoff. Used with permission.

Figure 61. Dispensing fluoridated toothpaste. For children younger than 3 years of age, a 'smear' or 'grain-of-rice sized' amount of fluoridated toothpaste is recommended. For children aged 3-6 years, use only a 'pea-sized' amount of fluoridated toothpaste. © 2014 University of Manitoba. All rights reserved.

Teens may be more receptive to advice from adults outside their family, so HCPs should not overlook opportunities to encourage good oral practices.

Emerging evidence suggests that obesity is a risk factor for periodontal diseases, especially in younger adults.[121 163 164] Consequently, as obesity rates continue to increase in adolescent populations, the incidence of periodontal diseases can be expected to rise in this cohort. This evidence provides a compelling rationale for non-dental HCPs to be more vigilant in identifying gingivitis in children and adolescents who are overweight or obese.

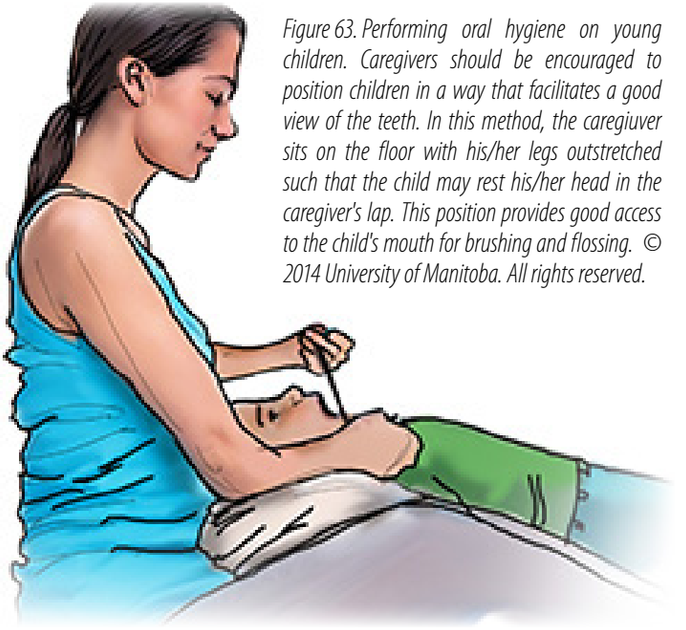


Figure 63. Performing oral hygiene on young children. Caregivers should be encouraged to position children in a way that facilitates a good view of the teeth. In this method, the caregiuver sits on the floor with his/her legs outstretched such that the child may rest his/her head in the caregiver's lap. This position provides good access to the child's mouth for brushing and flossing. © 2014 University of Manitoba. All rights reserved.

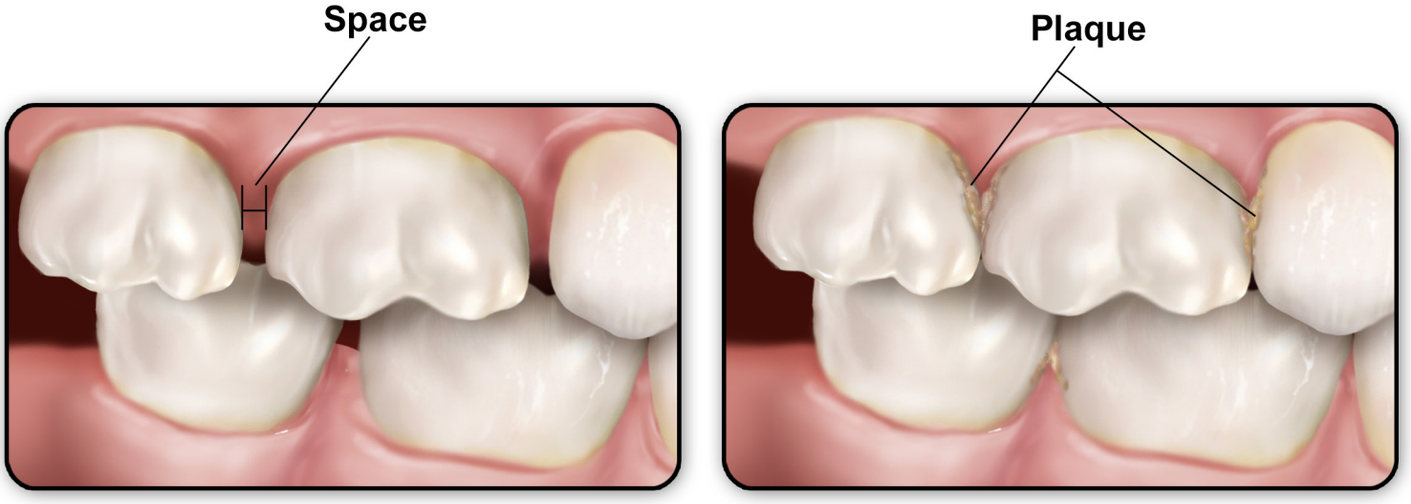


Figure 62. Interdental spaces. As children grow, the spaces between teeth (interdental spaces) usually narrow. Once this happens, there is greater surface area for hard-to-remove plaque to accumulate between teeth. This interdental plaque can only be removed by flossing. © 2014 University of Manitoba. All rights reserved.

Pearls to Practice

Oral Home Care and Dietary Practices

1. Maintaining adequate hydration is important. However, excessive consumption of sugared beverages puts many children at high risk for decay. **Non-dental HCPs should encourage moderate consumption of sugared beverages, with water serving as the primary form of hydration**.
2. Oral health literacy enables parents and caregivers to better participate in decisions about their child's oral health, and increases the likelihood that effective preventive practices will be adopted. During routine medical examinations, **non-dental HCPs should educate parents and caregivers about oral disease prevention strategies, involve them in oral health decisions and encourage them to select preventive options that are most appropriate for their circumstances**.
3. Infants and young children are not developmentally capable of performing adequate oral hygiene, making parents and caregivers integral to providing such care. **Non-dental HCPs should instruct parents to perform a child's daily oral hygiene during early life**.
4. Adolescence is a high-risk period for caries and gingivitis. Adolescents may be more likely to listen to advice from HCPs than other adult family members. Therefore, **non-dental HCPs should not overlook opportunities to encourage good oral hygiene in teens**.
5. Older children are able to perform oral hygiene independently. **Non-dental HCPs should advise parents to closely supervise children as they begin to practice their oral hygiene skills, and monitor oral hygiene.**
6. Parents need to be aware that feeding frequency has a greater impact on oral health than food selection. **Non-dental HCPs should promote less frequent eating, making healthier food choices, and limiting snacks and sweet drinks between meals**.

Common Oral Abnormalities Found in Children and Adolescents

While less common in children than adults, pediatric oral abnormalities and pathology are not unusual. As medical and nursing professionals begin performing oral screening examinations for children and adolescents, they will almost certainly encounter common types of abnormalities and pathology of the oral cavity.

Developmental Abnormalities Associated with Teeth

Natal and Neonatal Teeth

Primary teeth that present at birth are called **natal teeth**. Those that erupt within the first 30 days of life are classified as **neonatal teeth** (*Figure 64*). This phenomenon occurs most commonly in the area of the mandibular central incisors. They are usually not extra teeth, but rather primary teeth that have erupted prematurely. When possible, these teeth should be retained. In some circumstances a natal tooth may cause feeding difficulties due to ulceration of the **ventral** tongue (known as **Riga-Fede disease**; *Figure 65*). When either feeding difficulties or aspiration is a concern due to excessive mobility of teeth, premature teeth can be removed by an oral HCP.[165]

Eruption Cyst (Eruption Hematoma)

Occasionally, erupting primary and permanent teeth develop a soft tissue cyst surrounding the tooth's crown. This is visible as a fluctuant mass on the **alveolar ridge**. Chewing often leads to bleeding within the cyst and it will take on a bluish hue. This is commonly referred to as an eruption hematoma (*Figure 66*). Most of these eruption cysts require no treatment because they spontaneously rupture. If the cyst does not rupture, the crown can be surgically exposed and the cyst treated to facilitate eruption.[165]

Bohn's Nodules

White nodular growths on the gingiva are commonly seen in infants. Those located on the alveolar ridges are known as Bohn's nodules (*Figure 67*). These tiny, keratin-filled cysts are often found in multiples and arise from minor salivary glands. They typically resolve when the tooth erupts.[131]

Epstein's Pearls

White nodular growths in the mid-palate region are known as Epstein's pearls (*Figure 68*). Although similar in appearance to Bohn's nodules, they originate from epithelial inclusions entrapped in the **median palatal raphe**.[131]

Figure 64. Neonatal teeth. Neonatal teeth are premature primary teeth that erupt within the first 30 days of life. This 16-day-old infant has two mandibular central incisors, which is very premature. Photo source: Travis Nelson. Used with permission.

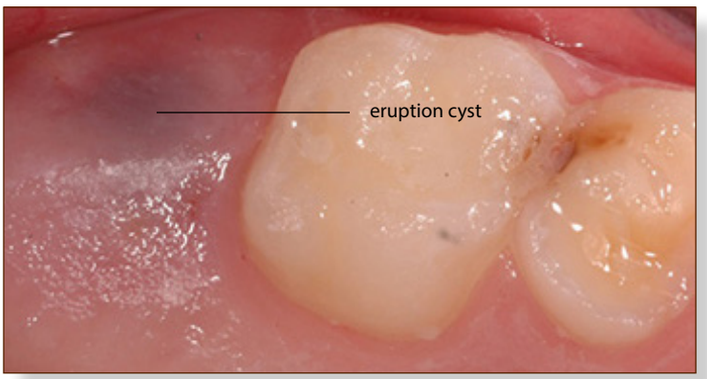


Figure 66. Eruption cyst/hematoma. This visible, fluctuant mass develops over the crown of an erupting tooth. Chewing often triggers bleeding within the cyst, giving it a bluish hue as is seen here. Photo source: Rebecca Slayton. Used with permission.

Figure 65. Riga-Fede disease. Natal or neonatal teeth may cause ulceration of the ventral tongue. In cases where feeding difficulty or aspiration is a concern, premature teeth may be extracted. Photo source: Macmillan Publishers Ltd. Jariwala D, Graham RM, and Lewis T. Riga-Fede disease. British Dental Journal. 2008:204(171);bdj.2008.113. Used with permission.

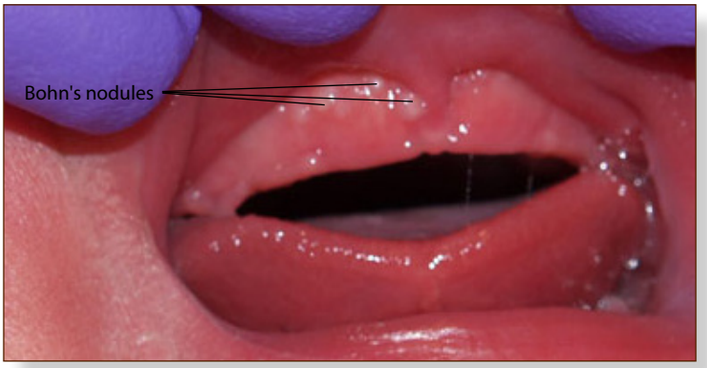


Figure 67. Bohn's nodules. Sometimes resembling a tooth, these soft, keratin-filled cysts are thought to arise from the remnants of salivary gland tissue. Their presentation on the labial surface of the gums (as seen here) and/or alveolar ridges distinguishes them from teeth. Bohn's nodules typically disappear spontaneously in a period of a few weeks to a few months. Photo source: Janelle Aby. Used with permission.

Hypodontia

The congenital absence of one or more teeth is known as hypodontia (*Figure 69*); a phenomenon that is usually genetic in origin. **Ectodermal dysplasia** is a common cause for multiple missing teeth. The prevalence of hypodontia in the primary dentition is less than 1% and usually involves the incisors.[131] The prevalence of hypodontia in the permanent dentition is estimated at 3.5-8% (excluding third molars, which are absent in approximately 20% of the population).[131]

Hyperdontia (Supernumerary Teeth)

Local factors and genetic predisposition may contribute to the occurrence of extra teeth. Supernumerary teeth (*Figure 70*) are found in less than 1% of primary dentitions and approximately 2-6% of permanent dentitions.[166,167] Children with craniofacial conditions such as cleft lip and palate and **cleidocranial dysplasia** are more likely to have excessive teeth.[142]

Double Teeth (Fusion and Gemination)

Double teeth may occur as a result of either fusion or gemination. Fusion results when two teeth are excessively close during development, causing them to fuse together (*Figure 71*). This results in a decrease in the total number of teeth present. Tooth gemination occurs when a tooth bud splits, resulting in either an increase in the total number of teeth or a single unusually wide tooth (*Figure 72 and Figure 73*). These phenomena most commonly occur in anterior teeth.[131]

Pericoronitis

When a tooth is partially covered by soft tissue, the area may become inflamed or infected (*Figure 74*). Pericoronitis commonly occurs with the eruption of the third molars (wisdom teeth) in late adolescence through the early thirties, but may also occur with other erupting molar teeth.

Children and adolescents who present with pericoronitis may be in acute discomfort. In cases where a referral to a dentist is not possible, the non-dental HCP can help alleviate the patient's symptoms by means of irrigation (under the gingival flap that overlies the erupting tooth) with an antibacterial agent and possibly prescribing a systemic antibiotic.

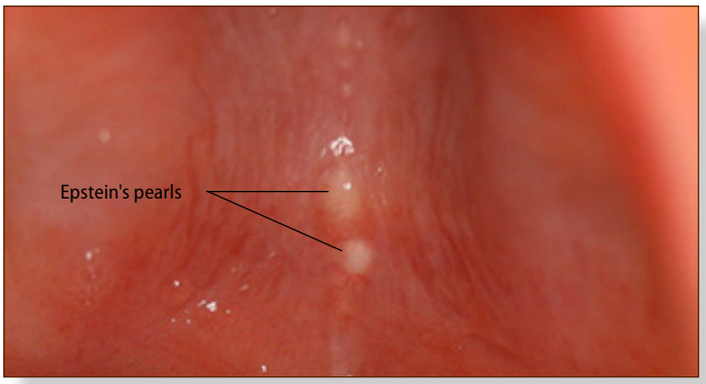


Figure 68. Epstein's pearls. Visible here are Epstein's pearls located at the palatal midline in this newborn baby. These cysts originate from epithelial inclusions and tend to form on the gums and roof of the mouth in newborns. Photo source: Rebecca Slayton. Used with permission.

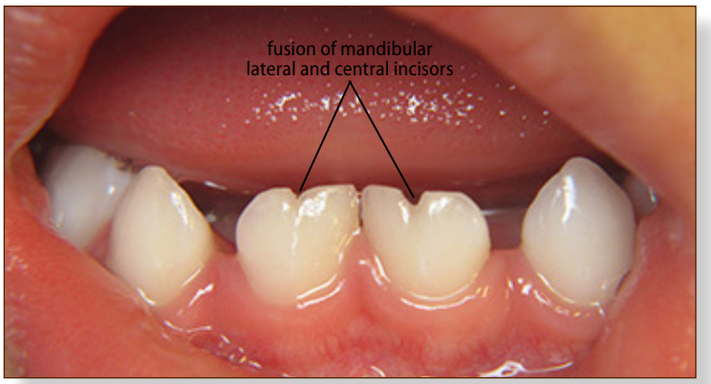


Figure 71. Fusion. Double teeth may result from either fusion or gemination. Fusion results when two tooth buds merge and give rise to a single, larger tooth. The mandibular lateral and central incisors of this 30-month-old child have fused, resulting in two larger teeth where four smaller ones are typically present. Photo source: Travis Nelson. Used with permission.

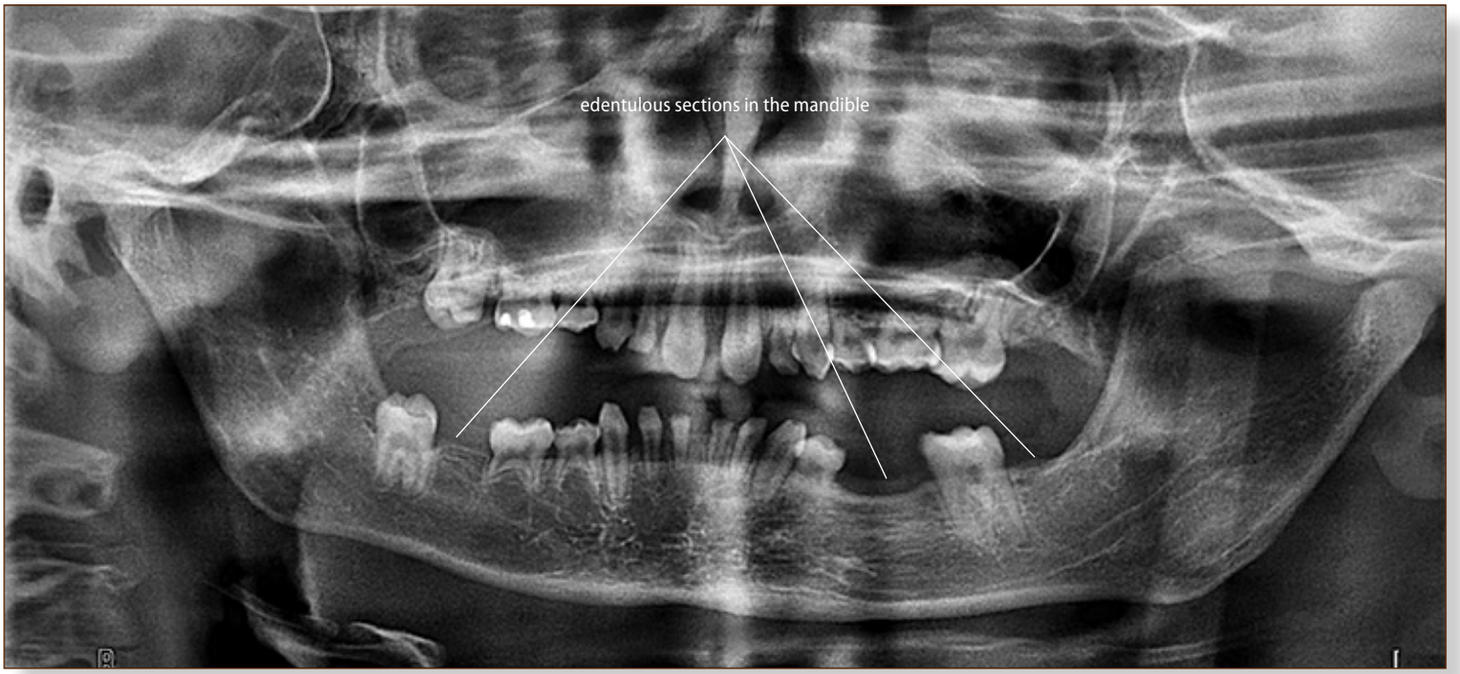


Figure 69. Hypodontia. A panoramic radiograph reveals hypodontia in a child with ectodermal dysplasia. Note the edentulous sections in the mandible. Many deciduous teeth in this radiograph do not have permanent successors. Photo source: Rebecca Slayton. Used with permission.

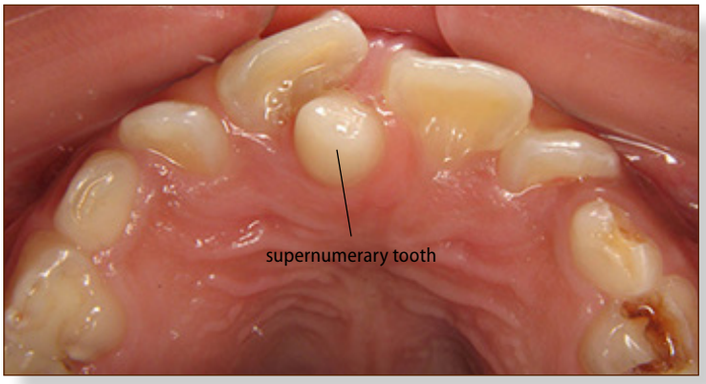


Figure 70. Hyperdontia. Local factors and genetic predispositions such as cleft lip and palate and cleidocranial dysplasia may contribute to hyperdontia, the occurrence of extra teeth. A supernumerary tooth located between permanent maxillary central incisors can be seen in this 8-year-old child. Photo source: Travis Nelson. Used with permission.

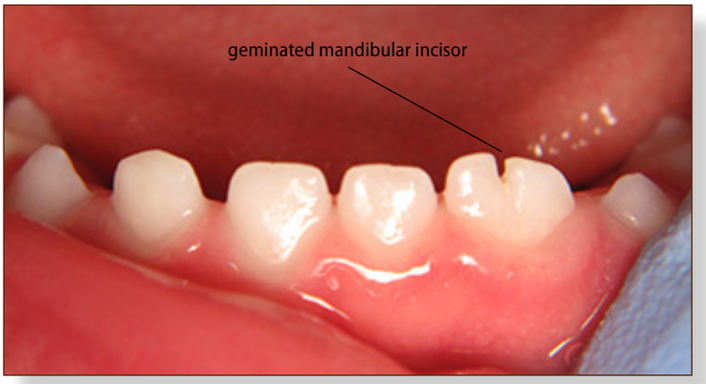


Figure 72. Gemination. Double teeth may result from either fusion or gemination. This 20-month-old child had a geminated mandibular incisor resulting in a tooth that is larger than its counterparts with a two-lobed appearance. Photo source: Travis Nelson. Used with permission.

Treatment may also involve extraction.[132]

In cases of mild pericoronitis, including localized tissue swelling and soreness, the area under the gingival flap should be irrigated with hydrogen peroxide or 0.12% chlorhexidine gluconate using a curved disposable syringe (*Figure 75*). Irrigation helps to reduce the bacterial load and wash out any debris that may exacerbate the condition. A curved tip syringe effectively dispenses the solution to the affected area. Following in-office irrigation, patients may be discharged with a take-home syringe, a prescription for the chlorhexidine rinse and instructions on how to clean the area.

When presentation includes mild facial swelling and fever, antibiotics should be administered in addition to irrigation. The antibiotics of choice are generally the same as those used to treat odontogenic infections: penicillin or clindamycin. Although third molar pericoronitis can typically be managed this way, definitive treatment generally involves extraction of the offending tooth. If the gingival tissues are left in place after the initial treatment, tissue excess and bacterial entrapment tends to occur, predisposing the area to recurrent infection (*Figure 76*). Often, the opposing tooth is also extracted because of its potential to exacerbate the condition (i.e., due to chewing, which traumatizes the surrounding tissue).[132]

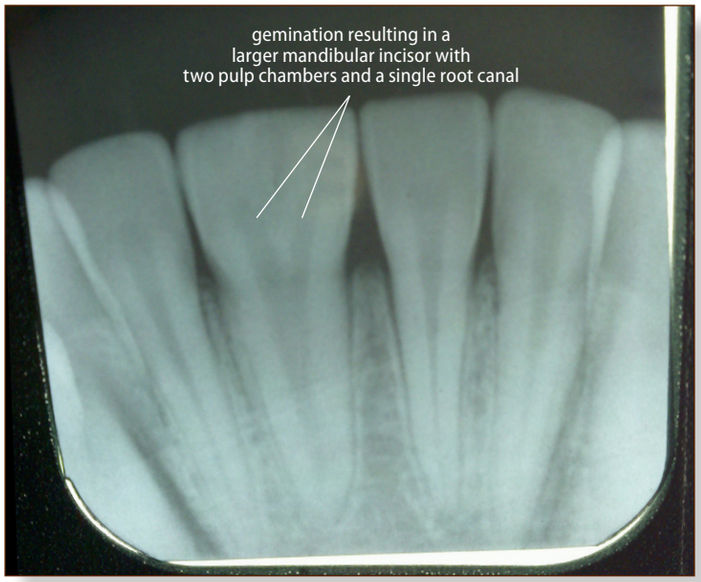


Figure 73. Gemination. Gemination occurs when a single tooth bud splits, giving rise to either additional teeth or a single, clefted, unusually large one. In some cases, a geminated tooth may have two independent pulp chambers and root canals. Photo source: Justin R. Marostica. Used with permission.

Figure 75. Pericoronitis commonly occurs with the eruption of the third molars (wisdom teeth). In cases of mild pericoronitis, non-dental HCPs can help alleviate the patient's symptoms by irrigating the area under the gingival flap of tissue using a curved disposable syringe and an antibacterial agent such as hydrogen peroxide or 0.12% chlorhexidine. © 2014 University of Manitoba. All rights reserved.

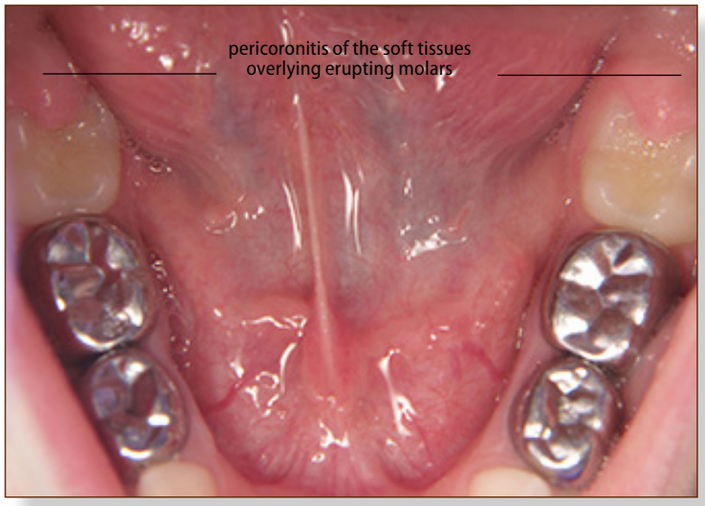


Figure 74. Pericoronitis. A 6-year-old child presents with pericoronitis occurring posterior to healthy erupting permanent first molars. Pericoronitis can develop if the soft tissue overlying the molars becomes infected. Photo source: Travis Nelson. Used with permission.

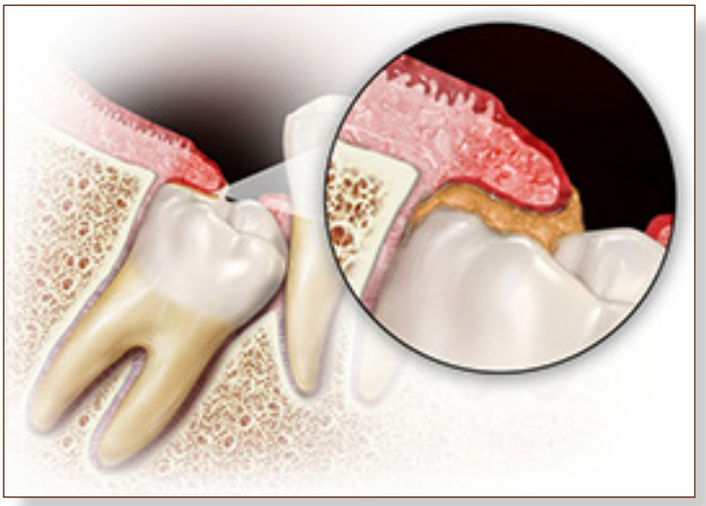


Figure 76. Pericoronitis associated with eruption of molar teeth. If the gingival tissues are left in place following initial treatment, bacterial entrapment tends to occur, predisposing the area to recurrent infection. Definitive treatment usually involves extraction of the offending tooth. © 2014 University of Manitoba. All rights reserved.

Soft Tissue Abnormalities

Normal Soft Tissues

The mouth normally contains a number of soft tissue **frena** that provide the attachments between the lips, tongue and the jaw complex. Notable frena are the **buccal** frenum, maxillary frenum, mandibular frenum and lingual frenum (*Figure 77*). Intraorally, mucosal tissues can be classified as unattached and attached. In the latter case, attached mucosa is keratinized and contains firm attachments to the underlying bone. This type of mucosa is most commonly found around the teeth, and its colour is reflective of the individual's skin pigmentation (i.e., dark skinned people have dark attached gingiva, while tissues of lighter skinned individuals have a paler hue; *Figure 78*). Unattached mucosa is only loosely adherent to the underlying bone, and is generally reddish-pink in colour in all individuals regardless of skin colour.

Ankyloglossia

Ankyloglossia (tongue tie; *Figure 79*) occurs with excessive soft tissue attachment of the tongue. Patients with this condition are unable to fully extend the tongue, sometimes impairing breastfeeding in infants and speech in older children.[131] In infants, ankyloglossia may be corrected by cutting the tissue with sterile scissors; a procedure that can easily be performed by dentists or physicians. In older children, correction typically involves administration of local anesthetic and possible referral to a surgical specialist.

Fibroma

Fibromas are non-malignant connective tissue lesions that result from excessive proliferation of fibrous tissue (*Figure 80*). This is often caused by a local irritant, such as a sharp tooth or filling. Fibromas are most commonly removed with an excisional biopsy technique.[131]

Geographic Tongue (Benign Migratory Glossitis)

Geographic tongue (*Figure 81*) results from the loss of the **filiform papillae**, causing multiple, irregularly-shaped erythematous patches. This lesion is a benign condition with an unknown cause and does not require treatment.[131]

Pyogenic Granuloma

Pyogenic granulomas (*Figure 82*) are a reactive proliferation of endothelial cells that usually occur in response to either a chronic irritation or an erupting tooth. Despite the name, pyogenic granuloma bears no relationship to an infective process. Treatment includes simple excision.[131]

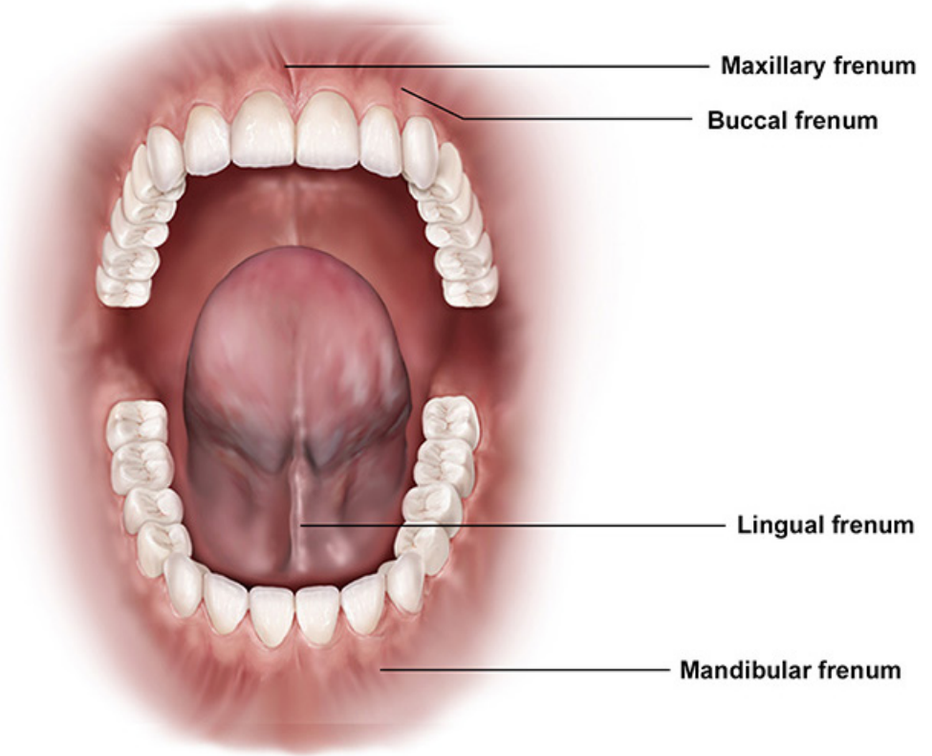


Figure 77. Frena. The mouth normally contains a number of soft tissue frena that provide attachments between the lips, tongue and the jaw complex. Notable frena are the buccal frenum, maxillary frenum, mandibular frenum and lingual frenum.

Figure 78. Attached oral mucosa. The oral cavity is lined with a mucous membrane, referred to as the oral mucosa. The colour of the attached oral mucosa varies, matching the skin pigmentation of the body. Photo source: Travis Nelson. Used with permission.

Figure 79. Ankyloglossia. This congenital abnormality occurs when there is excessive fibrous attachment of the lingual frenum, as seen here in a 5-year-old child. 'Tongue tie' can interfere with breastfeeding and affect the way a child eats, speaks and swallows. Many cases resolve over time as the frenum tissue loosens. However, some cases require minor surgical intervention. Photo source: Travis Nelson. Used with permission.

Figure 80. Fibroma. An overgrowth of soft tissue that appears as a round, smooth, firm lump in the oral cavity; fibromas commonly develop on the mucosal lining of the cheeks and lips in response to constant irritation. Cheek biting contributed to the formation of this fibroma on the buccal mucosa of a 9-year-old patient. Photo source: Travis Nelson. Used with permission.

Figure 81. Geographic tongue. This asymptomatic inflammatory disorder, characterized by exacerbations and remissions, affects the epithelium of the tongue. Local loss of filiform papillae leads to lesions of variable size and colour, as seen in this 8-year-old child. Photo source: Travis Nelson. Used with permission.

Figure 82. Pyogenic granuloma. This benign, vascular lesion of the oral mucosa commonly occurs on the gingiva in response to local irritants, such as tooth eruption. This case of pyogenic granuloma is associated with an erupting primary molar. Patients usually seek care because the lesion tends to grow rapidly and bleed easily. Photo source: Travis Nelson. Used with permission.

Aphthous Ulcer (Canker Sore)

Aphthous ulcers are small, painful ulcerations of the unattached gingiva (*Figure 83*). Although multiple systemic conditions are associated with aphthous ulcers (e.g., vitamin deficiency, immunocompromised conditions, **Becet's syndrome**), they are often related to an individual's immune response to minor intraoral trauma. Treatment may include application of topical steroid cream, although such treatment is more typically supportive than curative.[131]

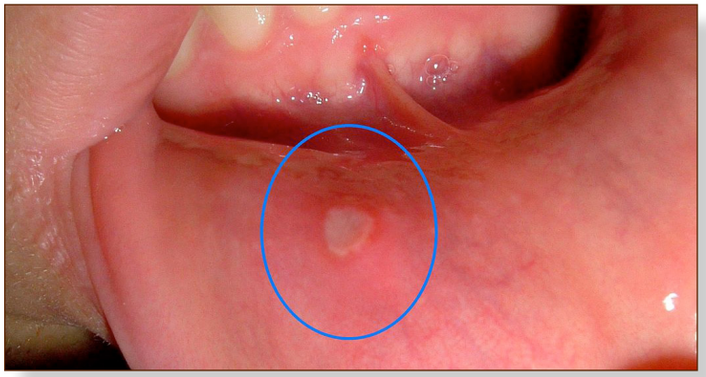


Figure 83. Aphthous ulcer (canker sore). These are common, painful ulcerations of the oral mucosa. Recurrent aphthous ulcerations may signal an underlying systemic pathology, including gastrointestinal, hematologic or immunologic disorders. Photo source: Susan Müller. Used with permission.

Figure 84. Mucocele. This type of mucous retention cyst formed after a 10-year-old child bit his lower lip, severing a salivary duct. Photo source: Travis Nelson. Used with permission.

Figure 85. Ranula. This type of mucous retention cyst formed on the floor of the mouth in response to a local trauma that ruptured a salivary duct. Photo source: Bang BD. Used with permission.

Mucous Retention Cyst

Mucous retention cysts consist of **mucoceles** and **ranulas**, which are distinguished based on their location. Mucoceles are common in the lips, while ranulas form on the floor of the mouth (*Figure 84 and Figure 85*). These benign tissue swellings are composed of pooled mucus that escapes into connective tissues after a salivary duct is severed. Treatment is monitoring for spontaneous resolution or surgical excision.[131]

Cleft Lip and Palate

Children with cleft lip and palate (*Figure 86*) experience conditions such as hypodontia, **ectopic eruption** of teeth and dental caries. Therefore, dental and orthodontic treatment is an integral component of care for this patient population. The American Cleft Palate-Craniofacial Association (ACPA) recognizes that regular oral health examinations, caries control, and preventive, restorative and prosthetic dental care should be provided for patients with cleft lip and palate. A **multidisciplinary team** (which may include health professionals from medicine, dentistry and the allied health fields) should coordinate treatment plans.[168]

Figure 86. Cleft lip. Children with cleft lip and palate are especially prone to dental problems due to malformed, malpositioned, missing and extraneous teeth, enamel defects and altered saliva composition. Shown here is a boy with cleft lip before and one month after surgery. Photo source: Wikimedia Commons/Felsir. Used with permission.

Cellulitis

Facial cellulitis (*Figure 87*) is a true medical and dental emergency. Definitive treatment involves removal of the infection source via extraction or root canal therapy and administration of antibiotics. Additionally, placement of a drain within the body of the infection may decrease proliferation of anaerobic bacteria within the body of the lesion. Selection of antibiotics is generally empiric, and strong consideration should be given to hospital admission and administration of IV antibiotics for severe infections.[55] (Treatment of cellulitis from odontogenic infections are described earlier in this course.)

Viral Lesions

Viral lesions commonly have intraoral manifestations. Presentation depends on infection type and severity. The most common viral lesions seen in children and adolescents, which include herpes viruses, coxsackie viruses and human papilloma viruses, are discussed here.

Herpes Viruses

The herpes family of viruses consists of herpes simplex virus 1 (HSV-1), Herpes simplex virus 2 (HSV-2), Vericella-zoster virus (VZV), **Epstein-Barr virus (EBV)**, Cytomegalovirus (CMV) and several others. The most common lesions associated with the herpes virus are due to **primary herpetic gingivostomatitis**, which presents as multiple shallow ulcers throughout the keratinized and gland-bearing intraoral surfaces (*Figure 88*). The lesions are often accompanied by systemic symptoms of fever, lymphadenopathy, and **myalgia.** This condition usually occurs in young children. **Herpes labialis** (i.e., cold sores; *Figure 89*) is the recurrent form of the condition that is found on the lips. Herpes labialis presents as small fluid-filled viral vesicles followed by rupture and ulceration. Epstein-Barr virus (EBV), which causes **infectious mononucleosis**, presents as multiple **petechiae** on the **soft palate**. Less than 10% of children develop infectious mononucleosis after EBV infection (*Figure 90*), but the incidence of infection increases with age, peaking in individuals between the ages of 15-24 years.[169,170]

Figure 87. Facial cellulitis. Generalized facial cellulitis is a true medical and dental emergency. Arising from infections, the condition is characterized by swelling, redness, warmth and pain. Photo source: Arsenault M. Used with permission.

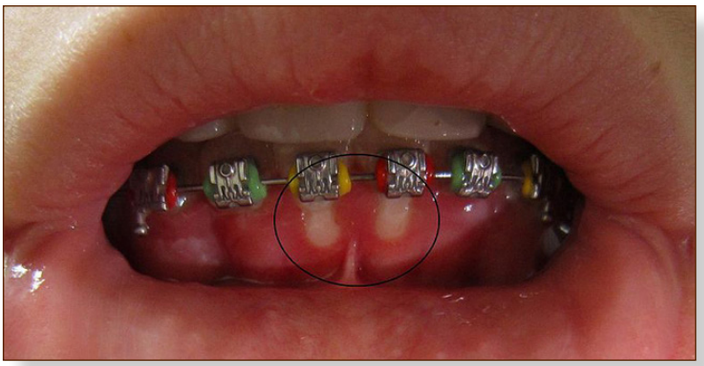


Figure 88. Primary herpetic gingivostomatitis (orolabial herpes). Ulceration and inflammation of the oral mucosa and gingiva are often the initial presentation of a primary herpes simplex infection, with subsequent presentations involving the lips (i.e., herpes labialis). This is the most common viral infection of the mouth. Photo source: Wikimedia Commons/James Heilman. Used with permission.

Figure 89. Herpes labialis (cold sore). This is the recurrent form of the herpes simplex virus. Manifesting on the lips, an outbreak typically causes small, fluid-filled, viral vesicles that heal within two to three weeks. Photo source: Wikimedia Commons/Lucyin. Used with permission.

Figure 90. Inflamed tonsils. Infectious mononucleosis, caused by the Epstein-Barr virus, is presented here. This is commonly associated with sore throat and fever. Photo source: Wikimedia Commons/Fateagued. Used with permission.

Coxsackie Viruses

Coxsackie viruses produce **herpangina** and **hand, foot and mouth disease**. Herpangina typically appears as multiple small, shallow ulcers in the posterior soft palate and **nasopharynx** (*Figure 91*). Hand, foot and mouth disease is a highly contagious infection that presents as ulceration and erythema of the palms of hands, soles of feet and mucosa of the anterior part of the mouth (*Figure 92*). Treatment for ulcerative oral viral lesions is supportive care, including fluid maintenance and analgesia.

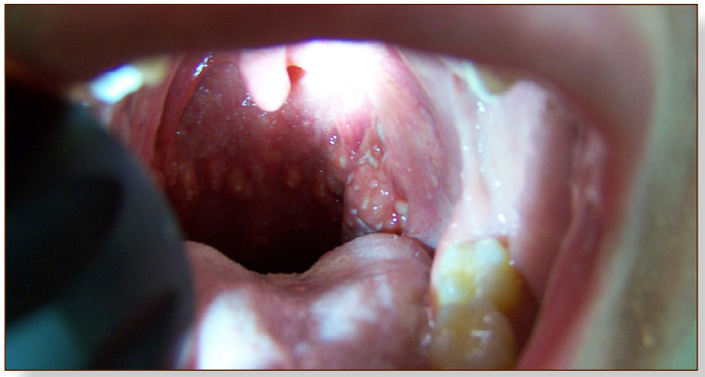


Figure 91. Herpangina. This contagious, self-limiting infection is primarily caused by coxsackieviruses. It typically manifests as painful blisters and ulcers in the posterior soft palate and nasopharynx. Photo source: Wikimedia Commons/Aphilosophicalmind. Used with permission.

Figure 92. Hand, foot and mouth disease. This contagious, self-limiting viral infection is primarily caused by coxsackieviruses. It presents as ulceration and erythema of the palms of hands, soles of feet and mucosa of the anterior part of the mouth. Photo source: Jamie Brady. Used with permission.

Human Papilloma Viruses (HPV)

Human papilloma viruses cause local lesions such as the squamous papilloma (*Figure 93*), verruca vulgaris (common wart; *Figure 94*) and **focal epithelial hyperplasia** (Heck disease; *Figure 95*). When these lesions do not spontaneously regress, they can be surgically excised.

Figure 93. Squamous papilloma. This benign, painless, noncontagious mucosal mass is caused by HPV infection. Once present, these lesions tend to persist but may be surgically excised. Photo source: Susan Müller. Used with permission.

Figure 94. Verruca vulgaris (common wart). This benign, flesh-coloured, keratotic lesion is caused by HPV infection. Although a variety of treatment options exist, the current treatment of choice in pediatrics tends to be cryotherapy with liquid nitrogen. Photo source: Roblan - Fotolia.com. Used with permission.

Figure 95. Focal epithelial hyperplasia (Heck disease). This rare, benign lesion is caused by HPV infection. Lesions are characterized by a proliferation of light-coloured papules that give the oral mucosa of the cheeks, lips and tongue a cobblestoned appearance, as can be seen in this 7-year-old boy. Source: Mike Blyth. Used with permission.

Potential Threats to Oral Health During Adolescence

There are a number of oral health considerations that are specific to the adolescent patient. This period of life is characterized by both increased independence and risk-taking behaviours that can jeopardize health.

Intraoral Piercing and Dental Grills

Dental grills (*Figure 96*) are a form of removable metal jewellery worn over the front teeth. These appliances, often fabricated by technicians with limited dental training, are not intimately adapted to the teeth. Grills can generally be removed, but contribute to plaque accumulation, gingival irritation and tooth damage. Intraoral piercings (*Figure 97 and Figure 98*) are another popular form of self-expression in the adolescent population, but they also pose a risk. Quite frequently, piercing sites become infected and the teeth and gingiva are damaged by metallic intraoral rings or studs. For these reasons, HCPs should caution adolescent patients against grills and intraoral piercings.[171]

Signs of Anorexia/Bulimia

According to the 2009 Youth Risk Behavior Survey, 44.4% of adolescents attempt to lose weight. In the 30 days before the survey was administered, 4% of adolescent girls reported that they had tried vomiting or taking laxatives to help control their weight.[172] Eating disorders such as anorexia and bulimia nervosa have multiple oral consequences.

One of the prominently visible signs of bulimia is enlargement of the parotid glands (*Figure 99*). Patients suffering from eating disorders may also exhibit gingival inflammation and loss of periodontal attachment (*Figure 100*). Studies[173,174] have shown that self-induced vomiting over an extended period of time often eventuates in soft tissue trauma to the palate and tooth erosion (*Figure 101*). This is particularly prominent on the maxillary palatal surfaces that are directly exposed to digestive acids.

Human Papilloma Viruses (HPV-16)

During adolescence, young people may engage in activities, such as sexual intercourse and oral sex. This facilitates the transmission of human papilloma viruses (HPV-16), which are known to cause the majority of cervical cancers.

Emerging research[175,176] has shown that HPV 16 is also strongly linked to oropharyngeal cancer. In fact, studies[177,178] have shown that infection with HPV-16 increases the risk of developing oropharyngeal cancer 15-fold. According to conservative estimates, more than 60% of all current cases of oropharyngeal squamous cell carcinomas are HPV-related.[177,178]

Little is known about the natural history of oral HPV infection.

Figure 96. Dental grills. Problems associated with long-term wear include dental decay, chipped teeth, shifting teeth, enamel wear on opposing teeth and gingival irritation. Photo source: Travis Nelson. Used with permission.

Figure 97. Lingual piercing. Oral and dental complications secondary to wearing intraoral piercing jewellery include tooth fractures, damaged dental prostheses, gingival injury and/or recession, increased salivary flow and interference with speech, mastication and swallowing. Photo source: Wikimedia Commons/Marnanel. Used with permission.

Figure 98. Lingual piercing. People who manipulate piercing jewellery with their teeth may cause damage to the dentition. Photo source: Wikimedia Commons/Erlaubt. Used with permission.

In healthy populations, the prevalence and incidence of oral HPV infection are low, with one study[178] showing a 2.4% prevalence in a college-aged population. HPV infection is associated with oral sex, the lifetime number of oral sex (performing) partners and the lifetime number of open-mouth kissing partners.[178] Other risk factors include being male and having a high number of vaginal-sex partners (i.e., 26 or more over a lifetime).[178] Because HPV-related oral cancer can affect anyone, HCPs should be diligent in oral and oropharyngeal cancer screening of adolescents and young adults.

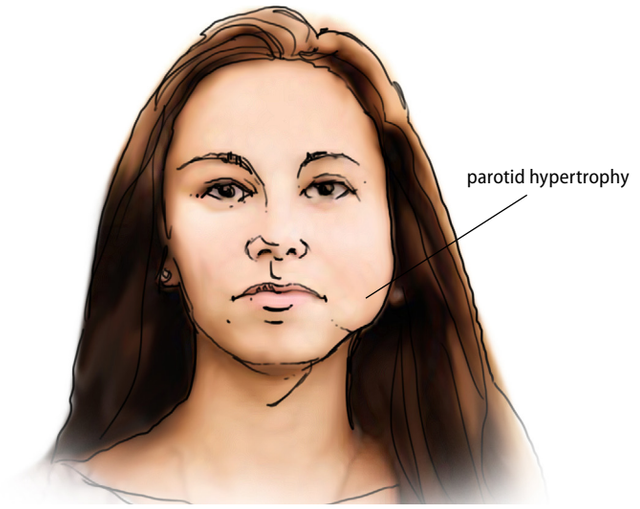


Figure 99. Parotid hypertrophy. Painless, noninflammatory, bilateral enlargement of the parotid glands (sialadenosis) is the most common presentation of bulimia nervosa.

Figure 100. Oral signs of anorexia/bulimia. Dental erosion, gingival inflammation and loss of periodontal attachment are common consequences of eating disorders. Photo source: Zsolt Bota Finna – Fotolia.com. Used with permission.

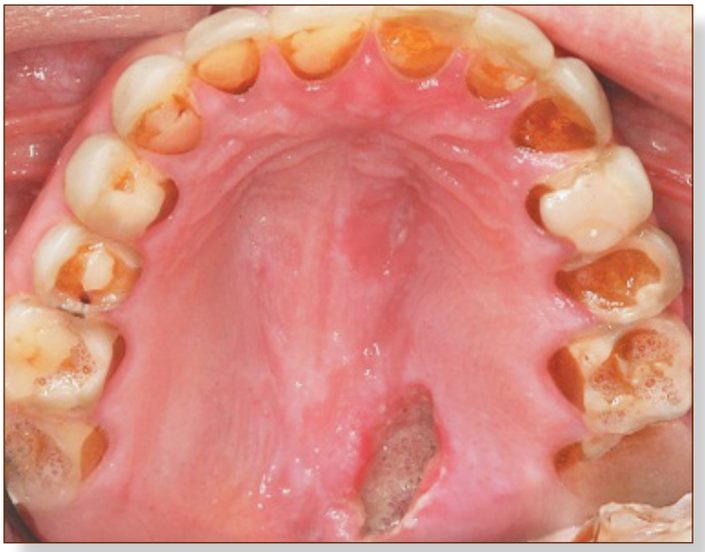


Figure 101. Consequences of self-induced vomiting. Stimulated vomiting causes soft tissue trauma to the palate and irreversible dental erosion. Patients with bulimia exhibit a common erosion pattern that favours the occlusal surfaces of the mandibular posterior teeth and the lingual surfaces of the maxillary anterior teeth. Affected teeth appear yellow as the enamel is worn and the underlying dentin is exposed. Photo source: Sedghizadeh PP. Bulimia nervosa. N Engl J Med 2013; 368:1238. Used with permission.

Transmission of HPV can be reduced through vaccination and by limiting the number of sexual partners. The HPV vaccination is currently being administered to girls and young women to protect against cervical cancer. However, we do not yet know whether this vaccine has the potential to reduce HPV-associated oropharyngeal cancer. With the significantly increased number of HPV-positive cancers of the tonsils and base of the tongue, and data showing an association with oral-to-oral contact, prophylactic vaccination of children may lead to a decrease in HPV-associated oropharyngeal cancer. The effects of vaccination on oropharyngeal cancer rates may not be realized for several decades, but considering the possibility of an HPV-induced epidemic, vaccination of both women and men against HPV infection may be an effective preventive measure.

Tobacco

During adolescence a significant proportion of young people will try smoking or tobacco products. According to recent estimates, approximately 20% of high school students have smoked at least one cigarette in the past month, while 15% of male and 2% of female adolescents currently use smokeless tobacco.[179]

The adverse health effects of tobacco use are well known. However, there are also many specific oral consequences. Oral cancer, periodontitis, compromised wound healing, a reduction in the ability to smell and taste and staining of the teeth are all seen in tobacco users.[180,181] Healthcare professionals should encourage adolescents who use tobacco to stop before a lifelong habit is developed.

Pearls to Practice

Potential Threats to Oral Health During Adolescence

1. Hard and soft tissue abnormalities are commonly encountered when performing oral health screening of children and adolescents. **Non-dental HCPs should be familiar with common abnormalities and be prepared to treat or refer accordingly**.
2. Pericoronitis is an infection of the tissues overlying an erupting tooth. **Non-dental HCPs can improve the symptoms of pericoronitis by using an antibiotic to irrigate under the soft tissue flap, showing the patient how to perform irrigation at home and, for more severe cases, prescribing a systemic antibiotic**.
3. Adolescent patients often engage in high-risk behaviours that can compromise their health. **Non-dental HCPs should caution against dental grills, oral piercings and tobacco use, examine teeth for erosive signs of bulimia and perform diligent oral and oropharyngeal cancer screening**.

Prevention and Management of Oral Trauma from Accidents

Risk for Oral Trauma

Children and adolescents frequently experience injuries to their dentition. The peak incidence of trauma in the primary dentition is at around age 2-3 years when children begin to develop motor coordination and start moving about independently.[182] By 5 years of age, approximately one-third of children have suffered a traumatic dental injury involving primary teeth.[182]

In the permanent dentition, the peak timing of dental trauma is 9-10 years of age, when vigorous playing and sports activities become more frequent.[183] By 12 years of age, approximately 20-30% of children have suffered dental injuries, boys being approximately 30% more likely to experience dental trauma than girls.[183]

During the peak timing of dental trauma, the roots of permanent anterior teeth are actively developing and injuries may have serious long-term consequences, including early tooth loss, fracture and loss of alveolar bone support. Therefore, proper assessment and treatment of dental injuries is essential to the prognosis of traumatized teeth in critical esthetic areas.

Educating Parents and Children on the Importance of Mouth Guards

When educating parents and adolescents about safety and injury prevention, non-dental HCPs should provide recommendations regarding dental trauma prevention. For example, parents of young children should be counseled regarding the high likelihood of trauma when a child is learning to walk.

Establishing a dental home in early childhood facilitates access to emergency dental care when needed. Non-dental HCPs should also inquire about sports or other physical activities in which children and adolescents participate.

All sports have the potential to cause dental injury. However, sports in which less protective gear is worn (e.g., basketball), may present increased risk of damaging injuries.[183] Therefore, use of protective gear (e.g., helmets and mouth guards) should be strongly encouraged. Such equipment absorbs and distributes the force of impact, improving outcomes when trauma occurs.

Classification of Dental Injuries

Caregivers should seek immediate dental care when children and adolescents sustain dental injury. Non-dental HCPs should refer cases of oral trauma to dentists who have in-depth knowledge of how to treat these cases and who are competent to deliver effective emergency care.

There are two classifications of dental injuries. The first classification is injuries to **hard dental tissues** and pulp. This includes fractures of enamel, dentin and roots. In these types of injuries, when the dental pulp is exposed the consequences are generally more serious. Complications may include infection, alteration in root development, and the need for root canal therapy. The second classification is injuries to **oral soft tissues** and **periodontium**. This includes concussion, subluxation, lateral luxation, extrusion luxation, intrusive luxation and avulsion of teeth. An explanation of these terms is listed in *Table 5*.[185]

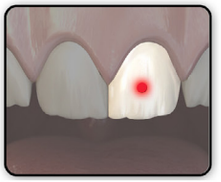
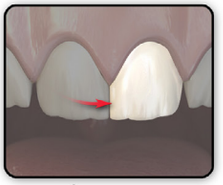
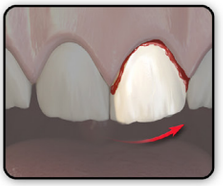
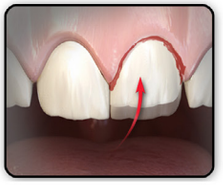
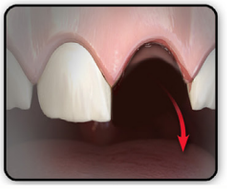
The majority of dental injuries can be effectively managed if they are treated within hours. However, permanent tooth avulsion injuries are time-sensitive dental emergencies. The sooner the avulsion is treated, the more likely the patient is to retain the tooth.

Tooth Luxation

Treatment of luxation injuries (*Figure 102*) is varied and depends on several factors, including: the child's age, the type of tooth (i.e., primary or permanent), the degree of tooth development, the direction of the luxation and injury severity. Definitive treatment may include monitoring, repositioning and splinting, or extraction of the tooth. In cases where access to a dentist is limited, physicians and nurses can improve patient comfort by prescribing systemic analgesics (e.g., non-steroidal anti-inflammatories; NSAIDs), recommending a soft diet, suturing soft tissue injuries and locating a dentist to provide definitive care.[185]

Figure 102. Lateral luxation. Tooth luxation injuries (i.e., extrusive luxation, lateral luxation, intrusive luxation) comprise the majority of dental traumas, most of which are caused by bicycle injuries, falls, fights and sports injuries. Photo source: Arztsamui/Moment Open/Getty Images. Used with permission.

Table 5. Classification of Soft Tissue Dental Injuries

Type of Soft Tissue Dental Injuries	Description	Clinical Presentation
Concussion	Tooth receives an impact, but is not loosened	
Subluxation	Tooth receives an impact, and is loosened, but maintains normal position	
Lateral Luxation	Tooth is loosened from its normal position in a lateral direction	
Extrusion Luxation	Tooth is loosened from its normal position in the direction of tooth eruption	
Intrusive Luxation	Tooth is loosened from its normal position in the opposite direction of tooth eruption	
Avulsion	Tooth is entirely lost from the oral cavity	

Tooth Fracture

When tooth fractures are encountered, the area in question should be thoroughly evaluated for other signs of injury (*Figure 103 and Figure 104*).

Under normal, healthy conditions, permanent teeth move ~0.25mm both vertically and horizontally to accommodate forces sustained while chewing (referred to as **physiological tooth mobility**). Tooth mobility is normally limited by the periodontal ligament, as well as alveolar bone. If there are signs of abnormal mobility or displacement (e.g., movement in the frontal plane; movement >1.0mm), the tooth has likely experienced a luxation-type injury. If the tooth is damaged but exhibits normal mobility, the non-dental HCP can be reasonably confident that the tooth has simply experienced tooth fracture.[207]

When fracture involves only dentin and enamel, the injury is considered 'uncomplicated'. When the pulp tissues are exposed, the injury is deemed 'complicated'. In either case, the best outcomes require immediate, definitive evaluation and treatment by a dentist. Cases of complicated injury require evaluation and treatment within 24 hours.[185]

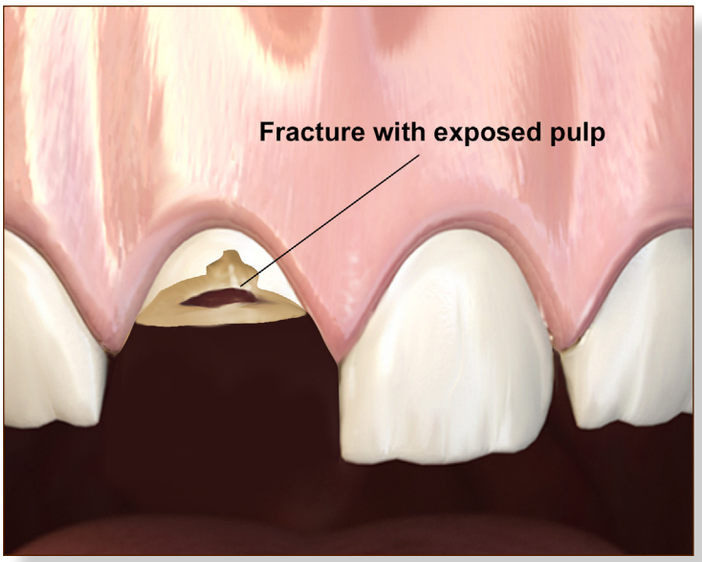


Figure 103. Complicated crown fracture. A tooth fracture is considered "complicated" when there is a loss of tooth structure, the enamel and dentin are involved and the pulp is exposed. © 2014 University of Manitoba. All rights reserved.

Figure 104. Complicated crown fracture. Despite the visible loss of tooth structures, a tooth that has sustained a complicated crown fracture tends not to be painful and exhibits normal mobility. Photo source: Wikimedia Commons/James Heilman. Used with permission.

Tooth Avulsion

Tooth avulsion or tooth loss from trauma is one of the most serious dental injuries. Prognosis is highly dependent on the steps taken immediately following the avulsion.

In all tooth avulsion cases, the HCP should first rinse both the **alveolus** and tooth of debris using water or saline, inspect the oral cavity and alveolus for other injuries, and determine whether the tooth was lost intact or residual root fragments remain within the alveolar bone (*Figure 105, a-c*). Retrieving an avulsed tooth by the crown helps to avoid additionally harming any viable **periodontal ligament** (PDL) cells that may still be attached to the root—These cells are critical for reattachment.

Subsequent treatment depends on two factors: 1) type of tooth (i.e., primary or permanent), and 2) condition of the PDL cells, which depends heavily on **extraoral** dry time.[184,185]

a

Figure 105. a. Tooth avulsion. In cases of avulsed permanent (not primary) teeth, long-term complications can be minimized by immediately replanting an avulsed permanent tooth into its socket. When this is not possible, place the tooth in a suitable storage medium and seek immediate emergency dental attention. © 2014 University of Manitoba. All rights reserved.

b

Figure 105. b. Tooth avulsion. Retrieving an avulsed permanent tooth by the crown helps to avoid additionally harming any viable PDL cells that may still be attached to the root. © 2014 University of Manitoba. All rights reserved.

c

Figure 105. c. Tooth avulsion. Holding an avulsed permanent tooth by the crown, gently rinse away any visible debris using either saline or cool water. © 2014 University of Manitoba. All rights reserved.

In cases of permanent (not primary) tooth avulsion, immediate replantation (i.e., replacement of the avulsed tooth into its alveolar socket) at the site of the accident significantly improves the prognosis. PDL cells are most likely to remain viable if the tooth is immediately replanted at the accident site or stored in a suitable physiologic medium such as these: Hank's Balanced Salt Solution (HBSS), Save-A-Tooth®, saline, milk or saliva (*Figure 105, d*). Extraoral dry times greater than 60 minutes yield increasingly poor outcomes, such as tooth **ankylosis**, **root resorption** and necrosis.[184,185]

Primary teeth should not be replanted because of the risk of adversely affecting the underlying, developing, permanent dental structures. The common consequence of primary tooth replantation is infection, which may affect permanent tooth calcification and aesthetics and/or alter the path of permanent tooth eruption.

In all tooth avulsion cases, the HCP should recommend that the patient receive immediate emergency dental care (which may involve splinting and an antibiotic) to minimize long-term complications.[184,185]

d

Figure 105. d. Dental storage media. Consider using Hanks Balanced Salt Solution (HBSS) as a dental trauma medium for an avulsed permanent tooth that must be stored/transported. In the absence of a dental trauma medium, keep the tooth moistened by submerging it in either saline solution, milk or saliva.

SUPPLEMENTAL RESOURCES

Permanent Tooth Avulsion

Use this curriculum resource to help train your staff to care for patients who have experienced permanent tooth avulsion as a result of oral trauma.

First Aid for a Lost Adult Tooth

Print this curriculum resource and distribute to parents, coaches and teachers to help ensure that best practices are followed at the accident site when an adult tooth is lost due to oral trauma.

Pearls to Practice

Prevention and Management of Oral Trauma from Accidents

1. Trauma from accidents is very common in children. **Non-dental HCPs should be aware that approximately one-third of children will experience trauma to their teeth, and be prepared to facilitate referral to a dentist who is knowledgeable in treating dental trauma**.
2. Permanent tooth avulsion is a true dental emergency. **Non-dental HCPs can minimize long-term complications by immediately replanting an avulsed permanent tooth into its alveolar socket**. When this is not possible, the tooth should be placed in a dental trauma medium such as Hank's Balanced Salt Solution or Save-A-Tooth®. Other suitable dental storage media include saline solution, milk or saliva.

Prevention of Infective Endocarditis from Dental Procedures in Children and Adolescents

Non-dental HCPs often have questions regarding antibiotic prophylaxis for children and adolescents with cardiac conditions who require dental care. **Infective endocarditis** (IE) is an infection of the endocardium that typically affects heart valves and adjacent structures (*Figure 106*). An extremely small number of IE cases may be prevented with antibiotic prophylaxis for dental procedures. In most cases, the risk of adverse events related to antibiotic use is greater than the benefits. Further, IE is more likely to result from frequent exposure to the bacteria associated with daily activities than the bacteria associated with dental procedures.[186] Maintaining optimal oral health and hygiene practices are more effective at preventing IE than prophylactic antibiotic use in most individuals.

In 2007 the American Heart Association (AHA) published guidelines for the prevention of IE,[187] which simplified the recommendations for antibiotic prophylaxis. These guidelines state that endocarditis prophylaxis is only reasonable for certain high-risk patients undergoing certain dental procedures, such as those patients presenting with any of the conditions listed below.

- Implanted cardiac devices, such as:
  - Prosthetic cardiac valves
  - Prosthetic material used for cardiac valve repair
- Congenital heart disease (CHD), such as:
  - Unrepaired cyanotic CHD, including palliative shunts and conduits
  - Repaired CHD with prosthetic material or device
  - Repaired CHD with residual defects at or adjacent to the site of the prosthesis
- Cardiac transplant recipients with valve regurgitation due to a structurally abnormal valve
- History of IE

Generally, any dental procedure involving perforation of the **oral mucosa** and/or manipulation of gingival tissues and/or manipulation of the **periapical region** of teeth requires antibiotic prophylaxis in patients who present with any of the above criterion. Such dental procedures include: extraction, routine cleaning, **scaling** and **root planing**, root canal treatment, fitting orthodontic bands, placing subgingival medications, biopsy and suture removal.[186]

The choice antibiotic for IE prophylaxis is oral amoxicillin. For those patients who are unable to take oral medication, ampicillin, cefazolin, or ceftriaxone may be used. In patients with allergies to penicillins or ampicillins, consider either cephalexin or clindamycin.[187]

SUPPLEMENTAL RESOURCES

AHA Guidelines on the Prevention of Infective Endocarditis

To ensure you're using the most current clinical practice guidelines, visit MyAmericanHeart.org (the AHA portal for healthcare professionals) and check for updates.

For the 2008 guideline update, download the *Circulation* journal article entitled "Prevention of Infective Endocarditis: Guidelines From the American Heart Association" at: circ.ahajournals.org/content/118/8/887.full.pdf

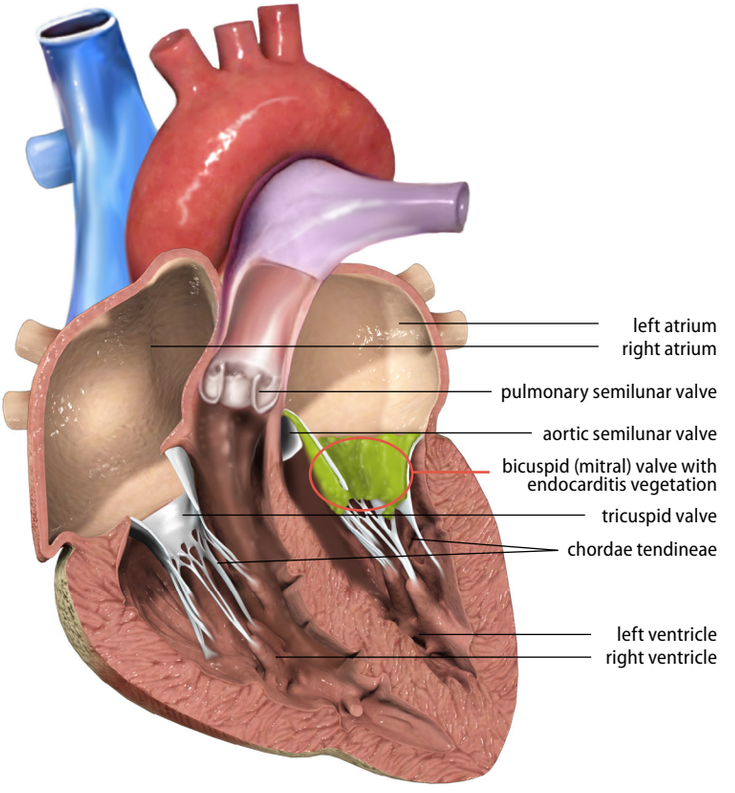


Figure 106. Infective endocarditis (IE). This infection of the endocardium typically affects heart valves and adjacent structures. Depicted here is a heart with an advanced lesion of the bicuspid (mitral) valve, with endocarditis vegetation extending onto the chordae tendineae. An extremely small number of IE cases may be prevented with antibiotic prophylaxis for dental procedures.

Pearls to Practice

Prevention of Infective Endocarditis from Dental Procedures in Children and Adolescents

1. Current AHA recommendations suggest that prophylactic antibiotics should only be prescribed for patients at high risk for IE. **Non-dental HCPs can reduce unnecessary prescription of antibiotics for dental procedures by becoming familiar with current IE guidelines.**

Performing an Oral Screening on a Child in a Medical Setting

Knee-to-Knee Exam

As suggested by the American Academy of Pediatrics,[2] one key role of non-dental HCPs is to provide dental screening of infants either within 6 months of the eruption of the first tooth, or by 12 months of age. Screening at this age is facilitated by proper positioning of the child.

The oral examination can be easily performed by placing the child on his or her back on an examination table. For young children, parents may restrain the child's hands and legs while the examiner uses a pen light or other directed light source to better illuminate the mouth.

For older children, a technique known as the **knee-to-knee exam** (*Figure 107*) can be employed. Following are step-by-step instructions on how to perform a knee-to-knee examination of the oral cavity of a child.

1. The parent and examiner sit so that they are facing each other.
2. The parent should hold the child in his/her lap as if to give the child a hug.
3. The parent should tip the child back so that the child's head rests in the lap of the examiner.
4. The parent should hold the child's hands and secure the child's legs.
5. The examiner should stabilize the child's head and evaluate the child's mouth and teeth.

When employed properly, this technique facilitates the oral examination in a way that is relatively comfortable and pleasant for the child. This position also allows the parent to easily see the child's teeth, and facilitates communication between the parent and healthcare provider. See the next section for the recommended sequencing of the oral screening.

Sequencing of the Oral Screening

The recommended sequencing that follows facilitates an accurate and efficient oral examination and, at well-child visits with the child still in the knee-to-knee position, facilitates fluoride varnish application and a parent-led demonstration of proper oral hygiene techniques.

1. Position the child in the knee-to-knee position so the child is laying across the lap of the HCP and parent/caregiver. Ask the parent to control the child's extremities while the oral soft tissues are examined.

Figure 107. Knee-to-knee exam. This method, ideally suited for children older than 12 months of age, facilitates the oral exam in a way that is comfortable for the child and allows the parent to easily see the child's teeth and communicate with the healthcare provider.

2. Observe closely the child's head, neck, arms and legs for evidence of child abuse.
3. Lift the upper lip and then the lower lip to observe the anterior teeth and oral soft tissues (e.g., lips, cheeks, tongue, gums and palate).
4. For children who have posterior teeth, use a dental mirror or tongue blade to retract the tongue while examining the posterior teeth.
5. Observe closely the child's teeth for any of the below listed conditions.
   - Plaque accumulation
   - Tooth discolouration
   - Tooth malformation (i.e., developmental abnormalities)
   - Carious lesions
6. Observe closely all oral soft tissues for any of the below listed conditions.
   - Frenum attachments that may impede breastfeeding, drinking or speaking
   - Fibromas, viral-associated lesions, aphthous ulcers, mucous retention cysts, clefts
   - Inflamed or edematous gingiva (gum tissues)
7. Conduct a brief interview with the parent to determine the child's overall risk for caries, asking questions such as those listed below. Also consider using an age-appropriate caries-risk assessment tool (CAT; as discussed previously in this course).
   - Snacking frequency, including consumption of sugared beverages
   - Frequency of tooth-brushing and use of a fluoridated toothpaste and dental floss
   - The oral health (i.e., oral hygiene, incidence of caries and/or periodontal diseases) of parents/caregivers and siblings
8. Make the recommendations for caries prevention such as those listed below.
   - Limit snacking frequency and select healthy snacks such as fruits, vegetables, cheeses and meats
   - Limit consumption of sugar-sweetened beverages
   - Brush twice a day with a fluoridated toothpaste
   - Get regular professional applications of fluoride from trained HCPs in either a dentist's or physician's office
9. Discuss the findings of the oral screening with the parent/caregiver, and make a special effort to explain the significance of the findings.
10. Refer to an oral HCP if any of the below listed conditions are evident.
    - Issues with teeth or oral soft tissues
    - High risk for caries
    - Child has not received his/her first dental visit
    - Child has not received a dental exam by a dentist or dental hygienist within the previous 12 months

At well-child visits and with the child still in the knee-to-knee position, reposition the child's head from the HCP's lap into the parent's lap. In this position, the parent can demonstrate proper oral hygiene while the non-dental HCP prepares to apply fluoride varnish to the child's teeth (as discussed previously in this course).

SUPPLEMENTAL RESOURCES

Performing an Oral Screening on a Child in a Medical Setting

Use this curriculum resource as a checklist when performing an oral exam.

Referral Form: Request for a Dental Examination

Use this University of Manitoba curriculum resource as a referral tool. Print and keep copies of this form in your clinic to assist with making timely and appropriate referrals of children to oral HCPs.

Pearls to Practice

Performing an Oral Screening on a Child in a Medical Setting

1. Early oral screening is a key role of the non-dental HCP. **Non-dental HCPs should perform dental screening of children under the age of one by placing the child on his or her back on an examination table, and for older children, using the knee-to-knee examination**.
2. **Non-dental HCPs should use a referral tool, such as the one developed by the University of Manitoba, to assist in noting abnormalities and pathologies and making timely and appropriate referrals to oral HCPs**.

Providing Access to Basic Dental Care for Children and Adolescents of Underserved Populations

Children and adolescents from underserved and impoverished populations often have greater challenges obtaining dental care than their more affluent peers. These individuals may be unable to access a dental clinic and may have poorer oral health. Due to the chronic nature of dental disease, early prevention is more effective than secondary treatment of disease. Prevention also results in significantly lower morbidity and can result in increased cost savings in the long term. This section highlights programs that have resulted in improved oral health outcomes for children. These are intended to serve as examples of how HCPs can advocate for children and adolescents in their own region.

Publicly Funded Dental Programs in Canada

Northwest Territories, Yukon and Nunavut

The Non-Insured Health Benefits Program (NIHB)[188] provides eligible First Nations and Inuit in the Northwest Territories and Nunavut with a limited range of medically necessary health-related goods and services that are not otherwise covered, including oral healthcare. NIHB offers emergency, diagnostic, restorative, endodontic, periodontal, prosthodontic, oral surgery and orthodontic dental services.

The Children's Dental Health Program[189] in Yukon offers two programs: one for preschool-aged children, and the other for all school-aged children from kindergarten to either Grade 8 or Grade 12, depending on their place of residence. Preventive, restorative, periodontal and oral surgery services are included. Emergency (accidental) services are not covered in the school-aged children's plan.

British Columbia, Alberta, Saskatchewan and Manitoba

The Healthy Kids Program[190] in British Columbia covers basic dental services and emergency treatment for pain relief for children up to 19 years of age.

The Alberta Child Health Benefit Program[191] and the Family Health Benefits Program[192] in Saskatchewan both offer basic coverage, including dental examinations, fillings and extractions for children up to 18 years of age.

In Manitoba, the Healthy Smile Happy Child[193] program provides oral health education to young and new parents, and covers preventative and basic treatment services for at-risk children under 6 years of age and their families. Through the Department of Family Services and Housing, older children and their families of low SES receive coverage for basic diagnostic, preventative, restorative, endodontic, periodontal, prosthodontic and oral surgery services.

Ontario

In Ontario, basic dental services are offered to children under 18 years of age through the Healthy Smiles Program[194] and the Children in Need of Treatment Program[195]. The latter includes diagnostic, preventive, restorative, prosthodontic, endodontic and oral surgery services and covers the cost of adjunct services, such as general anesthesia and conscious sedation; it is intended for one-time coverage with no ongoing care.

Québec

Until 10 years of age, children in Québec are entitled to receive basic dental hygiene, diagnostics and treatment in dental clinics (e.g., routine cleaning, scaling, application of fluoride, and dental exams, x-rays, fillings and extractions), paid by the Régie de l'assurance maladie du Québec.[196] All children and adults, regardless of age, receive certain oral surgery services in hospitals in the event of either trauma or illness. The dependents of social assistance clients between 10-16 years of age are eligible for extended coverage through the Régie.

Maritime Canada

A variety of programs are available in the Maritime Provinces. In Prince Edward Island, the Children's Dental Care Program (Prevention)[197] offers all school-aged children (3-17 years) oral health education, screening, scaling, topical fluoride and sealants. The same program also provides basic diagnostic and treatment services for school-aged children for an annual registration fee of $15/child to a maximum of $35/family. The fee is waived for low-income families. Under the program, parents pay 20% of treatment costs, unless their annual income is less than $30,000 per year.

The Children's Dental Health Program[198] in Newfoundland and Labrador is part of a poverty reduction strategy that provides children aged 12 years and younger with universal access to examinations, cleanings, fluoride applications, x-rays, fillings, extractions and sealants. This coverage is extended to children aged 13-17 years whose families receive income support.

In New Brunswick, children under 18 years of age in low income families may be covered for up to $1,000/year for services that include dental examination, basic diagnostics, extractions and some preventive treatment through the Dental Care for Low-Income Families Program.[199]

Nova Scotia's MSI Children's Oral Health Program[200] provides diagnostics, preventive services, treatment and general anesthesia in hospital settings for children aged 13 years and younger. Families are required to access private coverage first.

Unique Access-to-Care Programs in the United States

Into the Mouths of Babes

Into the Mouths of Babes (IMB) is a program in North Carolina that trains medical providers to deliver preventive oral health services to high-risk children who receive Medicaid social insurance. Children are eligible for services through IMB from the time of tooth eruption until 3-and-a-half years of age (i.e., 42 months). Care offered through the program includes screening, parental counseling, topical fluoride application and referral to a dentist if needed. Medicaid reimburses approximately $52 for each child's visit to medical providers who participate in the program.[201]

Medicaid-covered children enrolled in the program have fewer caries-related treatments in dental offices than those children who do not have IMB preventive services. Children with four or more IMB visits experienced an average 17% reduction in dental-caries-related treatments up to 6 years of age, compared to children with no IMB visits.[201] A critical component of the program is referral to selected dental providers who will treat eligible children. When weighed against projected emergency medical expenditures, the IMB program is effective in reducing oral-health-related costs.[202]

The Washington Dental Service Foundation has developed a similar program, which provides free training for medical providers, billing support and care coordination with network dental providers for Medicaid-eligible children. Washington Medicaid reimburses medical providers up to $70 for oral evaluation, topical application of fluoride and oral health education.[203]

Points of Light

The Points of Light (POL)[204] program in Michigan focuses on providing children with access to dental care early in life. By engaging HCPs, POL connects families with networks of dentists who provide a dental home. The primary focus of POL is to promote the first dental visit by 1 year of age. However, the program also provides a database of participating dentists who accept infants, "head-start" students and children with special healthcare needs.

Access to Baby and Child Dentistry

The Access to Baby and Child Dentistry (ABCD)[205] program in Washington State focuses on connecting low-income children with dentists who are trained to care for them. Through this program, ABCD coordinators connect with children from birth through 6 years of age with network dentists.

Following are the key components of the ABCD program.

- General dentists to care for pediatric patients.
- Employ a local dentist champion to identify, recruit and train local dentists.
- Provide enhanced dental benefits to HCPs who are certified and have received training.

From 2005 to 2010, results showed that the rate of untreated decay in low-income preschoolers was halved, and $525 in treatment costs per child was saved (based on average Medicaid restoration costs).[206] Dentists who are trained in the program are also three times more comfortable seeing very young children than non-ABCD trained dentists.[206] The program was initiated in 1995 with just one county, and today all 39 counties in Washington have a program. More than 1,600 ABCD providers, including general and pediatric dentists, have been trained to provide dental care to young children to date.[205]

SUPPLEMENTAL RESOURCES

Unique Access-to-Care Programs in the United States

Visit these online sources to learn about opportunities to connect low-income families with dentists who know how to provide optimal care for children and adolescents. Consider becoming involved with or launching a similar program in your area.

Into the Mouths of Babes
ncdhhs.gov/dph/oralhealth/partners/IMB.htm

Washington Dental Service Foundation
kidsoralhealth.org

Points of Light
pointsoflightonline.org

Access to Baby and Child Dentistry
abcd-dental.org

Pearls to Practice

Providing Access to Basic Dental Care for Children and Adolescents from Underserved Populations

1. Several government programs in Canada and the United States have successfully leveraged the expertise of medical professionals to improve oral health outcomes for children. **Non-dental HCPs should familiarize themselves with the programs available in their local areas and refer patients who have challenges with oral health.**
2. By linking young children with oral HCPs, the ABCD program has dramatically decreased rates of untreated decay in Washington State. **Non-dental HCPs should advocate for similar programs in their local areas and develop referral relationships with oral HCPs who treat young children.**

Case Study 2: Clinical Application

This case study illustrates the value of early oral screening by a child's PCP. As a result of implementing oral health screening in the medical office, dental caries was diagnosed at an early, treatable stage, which significantly reduced pain, infection and treatment costs.

DAY 1: A 2-year, 11-month-old boy whose family had recently relocated to the area presented to a new PCP for a well-child examination. She performed an intraoral examination and recognized the signs of ECC in the child's maxillary anterior teeth (*Figure 108 and Figure 109*). The PCP then discussed the child's diet and oral hygiene with the parent. This brief discussion revealed that the child was drinking fruit juice from a sippy cup several times a day, and had a habit of grazing on crackers and other carbohydrate-based foods rather than eating regular meals. The parent also reported that the child's teeth were only brushed a few times a week and that they were not using fluoridated toothpaste.

The PCP counseled the parent to put only water in the child's sippy cup and offer juice minimally. She discouraged grazing and instead suggested that the caregiver schedule regular meals and snacks consisting of healthy foods such as fruits, vegetables, cheeses and meats. The PCP recommended that the family begin using a pea-sized amount of fluoride toothpaste twice daily when brushing. Fluoride varnish was applied to the child's teeth and he was referred to a local dentist for evaluation.

Discussion Question: Within what time frame should this child be referred to a dental provider?

Consider: The white spot lesions and frank decay presented in this case are mild. There is no indication of pain or infection that might warrant urgent referral.

DAY 16: A general dentist evaluated the child's dentition. She determined that while carious lesions were present, they could be managed using a minimally invasive approach. The dentist also reinforced the messages of improved diet and oral hygiene.

As part of establishing the child's dental home, the family was counselled regarding growth and development of the mouth, injury prevention and appropriate use of fluoride products to reduce caries risk. They were also provided an emergency telephone number to contact the dentist in case of dental trauma. The decay was treated atraumatically by removing carious dentin with a dental instrument and applying an adhesive dental material containing fluoride

Figure 108. White spot lesions. Notice the white spot lesions present on the labial aspects of the child's maxillary incisors. If left unchecked, this will progress to frank decay. Photo source: Travis Nelson. Used with permission.

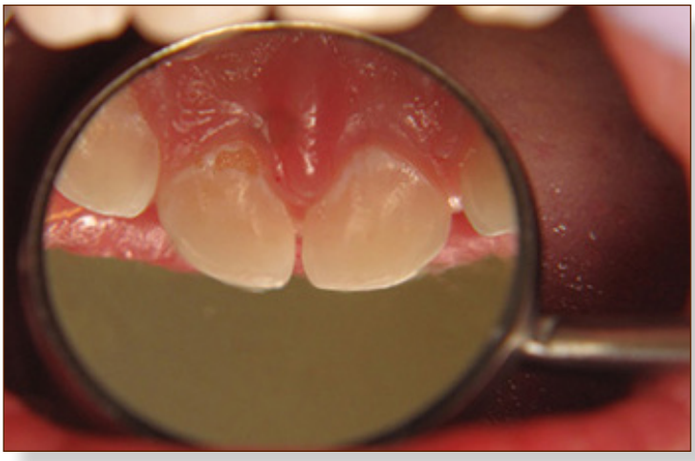


Figure 109. Caries lesions. Small caries lesions have formed at the gingival margin on the lingual aspects of the same teeth. Photo source: Travis Nelson. Used with permission.

(*Figure 110*). This treatment was performed while the child rested comfortably in the knee-to-knee position. A three-month follow-up appointment was made to evaluate the repaired lesion and apply fluoride varnish.

Discussion Question: How might you incorporate the message of healthy diet into your anticipatory guidance for pediatric patients?

Consider: Most PCPs regularly discuss healthy diet with patients in the context of maintaining optimal weight. The key messages you are already giving patients about healthy diet can be tailored to include oral health benefits by simply adding "...and this will help keep your child's teeth healthy, too."

DAY 115: Three months after the initial visit the family returned to the dental office for re-evaluation. A knee-to-knee examination was conducted, revealing that the adhesive restoration applied at the last visit remained intact. The child's mother informed the dentist that she was no longer allowing her child to drink juice in a sippy cup, and that she was doing her best to select fresh fruits, vegetables, cheeses and meats as between-meals snacks.

The dentist applauded the parent's efforts and reinforced the importance of diligently brushing the child's teeth twice daily with a pea-sized amount of fluoridated toothpaste. Fluoride varnish was applied and a return visit was scheduled for three months later.

DAY 206: At the three-month return visit, the dentist found that the white spot lesions had not progressed and the repaired teeth remained intact. The mother reported that she had been following the diet and hygiene recommendations discussed previously. The dentist again applied a fluoride varnish to all of the child's teeth.

The dentist determined that based upon the at-home changes made by the family, the child was no longer at high risk for developing new caries. The parent was encouraged to continue the healthy diet and dental hygiene practices and a follow-up examination was scheduled for six months later.

CONCLUSION: An astute PCP quickly identified early caries lesions in this child. By paying close attention to his teeth during the examination, intervention was possible and caries progression was prevented before this child needed GA for full mouth dental rehabilitation.

HCPs can make a real difference in their pediatric patients' lives by implementing oral screening beginning at 12 months of age.

Figure 110. Sodium fluoride varnish. Fluoride varnish is applied to all teeth, including those with visible white spots as well as those without visible signs of demineralization. Photo source: Travis Nelson. Used with permission.

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Glossary of Terms

[Dental] **Abscess**: An infection of the mouth, face, jaw or throat resulting from a bacterial infection whereby pus collects at the infection site (either **periapically**, affecting the root of the tooth, or **periodontally**, affecting the gums) causing pain until the abscess either ruptures or drains. Drainage may be either spontaneous or the result of surgical intervention.

Acrodynia: An early childhood disease characterized by pain, swelling, and erythema of the extremities; scarlet colouration of the cheeks and nose; cold, clammy skin; profuse sweating; and digestive disturbances. The disease is caused by mercury poisoning.

Adolescence: Period of life from 13 to 19 years of age.

Agranulocytosis: A rare, acute condition whereby the bone marrow is profoundly deficient in neutrophil progenitors and thus insufficiently produces mature white blood cells (granulocytes; specifically, neutrophils), resulting in severe neutropenia.

Alveolar bone/process: Designed for tooth anchorage, this especially thick bone is located in both the **mandible** (lower jaw) and **maxilla** (upper jaw) and contains the **dental alveoli** (tooth sockets).

Alveolar ridge/margin: Bony structures located posterior to the upper teeth on the maxilla and posterior to the lower teeth on the mandible; gives rise to the maxillary and mandibular dental arches. In North American English, vocalizations made while the tongue and alveolar ridge are in contact are referred to as 'alveolar consonants' and include the following sounds: [d], [l], [n], [s], [t], [z].

[Dental] **Alveolus**: Tooth socket; hollow cavity in the jaw that houses the root of a tooth and is separated by interdental septa. Attachment between a tooth and alveolus occurs via the periodontal ligament (PDL).

Ankylosis: Stiffness or fixation (fusion) of joints (e.g., between tooth and bone) resulting from either surgery or disease.

Anticipatory guidance: Provision of information concerning a child's development in order to manage patient expectations around significant physical, emotional and psychological milestones.

Becet's syndrome: A rare disease involving inflammation of the vasculature that is characterized by frequent, non-sexually transmitted ulceration of the mouth and genitals. The cause of this disease, which typically affects individuals aged 20-30 years, is still uncertain.

Biofilm: A densely-packed community of adherent microorganisms that resides within a self-produced matrix of extracellular polymeric substance (EPS; slime), which enables the bacteria to stick to a surface and manage a common internal environment.

Buccal: In close relation to or involving the cheek (i.e., the buccal-side of a tooth is the surface closest to the cheek).

Calculus: Tartar; hardened/mineralized plaque that adheres strongly to teeth and provides a bacterial reservoir that contributes to periodontal disease. Calculus should be removed via professional dental cleaning.

[Dental] **Caries**: Process of tooth decay whereby an infection of bacterial origin interferes with tooth remineralization leading to bacterial demineralization (evidenced by a **white spot lesion**) and cavitation.

Caries balance: Concept that helps explain the dynamic nature of, and the variables that contribute to, tooth decay.

Caries risk: Subjective appraisal of an individual's risk for tooth decay.

Caries risk assessment tool (CAT): Age-specific forms (i.e., children aged 0-6 years; individuals aged >6 years) used in a clinical setting to identify behavioural, environmental, general health, and clinical risk factors for dental caries.

Cariogenic: Causing dental caries (tooth decay).

Carious lesion: A tooth cavity that can no longer be remineralized. Carious lesions are typically the result of acid-producing bacteria that cause demineralization.

Cavitated lesion: An advanced carious lesion whereby the enamel is visibly collapsed and the cavity is pliable upon probing.

Cellulitis: An acute, spreading bacterial infection of the dermis and subcutaneous tissue that is commonly caused by the *Streptococcus pyogenes* or *Staphylococcus aureus* species. Cellulitis is considered a true medical and dental emergency.

Cementum: Calcified, avascular, mesenchymal (connective) tissue primarily located on the roots of teeth. Critical to tooth anchorage; cementum provides physical attachment between teeth and the gingival tissue covering adjacent alveolar bone via the periodontal ligament.

Chédiak-Higashi syndrome: A rare, inherited, autosomal recessive condition that damages the immune system. This condition is characterized by repeated and persistent (sometimes life-threatening) infections, oculocutaneous albinism, and

Glossary of Terms *(continued)*

difficulty with blood clotting.

Childhood: Period of life from 12 months to 12 years of age.

Chlorhexidine: An antiseptic antibacterial agent used to clean the skin; it is also an active ingredient in mouthwash.

Cleidocranial dysplasia: A congenital disorder that affects the development of bones and teeth. The severity of signs and symptoms can vary widely. However, characteristic of the disease are: short stature, decreased bone density, underdeveloped or absent clavicles, delayed closure of the fontanelles, delayed dental development and misalignment of the teeth and jaws (**malocclusion**).

Crown: Enamel-covered portion of a tooth that resides above the gingiva (gums).

Cyclic neutropenia: A rare genetic condition that affects the body's ability to fight infection. The disease is characterized by recurrent (typically every 21 days, lasting 3-5 days) episodes of neutropenia during which neutrophils are deficient in supply.

Debridement: Clinical removal of dead, damaged or infected tissues in order to optimize the health and recovery of adjacent, viable tissues.

Definitive care: Conclusive management; the point at which recommended treatment is complete.

Demineralization: Superficial dissolution of enamel caused by overexposure to acidic substances, such as those produced by bacterial plaque. Early tooth enamel demineralization is evidenced by visible white spot lesions.

Dentifrice: A paste, gel, powder or liquid used in conjunction with a toothbrush to clean and polish natural teeth.

Dentin: The yellowish, mineralized tissue that comprises the bulk of a tooth and lines the pulp cavity. Sensitivity to pain, pressure and temperature is transmitted through **dentinal tubules** that extend from the pulp through the dentin.

Dentinal tubules: Canals that are arranged in parallel throughout the dentin. Dentinal tubules contain the long, cytoplasmic processes of **odontoblasts** (cells that give rise to and maintain dentin) and facilitate communication between the dentin and pulp.

Disclosing agents: A dye-containing preparation available in liquid, tablet or lozenge form that is used in dentistry to stain plaque for visualization.

Down's syndrome (trisomy 21): A genetic disorder that arises from abnormal cell division, resulting in extra genetic material (i.e., the presence of all or some of a third copy of chromosome 21). The condition is characterized by physical growth delays, dysmorphic facial features and mild to moderate intellectual disability.

Early childhood caries (ECC): The presence of one or more decayed teeth (non-cavitated or cavitated lesions), missing teeth (due to caries) or filled tooth surfaces in any primary teeth in a child under 6 years of age.

Ectodermal dysplasia: A group of inherited developmental disorders resulting in defects to the sweat glands, hair, teeth and nails (e.g., malformed teeth, sparse hair).

Ectopic eruption: Budding tooth erupts in a location other than its intended site, typically in a **mesial** (toward the anterior midline of the dental arch) angular direction. This malpositioning is most common in the maxillary first molars and maxillary cuspids.

Enamel: Hard, mineralized tissue covering the crown of a tooth. Enamel protects from biological, chemical, and mechanical sources of damage to the dentition. As the hardest substance in the human body, enamel also serves to insulate the tooth from pain, pressure and temperature.

Endodontic therapy: Root canal therapy; invasive treatment of an infected dental pulp resulting in decontamination and protection from future infection.

Epstein-Barr virus (EBV; human herpes virus type 4): The most common viral infection in humans; EBV is spread primarily through bodily fluids, especially saliva. Most individuals will contract EBV at some point over the lifespan, with serious cases causing infectious mononucleosis.

Eugenol: A common dental analgesic and antiseptic derived from certain essential oils, especially clove oil. In dentistry, eugenol is applied topically to painful tooth cavities.

Extraoral: Outside the mouth.

Fascial spaces: Clefts (potential spaces between layers of fascia) and compartments (actual spaces between fascia and underlying tissues/organs) that contain connective tissue. The planar organization of fascia allows for the spread of infection from superficial to deep layers.

Fetid: Extremely unpleasant odour.

Filiform papillae (conical papillae): Thin, long, conical structures located on the dorsum of the tongue that function to clean and

Glossary of Terms *(continued)*

abrade the mouth. Filiform papillae are the most plentiful of the lingual papillae, giving the tongue its textured appearance. These are the only type of lingual papillae that do not contain taste buds.

Fluctuant lesion: Referring to a moveable, compressable mass. Generally, fluctuant lesions require incision and drainage.

Fluorosis: Also described as the mottling of tooth enamel; dental fluorosis is an esthetic disturbance of enamel resulting from overexposure to fluoride during childhood. In cases of mild fluorosis, teeth appear opaque, losing their translucence. More severe cases are characterized by discolouration.

Focal epithelial hyperplasia (Heck disease): A rare, benign, proliferative disease of the oral mucosa caused by the human papilloma virus (HPV). This disease is characterized by the presence of multiple flesh-coloured papules that range from 3-10mm in diameter and tend toward confluence, giving affected areas a cobbled appearance. The most commonly affected sites are the lower lip, upper lip, tongue and buccal mucosa.

Frank caries/decay (tooth decay): An overt carious lesion characterized by cavitation, whereby remineralization of the tooth cavity is no longer possible.

Frenum/frenulum: Skinfold that both supports and restricts body movement. Dental frena are the various soft tissue attachments located throughout the mouth (e.g., attachments of the lips, tongue and cheeks to the oral mucosa).

Gingivitis: A non-destructive periodontal disease characterized by inflammation of the gum tissue, most commonly in response to plaque build-up. Gingivitis is reversible with good oral hygiene.

Hand, foot and mouth disease: A relatively common infection typically caused by **Coxsackie virus A16**. The disease spreads via the exchange of bodily fluids, typically: saliva, nose and throat discharge, fluid from blisters and fecal matter.

Hard dental tissues: Referring to enamel, dentin and cementum.

Hard palate: Located at the anterior aspect of the roof of the mouth, the hard palate is comprised of ridged bone that is covered with a mucous-secreting membrane. The hard palate functions to grip food during chewing and provide rigid support to the nasal cavity so that oral pressures don't occlude the nasal passage.

Herpangina: A common childhood virus involving sore throat, fever, headache, ulcers and lesions in inside the mouth.

Herpes labialis (cold sore/fever blister): An infection of the lips, mouth or gums due to herpes simplex virus type 1 (HSV-1) resulting in small, painful blisters that last up to three weeks.

Histiocytosis-X (Langerhans cell histiocytosis; LCH): A broad term for a group of cancer-like conditions in which immune cells attack rather than protect the body from infection. The disease is characterized by abnormal proliferation of histiocytes. In some cases, the extraneous immune cells form tumors.

Hydroxyapatite/$Ca_{10}(PO_4)_6(OH)_2$: The naturally-occurring mineral form of calcium apatite that gives enamel its hard, crystalline structure.

Hyperbilirubinemia: A condition characterized by abnormally high amounts of bilirubin in the blood resulting in jaundice. Bilirubin is the yellow-pigmented product of normal red blood cell catabolism, which is usually processed in the liver for removal by the kidneys.

Hypocalcemia: Low serum calcium.

Hypomineralization: A developmental condition affecting the enamel of the dentition that forms during the last trimester of pregnancy through the first four years of life. Hypomineralized enamel contains less mineral than normal, healthy enamel, resulting in increased tooth sensitivity.

Hypoparathyroidism: A very rare condition characterized by inadequate parathyroid hormone (PTH) production by the parathyroid glands, resulting in low serum calcium (**hypocalcemia**) and high serum phosphorus (**hyperphosphatemia**). The disease is most commonly caused by surgical damage/removal or congenital defects of the parathyroid glands.

Hypophosphatasia: A rare and sometimes fatal inherited metabolic bone disease characterized by disrupted mineralization of teeth and bones. The mildest form of the condition is **odontohypophosphatasia**, which results in abnormal tooth development and premature tooth loss.

[Dental] **hypoplasia**: Hypoplasia refers to the underdevelopment of a tissue or organ. Dental hypoplasia refers to the incomplete development of hard dental tissues.

Hyposalivation: Decreased salivary flow or altered saliva composition commonly resulting from systemic diseases, medications or radiotherapy to the head and neck.

Infancy: Period of life from birth through 11 months of age.

Infectious mononucleosis: Most commonly caused by Epstein-Barr virus (EBV, human herpes virus type 4); infectious mononucleosis is characterized by fatigue, fever, pharyngitis and

Glossary of Terms *(continued)*

lymphadenopathy.

Infective endocarditis (IE): A highly morbid and deadly infection causing inflammation of the inner lining (**endocardium**) of the heart and heart valves. Risk factors for IE include: structural heart disease, prosthetic cardiac valve implantation, history of IE, invasive medical procedures and injection drug use.

Interproximal gingiva (interdental gingiva/papilla): Referring to the soft, conical gum tissue that fills the space between adjacent, contacting teeth to prevent food impaction.

Invasive [dental**] procedures**: Referring to any diagnostic or remedial procedure that requires insertion of an instrument or device into the body through either the skin or a body orifice. In dentistry, this includes: extraction, routine cleaning, scaling and root planing, root canal treatment, fitting orthodontic bands, placing subgingival medications, biopsy and suture removal.

Knee-to-knee examination: Examination technique in which the caregiver and healthcare provider position the child in a supine position on the lap of the healthcare provider.

Labial: In close relation to or involving the lip (i.e., the labial-side of a tooth is the surface closest to the lip), also referred to as **facial**.

Leukemia: A malignant cancer that originates in blood stem cells in the bone marrow, resulting in uncontrolled production of structurally and functionally abnormal white blood cells.

Leukocyte adhesion deficiency: A rare genetic disorder caused by a deficiency in the adhesive glycoproteins located on the surface of white blood cells. This defect interferes with the ability of granulocytes and lymphocytes to participate in cytotoxic and phagocytic reactions, resulting in immunodeficiency.

Lingual: In close relation to or involving the tongue (i.e., the lingual-side of a tooth is the surface closest to the tongue).

Loculation/loculus: A loculus is a small cavity or compartment within an organ; loculation is the process that results in the formation of loculi.

Lymphadenopathy: Localized or generalized enlargement of the lymph nodes or lymph vessels, commonly caused by infection or disease.

Malocclusion: Poor bite; abnormal alignment between the maxillary and mandibular teeth.

Mandible/mandibular: Referring to the lower jaw bone. The mandible, which houses the lower arcade of teeth, is the largest, strongest bone of the face, and the only movable bone of the skull. The mandible and maxilla work together to accomplish **mastication** (chewing) and verbal communication.

Maxilla/maxillar: Referring to the upper jaw bone. The maxilla, which houses the upper arcade of teeth, is comprised of two fused bones that join at the intermaxillary suture to form the superior, immovable portion of the jaw. The maxilla and mandible work together to accomplish mastication (chewing) and verbal communication.

Median palatal raphe: A longitudinal ridge along the midline of the mucosa of the hard palate resulting from normal gestational fusion of the lateral palatine processes. Most craniofacial anomalies are the result of defective tissue fusion; cleft palate, for example, results from failure of the lateral palatine processes to fuse.

Metabolic syndrome: A cluster of metabolic risk factors for cardiovascular disease. The syndrome is characterized by the presentation of any three or more of the following measurements: abdominal obesity (a waist circumference ≥102cm in men or ≥88cm in women), a blood triglyceride level of ≥150 mg/dL, HDL cholesterol of <40 mg/dL in men or <50 mg/dL in women, a systolic blood pressure ≥130 mmHg and/or a diastolic blood pressure ≥85 mmHg, fasting glucose of ≥100 mg/dL. Metabolic syndrome is largely the result of poor diet, physical inactivity and genetic factors.

Methemoglobinemia: A life-threatening blood disorder in which the ferrous (2+) form of heme is oxidized to the ferric (3+) form (methemoglobin, MetHb), reducing both the oxygen-carrying capacity of blood as well as the oxygen-unloading capacity of blood at the tissue level. The condition is primarily inherited, but may be acquired from drugs and toxins.

Minimally invasive dental procedures (microdentistry): Dental practices that aim to prevent and reduce risk for dental decay by conserving healthy dental structures and promoting tooth remineralization. Practitioners never remove more of a dental structure than is necessary to restore it, and often use long-lasting dental materials to minimize future repairs. Minimally invasive dentistry techniques include: fluoride application, air abrasion, sealants, inlays, onlays and bite splints.

Mucoceles: A type of pseudocyst that is associated with the leakage of mucus into the surrounding soft tissues. Mucoceles originate from the minor salivary glands.

Multidisciplinary team: Professionals from different disciplines collaborate to create new methods of addressing common issues. Related terms are **interdisciplinary** (relating to more than one

Glossary of Terms *(continued)*

branch of knowledge) and **transdisciplinary** (relating to more than one professional approach).

Myalgia: Muscle pain.

Nasopharynx: The **pharynx** (throat) has three anatomical regions: nasopharynx, oropharynx and hypopharynx. The nasopharynx is located superior to the soft palate and uvula, and connects the nasal cavity and throat.

Natal teeth: Teeth that are present at birth.

Neonatal teeth: Teeth that emerge within the first month of life.

Neutrophil defects: Any clinical scenario in which the structure, function and/or supply of neutrophil granulocytes is inadequate.

Non-cavitated lesion: Initial caries lesions that have an intact enamel surface.

Odontogenic: Arising from the teeth, such as in infections.

Oral mucosa: Mucus membrane lining of the oral cavity, comprised primarily of stratified squamous non-keratinized epithelium.

Oral soft tissues: Referring to the oral mucosa, tongue, lips, cheeks and gingiva.

Otitis media (tympanitis): Inflammation of the middle ear complex (i.e., the air-filled space located behind the eardrum containing the ossicles) resulting from bacterial or viral infection.

Papilla: A small projection/elevation on the skin. Papillae are located on dermal surfaces throughout the body, performing a variety of specialized sensory and mechanical functions.

Papillon-Lefèvre syndrome: A very rare autosomal recessive disorder characterized by hyperkeratosis of the skin covering the palms of the hands and soles of the feet, and severe periodontal disease causing destruction of alveolar bone resulting in tooth loss.

Parulis (gum boil): A common oral lesion (localized collection of pus) that develops exclusively on the gingiva.

Periapical: Referring to the region at or around the apex of the root of a tooth.

Pericoronitis: A dental condition characterized by the presence of a swollen, infected flap of gingival tissue that overlies emerging molars and/or wisdom teeth.

Periodontal disease: Any disease of bacterial origin that destroys the periodontium (i.e., gingiva, periodontal ligament, alveolar bone, cementum).

Periodontal ligament (PDL): Fibre complex that attaches each tooth to its respective alveolus in the jaw bones. PDL viability is critical to successful replantation following tooth avulsion.

Periodontist: A dentist specialized in working with tooth-supporting structures, including the prevention, diagnosis, treatment and management of periodontal diseases, as well as in the placement of dental implants.

Periodontium (periodontal tissues): Dental complex comprised of the following four structures, which are required for tooth anchorage: gingiva, periodontal ligament, alveolar bone and cementum.

Permanent teeth: Adult teeth.

Petechiae: Small (1-2mm diameter) red or purple spots on the skin resulting from a minor hemorrhage, such as from a broken capillary.

Physiological tooth mobility: Normal, healthy teeth move ~0.25mm in both vertical and horizontal directions in response to forces sustained while biting and chewing. Tooth mobility is limited by the periodontal ligament and alveolar bone.

[Dental] **plaque**: A sticky, pale yellow biofilm caused by colonizing bacteria that commonly result from poor oral hygiene.

Povidone-iodine: A stable chemical complex of polyvinylpyrrolidone and elemental iodine that is applied as a topical antiseptic to treat minor wounds and infections.

Primary/acute herpetic gingivostomatitis: A common oral infection caused by the primary herpes simplex virus and characterized by gingival erythema and the presence of multiple small ulcers and vesicles on the attached gingiva. The condition is more common in children than adults.

Primary teeth (baby/deciduous/milk teeth): First set of teeth to erupt.

Proprioception: The interpretation of stimuli received by proprioceptors that indicates the position of the body and its parts relative to each other and the physical environment.

[Dental] **pulp**: Located at the centre of the tooth extending from root to crown, this soft tissue structure contains a nerve, blood and lymphatic vessels and connective tissue. The pulp is responsible for nourishing the dentin and relaying information about pain, pressure and temperature to/from the nervous system.

Glossary of Terms *(continued)*

Pulpitis: Inflammation of the dental pulp.

Pulpotomy: An endodontic procedure for primary teeth that involves removal of diseased dental pulp and decontamination. Similarily, root canal therapy is used to treat diseased dental pulp in permanent teeth.

Purulent exudate (pyogenic/suppurative exudate): Pus; a fluid characteristically high in protein and white blood cells that is exuded from infected or injured tissues and/or capillaries.

Rampant caries: Sudden onset of widespread caries, characterized by severe decay on multiple surfaces of numerous teeth. This is common in individuals with xerostomia, poor oral hygiene, frequent stimulant use, frequent sugar consumption and radiation to the head and neck.

Ranula: A type of pseudocyst that is associated with the leakage of mucus into the surrounding soft tissues. Ranulas originate from the major salivary glands, typically the sublingual gland.

Remineralization: The process by which minerals are added back to teeth, strengthening them.

Replantation: Replacing an avulsed tooth in its socket.

Restorations: Fillings, crowns, bridges, implants, dentures, inlays and onlays.

Restorative dental procedures: Dental practice of replacing or repairing missing and damaged teeth. Restorative techniques include: fillings, crowns, bridges, implants, dentures, inlays and onlays.

Riga-Fede disease: A rare oral condition found in newborns characterized by ulceration on the ventral surface of the tongue due to rubbing the tongue over the anterior teeth.

Root: Cementum-covered portion of a tooth that resides below the gingiva (gums).

Root planing: A method of conventional periodontal therapy; the non-surgical removal of inflammatory agents (e.g., **plaque**, **calculus**) from the **root** of a tooth.

Root resorption: Catabolism of the root complex of a tooth. **Physiological root resorption** is an entirely normal process that occurs with the timely loss of primary teeth. However, **internal root resorption (IRR)** is a pathological pulp disease that results in loss of dentin, cementum and/or bone from the permanent dentition.

Sialadenosis (sialosis): Asymptomatic, noninflammatory, non-neoplastic bilateral enlargement of the salivary glands, most commonly affecting the parotid glands. Sialosis is commonly seen in alcoholics, diabetics and the malnourished.

Scaling: A method of conventional periodontal therapy; the non-surgical removal of inflammatory agents (e.g., plaque, calculus) from the **crown** of a tooth.

Soft dental tissues: Referring to the pulp and periodontal ligament.

Soft palate: Located at the posterior aspect of the roof of the mouth, the soft palate is comprised of muscle and connective tissue, giving it both mobility and support. While elevated to accommodate swallowing and sucking, the soft palate also functions to create a vacuum that prevents food from entering the nasal cavity and respiratory tract.

Stippling: A pattern of small circular depressions, often seen on gingival surfaces of adolescents and adults. It is only present in areas with underlying connective tissue, such as on the gingival surfaces covering the alveolar ridge

Suppuration; suppurate: Referring to the production and/or discharge of pus. Bacteria that cause pus are referred to as suppurative, pyogenic or purulent.

Trismus: Any restriction to the jaw (such as due to surgery, trauma, radiation, or tonic contraction of the muscles of mastication) that interferes with the ability to fully open the mouth.

Ventral: Relating to the anterior aspect of a structure.

Vertical transmission: The direct transfer of a pathogen from a parent to its progeny.

Virulence: Disease-causing potential.

White spot lesions: Non-cavitated lesions; the first visible sign of dental caries indicating sites where tooth demineralization has occurred.

Xerostomia: Dry mouth resulting from reduced or absent saliva flow, which may be a side effect of radiation therapy to the head and neck, or a wide variety of medications.

Post-Test Practice Questions

To complete the post-test for this course and apply for CME credit, please visit oralhealthed.com. To help you prepare, the questions that follow will appear on the final test.

1. By what age do the Canadian Dental Association and the American Academy of Pediatrics recommend that children receive an oral health screening?
   a. 6 months
   b. 9 months
   c. 12 months
   d. 36 months

2. The two most-common oral health problems in children and adolescents are:
   a. Dental caries and oral cancer
   b. Halitosis and dental caries
   c. Periodontal disease and tooth decay
   d. Periodontitis and candidiasis

3. Approximately what percentage of Canadian children aged 6-11 years have experienced dental caries?
   a. 20-30%
   b. 30-40%
   c. 40-50%
   d. >50%

4. Which of the following are risk factors for dental caries?
   a. Diet high in protein
   b. High levels of virulent bacteria
   c. High salivary flow
   d. Use of fluoride toothpaste

5. Which group accounts for the majority of children who experience tooth decay?
   a. Children of low socioeconomic status
   b. Children with special healthcare needs
   c. Children with xerostomia
   d. Premature infants

6. What is the earliest clinical sign of dental caries?
   a. Extrinsic stain
   b. Frank decay
   c. Primary dentinal lesion
   d. White spot lesion

7. Definitive treatment of a tooth abscess typically requires:
   a. Antibiotics and analgesics
   b. Antibiotics and surgical drainage
   c. Root canal or extraction
   d. Root canal or filling

8. The following are characteristics of healthy gingiva in children.
   a. It is flat and fits snugly around the teeth.
   b. The papilla are pointed and pyramidal, filling the interproximal area between the teeth
   c. The shape is thick, rounded or rolled with a shiny appearance
   d. The shape is thick, rounded or rolled with a stippled appearance

9. Which product has the highest concentration of fluoride?
   a. Mouthwash
   b. Prescription-strength toothpaste
   c. Professional foam
   d. Varnish

10. Which caries-preventive product is generally found in gum, syrups, or candies?
    a. Chlorhexidine gluconate
    b. Povidone iodine
    c. Silver diamine fluoride
    d. Xylitol

11. Which bacterial species is most commonly used in dental probiotic agents?
    a. Enterococcus
    b. Lactobacillus
    c. Staphylococcus
    d. Streptococcus

12. Which periodontal condition is reversible through good home oral hygiene alone?
    a. Calculus
    b. Gingivitis
    c. Necrotizing ulcerative gingivitis/periodontitis
    d. Periodontitis

13. Which periodontal condition is most often treated with antibiotics?
    a. Acute necrotizing ulcerative gingivitis/periodontitis
    b. Chronic periodontitis
    c. Gingivitis
    d. Periodontitis

Post-Test Practice Questions *(continued)*

14. The first teeth to emerge in an infant, erupt around 6 months of age and are generally:
    a. Canines
    b. Incisors
    c. Molars
    d. Premolars

15. To address teething symptoms, PCPs should consider:
    a. Systemic pain medication and teething rings
    b. Teething rings and hot compresses
    c. Topical anesthetic teething gel and referral to dental provider
    d. Topical anesthetic teething gel and teething rings

16. Which type of diet presents the greatest risk for decay?
    a. Frequent consumption of fat and protein
    b. Frequent consumption of refined carbohydrates
    c. Infrequent consumption of fat and protein
    d. Infrequent consumption of refined carbohydrates

17. Which of the following correctly describes the appropriate course of treatment for most eruption cysts?
    a. Fully enucleate with a wide margin
    b. Lance under local anesthesia
    c. Monitor for spontaneous rupture
    d. Refer to a dental provider for imaging and excision

18. Treatment of pericoronitis typically involves:
    a. Irrigation with xylitol solution
    b. Prescription of topical analgesics
    c. a and b
    d. None of the above

19. What percentage of all current cases of oropharyngeal squamous cell carcinoma are estimated to be HPV-related?
    a. Less than 10%
    b. 10-20%
    c. 20-40%
    d. >60%

20. A dental injury in which the tooth is loosened, but maintains its normal position is considered:
    a. Concussion
    b. Extrusion
    c. Luxation
    d. Subluxation

21. The main difference in treatment of primary and permanent teeth that are avulsed is that:
    a. Permanent teeth have poorer prognosis when replanted than primary teeth
    b. Permanent tooth avulsion requires antibiotic administration, while avulsion of primary teeth does not
    c. Primary teeth are not generally replanted, but permanent teeth are
    d. Primary teeth are splinted for less time than permanent teeth

22. According to the American Heart Association guidelines, antibiotic prophylaxis before dental care is indicated for which of the following patients?
    a. Adolescent with cyanotic congenital heart disease
    b. Child with a history of heart palpitations
    c. Patient who received a heart transplant two years ago and now has normal valve function
    d. None of the above

23. When performing a dental screening on a child, the provider should assess:
    a. Oral hygiene
    b. Oral soft tissues
    c. Teeth
    d. All of the above

24. Which of the following best describes programs in Canada that provide assistance to Canadian children from low-income families?
    a. A number of provincial and territorial oral health programs are available, benefits are uniform throughout Canada
    b. A number of provincial and territorial oral health programs are available, benefits depend on the region
    c. All programs provide uniform dental care for all children under 18 years of age in Canada
    d. None of the above

25. Examples of United States programs that provide access to dental care include:
    a. Access to Baby and Child Dentistry, which provides pediatric training to dentists and enhanced reimbursement to certified providers
    b. Into the Mouths of Babes, which reimburses medical providers for screening and fluoride application
    c. Points of Light, which connects families with dentists
    d. All of the above

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