Episode 115 – Children and Oral Health: Part One August 23, 2024

Introduction

Oral health in infancy and early childhood is the precursor to good oral health at later stages of life. The World Health Organization defines oral health as:

> *The state of the mouth, teeth and orofacial structures that enables individuals to perform essential functions such as eating, breathing and speaking, and encompasses psychosocial dimensions such as self-confidence, well-being and the ability to socialize and work without pain, discomfort and embarrassment. Oral health varies over the life course from early life to old age, is integral to general health and supports individuals in participating in society and achieving their potential.* [1]

Oral diseases affecting children and adolescents encompass a variety of conditions, such as dental caries, periodontal disease, head and neck cancers, orofacial trauma, congenital malformations (e.g., cleft lip and palate), and noma. Most oral health conditions are largely preventable. Poor oral health significantly impacts quality of life, causing pain and embarrassment, limiting function, and being costly to treat. [1]

Dental caries and periodontal disease are the most common oral diseases among children and adolescents worldwide. Data show that dental caries have a prevalence of around 40%, while gingival disease affects 60-80% of these populations. [2]

Oral diseases disproportionally affect individuals experiencing poverty. There is a strong association between socioeconomic status[1] and the prevalence and severity of oral diseases. This association exists from early childhood to older age and across populations in high-, middle- and low-income countries. [3]

Dental caries

Dental caries are the most common noncommunicable disease affecting people of all ages worldwide. Untreated caries in primary teeth is the single most common chronic childhood disease, affecting 514 million children globally. [4] [5]

Between 1990 and 2019, there was a 15% increase in the number of new cases of dental caries in the permanent teeth of children aged 5-14 globally, while the incidence

[1] Socioeconomic status (SES) is a descriptive term for individuals in society, based on a combination of income, occupation, and educational level. [53]

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rate remained steady at approximately 34%. Children aged 10-14 had higher numbers of new cases and incidence rates of dental caries in permanent teeth in both 1990 and 2019 compared to children aged 5-9. These unfavourable trends in dental caries incidence rates in children are likely from a combination of factors, including excessive sugar consumption, poor oral hygiene, insufficient fluoride exposure, low family income, and inadequate access to primary oral healthcare. [6]

A recent review reported the mean prevalence of early childhood caries (ECC) in 3-, 4-, and 5-year-old children worldwide to be as high as 43%, 55%, and 63%, respectively, highlighting that nearly half of the preschool children are affected by ECC. [7]

In a systematic review and meta-analysis by He et al. (2024), caries patterns among preschool children of the 21st century were assessed. The study found cavitated lesions were common in maxillary incisors and molars in both arches. The most commonly affected teeth were the maxillary central incisors and mandibular second molars, while the least affected were the mandibular lateral incisors. The occlusal surface of mandibular molars was the most frequently affected. The overall caries prevalence was higher in maxillary teeth and tended to be higher in older children. This pattern of ECC was not influenced by socioeconomic status or geographical location. These findings underscore the importance of understanding caries patterns among preschool children for early intervention and management. [8]

Based on the 2019 Global Burden of Disease study, the prevalence of untreated caries of primary teeth in Canadian children 1-9 years was 39% and prevalence of untreated caries of permanent teeth in individuals 5+ years was 25%. [9]

Negative effects from untreated dental caries are common among children and adolescents, often causing acute infection, dental pain, and discomfort. Untreated caries affects children's ability to eat, leading to poor nutrition, growth, and weight gain. It also negatively impacts speech, learning, sleep, appearance, and self-esteem. Tooth pain can affect school attendance, resulting in poorer academic performance. These negative impacts disproportionally affect those from disadvantaged backgrounds. [4] [10]

Various measures are available to help prevent and control dental caries, including fluorides (e.g., water fluoridation, fluoride toothpaste, fluoride varnish, silver diamine fluoride), sugar reduction, optimum oral hygiene, and dental sealants.[2]

Adequate fluoride exposure is a crucial factor to prevent dental caries. Water fluoridation is a key strategy in reducing rates of dental caries. However, implementing fluoride use presents different challenges in low-income and high-income societies. Low-income countries, and sometimes low-income regions in developed countries, lack financial resources to introduce fluoride in drinking water or other products. In the United States, children living in low-income families, but not below the poverty line. are

[2] Refer to Episodes 86 and 87 for additional information on dental caries risk factors and prevention.

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more likely to live in a county with non-fluoridated water. In high-income societies, there is a more widespread opposition to water fluoridation. [11]

Fluoride hesitancy

Fluoride is a mineral naturally present in water, soil, plants, and many foods. The main sources of fluoride intake are drinking water and toothpaste. Fluoride inhibits or reverses the initiation and progression of dental caries. [12]

Although fluoride is safe and helps prevent dental caries in children, growing numbers of parents and caregivers are hesitant about it, increasing refusal rates during children's oral health and medical appointments. The increasing prevalence of fluoride hesitancy has implications for both children's oral health and the oral health practitioners seeking to improve the uptake of evidence-based care to enhance oral health. [13]

One preliminary study reported13% of parents refuse fluoride treatments for their children. Additionally, more parents are fluoride hesitant, meaning they may accept fluoride for their children but have unresolved concerns. Concerns about the necessity and safety are two reasons why some caregivers are hesitant about. [14] [15]

In a qualitative study by Chi et al. (2023), 56 fluoride-hesitant caregivers were interviewed to understand their hesitancy. Six themes were revealed: thinking topical fluoride is unnecessary, wanting to keep chemicals out of their child's body, thinking fluoride is harmful, thinking there is too much uncertainty about fluoride, feeling pressured to get topical fluoride, and feeling fluoride should be a choice. [13]

The reasons for topical fluoride hesitancy and refusal are not fully understood, as topical fluoride hesitancy is complex and multifactorial. One potential explanation is incomplete knowledge about fluoride, which may lead to not only refusing topical fluoride during oral health appointments, but also to avoiding other common fluoride sources including fluoridated water and toothpaste. [16]

Ko and Chi (2022) investigated whether caregivers who were hesitant about professionally applied topical fluoride were also hesitant about other forms of fluoride for their children. The findings showed hesitancy towards professionally applied topical fluoride varnish was significantly associated with hesitancy towards fluoridated water and toothpaste. Caregivers who were hesitant about topical fluoride varnish were more comfortable with fluoridated toothpaste compared to fluoridated water because it is not ingested, and exposure can be controlled. These results emphasize the importance of educating parents and caregivers about the benefits of professionally applied topical fluoride varnish.[3] [17]

Before making healthcare decisions, caregivers often seek information, which could expose them to misinformation and disinformation on the internet. Between 2009 and

[3] Fluoride varnish is relatively thick and sets rapidly, which contributes to its ease of application and adherence to tooth structures. Proper application technique reduces the possibility that a client will swallow varnish during its application and limits the total amount of fluoride swallowed as the varnish wears off the teeth over several hours. [55]

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2017, 60% of mentions on water fluoridation on Twitter were negative, while 15% were positive. Tweets often used words such as “poison” and “waste” to express strong negative sentiments. Furthermore, some caregivers believe fluoride is a neurotoxin that causes lower IQ, autism, cancer, and other diseases. [16] [18]

Vaccine refusal has been associated with topical fluoride refusal. The factors driving vaccine refusal may be similar to those that lead to topical fluoride refusal. Similar to topical fluoride, more parents who are hesitant about vaccines than those who refuse vaccines. Parent attitudes and beliefs about health are important determinants of vaccine hesitancy. The most common belief is that vaccines are unsafe and lead to conditions like autism, which parallel concerns about fluoride. Many parents believe vaccines are no longer necessary. These beliefs are spread through social networks, social media, and anti-vaccine websites. Low health literacy influences the way parents understand and process information about vaccine necessity, safety, and risks. Other factors include religious beliefs, a desire for autonomy, and concerns about the true intent of vaccines (e.g., financial interest of pharmaceutical companies, government conspiracy). These factors have led to a growing number of vaccine-hesitant parents. [14] [16] [19]

Oral health practitioners who indiscriminately recommend fluoride varnish for all children regardless of their dental caries risk may increase fluoride refusal. Recommendations for fluoride should be based on risk, but there is little evidence that this is what actually occurs in practice. There is also increasing scrutiny of overtreatment by oral health practitioners seeking to increase revenue. Some caregivers may be skeptical about oral health practitioners who recommend topical fluoride without explaining why, which can lead to strained communications, loss of trust, and resistance. [13] [14] [20]

Strategies to improve topical fluoride communication
Clinical and community-based strategies to help improve topical fluoride-related communication with parents and caregivers include:

1. **Acknowledge fluoride refusal is a problem**. Some oral health professionals may not recognize there is a significant number of parents concerned about fluoride.

2. **Assess caregivers’ knowledge, beliefs, and attitudes about fluoride**. It is important to screen for these views at the start of the preventive appointments by asking open-ended, nonjudgmental questions that provide an opportunity to start a conversation about fluoride.

3. **Incorporate caries risk into discussions**. Before making recommendations for topical fluoride, explain the child’s caries risk to the parent.[4]

4. **Determine why the caregiver refuses fluoride.** Avoid pro-fluoride sales pitches for caregivers who refuse topical fluoride treatment. Rather, ask open-ended, respectful

[4] A case-control study by Almatkyzy et al. (2024) found parents of children with a history of dental caries were less likely to refuse topical fluoride treatment, suggesting untreated dental caries may motivate parents to accept preventive treatments such as fluoride. [58]

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questions about the reasons that motivated their decision to decline fluoride, such as "I respect your decision. Can you tell me some of the reasons that helped you to reach the decision to skip fluoride for your child today?" Listening without interrupting is key to help build trust with fluoride-hesitant caregivers.

5. **Tailor explanations on topical fluoride importance based on the child's risk factors**. For instance, pointing out white spot lesions on the child's teeth to the caregiver, with a description on how fluoride helps to prevent white spots from turning into cavities that require fillings.

6. **If fluoride refusal continues, discuss alternative fluoride sources and strategies.** Some caregivers who refuse fluoride during visits may be open to using at-home fluoride products, so it is important to discuss alternative fluoride sources (e.g., fluoridated toothpastes and mouthrinses[5]). Twice-daily brushing with fluoride toothpastes should be stressed. For caregivers who avoid all fluoride-containing products, then guidance should include strategies to reduce dietary sugars and acids, improve oral hygiene, etc.

7. **Maintain open communication**. Some caregivers need to engage in multiple discussions over time before reconsidering their fluoride decision. Trust is an important aspect of caregiver decision making. Building trust involves continuity of care and reassurance the oral health practitioner respects their healthcare decisions. Asking caregivers for permission to discuss fluoride at future appointments is one way to maintain open communication. It is important to document conversations with caregivers so that future interactions can be framed appropriately without repeating information and highly sensitive topics can be avoided.

8. **Some caregivers will continue to refuse fluoride.** Despite repeated attempts at behaviour modification, some caregivers will continue to refuse fluoride. It is important to maintain open communication with caregivers, monitor the child's caries risk, and incorporate findings from risk assessments into caregiver guidance. Some children whose parents refuse fluoride may start as high-risk but may become low-risk over time (e.g., secondary to dietary or self-care modification). In these cases, acknowledge the improvements and the decrease in caries risk. Explain that professional fluoride treatments may not be needed as long as healthy behaviours and low caries risk status are maintained.

9. **Communicate with local health professionals to reinforce the importance of fluoride.** During discussions with parents who refuse fluoride, oral health practitioners may learn about health providers in the community who are misinforming parents about fluorides. Some health providers believe caries rates have reached such low levels that fluorides are no longer necessary.

10. **Engage in public health advocacy**. It is important to educate the public about the importance of fluoride, especially community water fluoridation. Many individuals are

[5] Refer to Episode 103 for additional information on mouthrinses.

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not aware that dental caries continues to be the most common disease in children and adults. Public advocacy can take place in the form of community outreach events and education aimed at city council members and provincial lawmakers. [14]

Fluoride varnish

Fluoride varnish can help prevent and arrest carious lesions. It is a clear liquid typically containing 1-5% fluoride that is applied topically and stays on teeth for several hours. Depending on the manufacturer, fluoride varnish comes in a variety of flavours in either unit doses or multidose containers enabling the clinician to dispense the amount required. [21]

There are many benefits to using fluoride varnish including it is safe, simple to use, and cost-effective. A Cochrane review (2013) found fluoride varnishes application two to four times a year, either in the permanent or primary dentition, was associated with a substantial reduction in dental caries. [21] [22]

Fluoride varnishes have been advocated for preventing ECC. A 2024 double-blinded, randomized controlled trial compared the effectiveness of two 5% sodium fluoride varnishes containing casein phosphopeptide amorphous calcium phosphate or tricalcium phosphate to conventional 5% sodium fluoride varnish in preventing ECC in 582 children aged 3 to 4 years at high-risk for ECC. All varnishes demonstrated similar preventive effectiveness over the two-year period. [23]

Sugar substitutes in caries prevention

Controlling carbohydrate intake is important to prevent dental caries. Excessive sugar consumption is increasingly common, posing a significant risk to general and oral health by contribute to the development of diseases such as diabetes and dental caries.

Sugar substitutes provide an alternative to traditional sugar. Sugar substitutes are typically classified as low-intensity sweeteners (e.g., xylitol, sorbitol, erythritol) and high-intensity sweeteners (e.g., saccharin, aspartame, acesulfame potassium, sucralose, neotame, advantame). Low-intensity sweeteners provide a sweet taste with fewer calories than sugar. High-intensity sweeteners are sweeter than sugar and require smaller amounts to achieve the same level of sweetness.

A systematic review and meta-analysis by Luo et al. (2024) examined the effect of sugar substitute consumption on caries prevention in permanent teeth of children and adolescents. Results indicated consuming xylitol or sorbitol is potentially effective in preventing dental caries in permanent teeth of children and adolescents. Currently, no clinical evidence available on the role of high-intensity sweeteners in dental caries prevention. [24]

A systematic review by Pienihäkkinen et al. (2024) assessed the dental caries-preventive effects of xylitol chewing gums and candies in children. The review evaluated randomized controlled clinical trials and controlled clinical trials published between 1974-2022 that investigated the efficacy of xylitol-containing chewing gums and candies in preventing dental caries in children aged ≤18 years.

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The findings suggest adding xylitol chewing gum to the daily diet of children at high or moderate caries levels has a dental caries reducing effect. The surface-specific analyses suggest xylitol gum[6] use could offer the most benefit in children with active incipient caries lesions detected on the buccal or lingual surfaces of teeth. A caries-reducing effect could not be demonstrated for xylitol candies, but more research is needed on this topic, especially in high-caries risk children. The authors highlight that xylitol is one component in caries prevention, and should be used in conjunction with dietary changes (e.g., reduced sugar intake) and fluoride toothpaste in those at risk of dental caries. [25]

Childhood caries and midlife health and aging

A higher caries experience in childhood has been associated with poorer oral health and self-reported general health by midlife. A recent life course study assessed whether childhood caries is associated with poor health and a faster pace of aging by midlife. Findings showed a higher caries experience at five years of age was associated with metabolic abnormalities by age 45, including obesity and high serum leptin[7] levels. Individuals with a high caries experience at five years old were aging faster by age 45 than those who had been caries-free (i.e., 0.1 years of physiological change per chronological year faster). Oral health is essential for well-being. Poor oral health can be an early signal of a trajectory toward poor health in adulthood. [26]

Bullying and dental caries

Adverse childhood experiences (ACEs) are potentially traumatic events that occur before 18 years of age and can include physical abuse, sexual abuse, emotional abuse, neglect, household dysfunction, and bullying. Studies have consistently shown ACEs are associated with health risk behaviours and poor health, including unfavourable oral health behaviour and poor oral health.

A cross-sectional study by Myran et al. (2023) found adolescents exposed to physical abuse, sexual abuse by peers, parental separation or divorce, bullying, or who had witnessed violence were more likely to report not brushing their teeth daily compared with those with no ACE exposure. For each additional ACE exposure, there was a 30% higher likelihood of not brushing their teeth daily. Similarly, experiencing more ACEs

[6] Facial fitness gum is gaining popularity on social media, particularly among teenage boys, as manufacturers claim it can help define jawlines and tone facial muscles. However, scientific evidence is lacking to support these claims, emphasizing that significant changes in facial aesthetics usually require more than just chewing gum. The concept behind facial fitness gum is that repetitive chewing motions strengthen the jaw and facial muscles, particularly the masseter muscles, potentially creating a more chiselled appearance. Because facial fitness gum is more difficult to chew than regular gum, the manufacturers have likened the gum to a facial workout. However, research supporting this is limited and inconclusive. Most scientific studies on chewing gum focus on benefits such as improved concentration, stress relief, and oral health rather than its impact on facial aesthetics. The primary reason chewing gum is unlikely to define the jawline is that facial aesthetics are influenced by a combination of bone structure, skin quality, and fat distribution, not just muscle tone. Although chewing gum does not often cause issues in the jaw, excessive chewing can lead to inflammation and jaw pain. Also, some facial fitness gum varieties may contain caffeine and vitamin B5, which can be a laxative in higher doses. Oral health practitioners need to be aware of these social media trends to help combat misinformation. [56] [57] [58]

[7] Leptin, an adipocyte-secreted hormone, regulates appetite and promotes energy expenditure. Hyperleptinemia is positively associated with central obesity and insulin resistance.

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was associated with higher dentin and enamel caries. The impact of ACEs on dentin caries was influenced by age with dentin caries experience being more predominant in the 16-17-year-old group than among the 13-15-year-olds. Furthermore, bullying was associated with a higher likelihood of not brushing teeth daily and increased dentin caries experience among 16-17-year-olds. [27]

Periodontal disease

There are three main categories of periodontal diseases and conditions based on the 2017 American Academy of Periodontology (AAP) classification:[8]

Periodontal health, gingival diseases/conditions

- Periodontal health and gingival health
- Gingivitis, dental plaque biofilm-induced
- Gingival diseases, non-dental plaque biofilm-induced

Periodontitis

- Necrotizing periodontal diseases
- Periodontitis
- Periodontitis as a manifestation of systemic disease

Other conditions affecting the periodontium

- Systemic diseases or conditions affecting the periodontal supporting tissues
- Periodontal abscesses and endodontic-periodontal lesions
- Mucogingival deformities and conditions
- Traumatic occlusal forces
- Tooth and prosthesis related factors [28]

The most frequent form of periodontal diseases in children and adolescents is plaque-induced gingivitis, a preventable and reversible condition. Gingivitis occurs in half of this population by age of four or five years and peaks nearly to 100% at puberty. The prevalence of gingivitis can be similar to or greater than dental caries during childhood. Periodontitis is less common within this population. However, gingivitis can progress to the initial stages of periodontitis in adolescents. The use of e-cigarettes[9] and the rise in childhood obesity rates are factors which may lead to increases in periodontal problems in the pediatric population. [29] [30] [31] [32]

Most periodontal disease in children and adolescents is not severe. However, there is a subgroup of children who are susceptible to more severe, destructive forms of periodontal disease, which can have various consequences during childhood,

[8] Refer to Episodes 49 and 50 for more information on the AAP classification of periodontal diseases. **PERIObrain** is a user-friendly app, designed to assist oral health professionals in effectively using the 2017 AAP/EFP classification of periodontal and peri-implant diseases and conditions for clients ≥16 years. The app was created by alumnus of the European Federation of Periodontology (EFP) and is currently available on the AppStore and Google Play Store as a free download.
AppStore: https://apps.apple.com/gb/app/perio-brain/id1567282977
Google Play Store: https://play.google.com/store/apps/details?id=com.sho_me.perio&hl=en_CA

[9] Refer to Episodes 19 and 101 for additional information on e-cigarettes and vaping.

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adolescence, and into adulthood, such as tooth loss, pain, halitosis, and loss of aesthetics and function. [29] [33]

Early recognition and diagnosis of gingival and periodontal diseases in children and adolescents is vital to help ensure successful treatment. Thus, a periodontal examination and risk assessment are important parts of comprehensive and periodic oral examinations of pediatric clients. Prevention and management strategies include effective oral self-care practices in childhood and adolescence to facilitate a healthy periodontium into older ages. [34]

Periodontal health

Pristine periodontal health is no attachment loss, no bleeding on probing, no sulcular probing >3 mm, normal bone heights, and no redness, edema, or suppuration (pus). Gingival health is defined as <10% bleeding sites with probing depths ≤3 mm on an intact periodontium or a reduced and stable periodontium. [35] [36]

Periodontal probing

Bleeding on probing remains the best tool to monitor gingival health or gingival inflammation. Even at a few sites, bleeding on probing in primary teeth during early childhood indicates a high susceptibility to periodontal diseases. Documenting bleeding on probing helps establish a baseline and detect early signs of periodontal disease to initiate treatment to prevent disease progression. Probing may begin after the first permanent molars and incisors have fully erupted (approximately age 7) and if tolerated by the child. The probing force should be light and not exceed 0.25 Newton to not cause bleeding from excessive pressure or trauma. [29] [33]

In children with a healthy gingival and periodontal status, the gingival margin is several millimetres coronal to the cementoenamel junction (CEJ). The gingival sulcus may be 0.5 to 3 mm deep on a fully erupted tooth. [33]

Pseudopockets (i.e., >3 mm) may be present around partially and newly erupted teeth. Probing before the eruption of the first permanent molars and incisors may be necessary when clinical or radiographic signs indicate periodontal tissue damage. [29] [34]

Dental radiographs

Dental radiographs of children should be analyzed for interproximal caries lesions, alveolar bone loss, developmental anomalies, and other pathologies. Good quality bitewing radiographs are necessary to diagnose alveolar bone loss. Alveolar bone loss in the primary dentition indicates increased susceptibility to periodontal disease and further bone loss. [29] [34] [35]

For the primary dentition, 1.0 ± 0.5 mm distance from the most coronal portion of the alveolar bone crest to the CEJ is considered a normal alveolar bone height, while a distance of more than 2 mm may represent bone loss. A distance of more than 2.0 mm may be considered normal when the bone is adjacent to exfoliating primary teeth or erupting permanent teeth.

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For the permanent dentition, 2.0 mm distance (on average, varying between 1.0 ± 3.0 mm) from the most coronal portion of the alveolar bone crest to the CEJ is considered a normal alveolar bone height. [34]

It is not recommended to use tooth mobility as a sign of periodontal health or periodontal. [29] [35]

Gingival diseases
There are two broad categories of gingival disease: dental plaque-induced gingivitis and non-plaque-induced gingival disease. [29]

Dental plaque-induced gingivitis
Plaque biofilm-induced gingivitis can occur at any age, from early childhood through adolescence and beyond. Studies show there is a low prevalence of gingivitis during preschool age, with prevalence gradually increasing and reaching a peak around puberty. This increase may be due to changes in the bacterial composition of dental plaque, the inflammatory cell response, and hormonal changes. [33]

The common features of plaque-induced gingivitis include:
- Clinical signs of inflammation confined to the gingiva, which does not extend to the periodontal attachment (cementum, periodontal ligament, and alveolar bone);
- Inflammation results from interactions between the dental plaque biofilm and the host's immune-inflammatory response; and
- Inflammation is reversible by biofilm removal. [29] [36]

Clinical signs of gingivitis include swelling (loss of knife-edged gingival margin, blunting of papillae), redness, and bleeding and discomfort on gentle probing. Clients may report bleeding gums, metallic or altered taste, pain or soreness, halitosis, difficulty eating, and swollen red gums. Diagnosis of gingivitis is based on clinical features. Radiographs and attachment levels are not used to diagnose gingivitis. [29] [36]

Although there are no objective clinical criteria for defining gingivitis severity, the extent of gingivitis (referred to as mild, moderate, and severe) can be a useful client communication tool. The definitions of mild, moderate, and severe gingivitis continue to be a matter of professional opinion. [29] [36]

For example, gingivitis may be defined as percentages of bleeding on probing sites:
- Mild = <10%
- Moderate = 10-30%
- Severe = >30%

The extent or number of gingival sites with gingival inflammation can be described as:
- Localized (< 30 percent of the teeth are affected); or
- Generalized (≥ 30 percent of the teeth are affected) [29] [36]

Plaque-induced gingivitis can be influenced by local (predisposing) and systemic (modifying) factors. Local oral factors that exacerbate plaque-induced gingivitis are

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those that can influence the initiation or progression of gingival inflammation by facilitating bacterial plaque accumulation, inhibiting daily plaque removal, or encouraging plaque accumulation, such as poorly contoured restorations and oral dryness from hyposalivation. [29]

Systemic risk factors can modify the host immune inflammatory response in the presence of dental plaque biofilm causing an exaggerated inflammatory response. Systemic risk factors include:

- Sex steroid hormones (e.g., puberty, pregnancy, menstrual cycle, oral contraceptives)
- Hyperglycemia
- Leukemia
- Malnutrition
- Tobacco use
- Pharmacologic agents [29] [37]

Sex steroid hormones

Elevations in sex steroid hormones, especially during puberty, may modify the gingival inflammatory response resulting in exaggerated gingival inflammation even with relatively small amounts of plaque present. Other factors that predispose to gingivitis in both female and male adolescents include dental caries, mouth breathing, dental crowding, and tooth eruption. [29]

The current lower-dosage formulations of oral contraceptives are not linked to an exaggerated gingival inflammatory response to plaque, as was previously seen with first-generation high-dose oral contraceptives. Although minor gingival inflammation changes have been noted during ovulation, most females with gingival inflammation associated with menstrual cycles will show no detectable clinical signs of the condition. [29]

The incidence of chronic gingivitis and the risk of periodontitis are higher among children with poorly controlled type 1 diabetes. The severity of gingival inflammation may be more linked to the level of glycemic control than to the quality of plaque control. Therefore, it is crucial to diagnose and prevent periodontal issues among children and adolescents with diabetes through regular periodontal screenings.[10] [29]

Certain hematologic malignancies, such as leukemia, are associated with signs of excess gingival inflammation inconsistent with the level of plaque biofilm accumulation. Leukemia is the most commonly diagnosed cancer in children in Canada. Oral manifestations of leukemia include gingival bleeding and enlargement, petechiae, oral ulcerations and infections, and cervical lymphadenopathy. Gingival bleeding is the initial oral sign and symptom of leukemia. Signs of gingival inflammation include swollen, glazed, and red to deep purple spongy tissues. Local irritants can exacerbate the gingival response but are not necessary for the oral lesions to form. It is crucial to

[10] Refer to Episodes 91, 93, and 94 for detailed discussion on diabetes and oral health.

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recognize oral signs of leukemia early and refer to appropriate medical providers for timely treatment to increase chances of improved treatment outcomes.[11] [29] [37] [38]

Nutrition

The literature lacks information about the specific role of nutrition in the development and progression of periodontal diseases. However, the role of vitamin C (ascorbic acid) in supporting periodontal tissues is well-documented, as it plays an essential role in collagen synthesis. Nevertheless, gingival inflammation due to vitamin C deficiency may be difficult to detect and indistinguishable from plaque-induced gingivitis. Scurvy may occur in certain pediatric populations, such as infants and children from low socioeconomic families. [29] [37]

Tobacco use

Smoking is a significant risk factor for periodontitis, primarily from changes in the microflora and host response. Smoking and smokeless tobacco use are often initiated and established in adolescence. The most common tobacco products used by middle and high school students include e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, and bidis (unfiltered cigarettes from India).[12] In 2022, the prevalence of cigarette smoking among Canadian youth aged 15-19 was 4.2%. [29] [39]

Tobacco smoking can mask underlying gingivitis as inhaled smoke causes vasoconstriction of the periodontal tissues and gingival fibrosis. Clinical signs associated with smokeless tobacco may include increased gingival recession and attachment loss, particularly at the sites adjacent to mucosal lesions associated with the habit. [29] [36]

Canadian youth (aged 15-24) have one of the highest rates of cannabis use[13] worldwide with prevalence rates that are almost double that of adults. Recent Canadian data indicate 43% of youth aged 16-19, and 48% of youth aged 20-24, report past year cannabis use versus 23% of adults over the age of 25. Frequent cannabis use is associated with deeper probing depths, more clinical attachment loss, and increased risk of severe periodontitis. [29] [40] [41]

Oral health practitioners who treat adolescents and young adults should be aware of the signs of tobacco and cannabis use[14] and be able to provide counselling (or referral to an appropriate provider) to encourage cessation.[15] [29]

[11] Refer to Episode 60 for additional information on leukemia.
[12] Refer to Episode 101 for discussion on the various types of tobacco products.
[13] Refer to Episodes 58 and 105 for discussion on cannabis and oral health.
[14] A large multicentre cohort study by Gallagher et al. (2024) showed excessive use of cannabis was associated with a higher risk of head and neck cancer. The finding indicated adults with cannabis dependence, known as cannabis use disorder, are 3.5 to 5 times more likely to develop head and neck cancer than those who do not use the substance.
[15] Refer to Episode 101 for more information on tobacco cessation.

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Pharmacological agents

Pharmacological agents (prescription, nonprescription, and unregulated drugs) can increase susceptibility to gingivitis. This may include drugs that reduce salivary flow[16] or induce gingival enlargement and pseudo-pocketing. [29] [36]

Drugs that influence gingival enlargement[17] include:

- Anticonvulsants (e.g., phenytoin, sodium valproate),
- Calcium channel blockers (e.g., verapamil, nifedipine, diltiazem, amlodipine, felodipine)
- Immunosuppressants (e.g., cyclosporine) [34] [37]

In most cases, gingival enlargement results from a combination of the drug (fibrotic aspect) and plaque biofilm accumulation (inflammatory aspect). Treatment options may include:

- Medication discontinuation or change
- Biofilm control through oral self-care, use of antimicrobial agents (e.g., chlorhexidine), frequent professional scaling, removal of plaque-retentive areas (e.g., faulty restorations)
- Surgical removal of enlarged gingiva [34] [37]

Non-plaque-induced gingival diseases

Non-plaque-induced gingival lesions are often manifestations of systemic conditions or medical disorders. They may also represent pathologic changes confined to the gingiva. These gingival lesions are not caused by plaque and usually do not resolve after plaque removal. However, the severity these lesions often depends on plaque accumulation and subsequent gingival inflammation. [29] [42]

The classification of non-plaque-induced gingival conditions is based on the etiology of the lesions. These include genetic/developmental disorders; specific infections (e.g., bacterial, viral, fungal); inflammatory and immune conditions and lesions; reactive processes; neoplasms; endocrine, nutritional and metabolic diseases; traumatic lesions; and gingival pigmentation. [42]

Viral infections that may occur in the pediatric population may include:

- Hand-foot-and-mouth disease, which causes small vesicles that rupture leaving fibrinous coated ulcers. Lesions are primarily seen in children and are mainly caused by coxsackie viruses A6, A10, and A16.
- Primary herpetic gingivostomatitis, which causes severe manifestations including painful gingivitis, ulcerations, edema, and stomatitis. Lesions typically occur in early childhood and are primarily caused by herpes simplex virus type 1
- Chicken pox (varicella), which causes small yellowish vesicles which rapidly rupture. Lesion mainly occur in children and are caused by the varicella-zoster virus[18] [42]

[16] Refer to Episode 62 for types of medications that reduce salivary flow.
[17] Drug-influenced gingival enlargements have been associated with:
[18] Note chicken pox is a vaccine-preventable disease.

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Types of traumatic lesions that may occur in the pediatric population include:
- Physical/mechanical insults (e.g., self-inflicted trauma)
- Chemical (toxic) insults, which may cause surface sloughing or ulceration (e.g., toothpaste detergents, dental acid etch, silver diamine fluoride solution)
- Thermal insults (burns to the mucosa) [42]

Self-inflicted gingival injuries in children and adolescents can occur as a result of accidental trauma, premeditated infliction, aggressive toothbrushing, or chronic habits such as gingiva picking or scratching, fingernail biting, digit sucking, or sucking on objects such as pens, pencils or pacifiers. [42] [43] [44]

Periodontitis

The key features of periodontitis are:
- Loss of attachment of the periodontal connective tissues to cementum,
- Apical migration of the junctional epithelium beyond the cementoenamel junction to form a periodontal pocket, and
- Alveolar bone loss. [33]

There are three distinct forms of periodontitis, all of which can affect children and adolescents:
- Periodontitis
- Necrotizing periodontal diseases
- Periodontitis as a manifestation of systemic conditions [28] [34]

Periodontitis

Periodontitis in the pediatric population is frequently caused by local factors including plaque, calculus, dental anomalies, and orthodontic devices, or systemic factors, such as systemic diseases. [33]

A substantial proportion of adolescents may begin to manifest loss of attachment of 1 mm or more, consistent with initial stages of periodontitis. Sites with clinical attachment loss of 1 mm or more generally had probing depths of at least 4 mm, indicating formation of true periodontal pockets. Serial bitewing radiographs have been used to measure small changes in crestal bone over 18 months in adolescents and it has been suggested that clinical attachment loss of 1 mm or more precedes these changes. [33]

Evidence from retrospective studies has shown radiographic bone loss around the primary dentition in some children reinforcing the concept that periodontitis can develop at an early age. [33]

It is important to note the potential for pseudo-pocketing of partially erupted teeth in the mixed dentition. Therefore, when determining a diagnosis of periodontitis it is necessary to determine whether there is clinical attachment loss, true periodontal pocket formation of 4 mm or more where the base of the pocket is apical to the cementoenamel junction, and alveolar bone loss. [33]

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Orthodontic movement of the teeth outside the alveolar process may cause problems such as gingival recession, root resorption, dehiscence and fenestration, and reduction of buccal bone thickness and alveolar crest levels. [33]

Diagnosis of periodontitis involves staging and grading the disease. Staging considers the severity and extent of disease while grading assesses the future risk of periodontitis progression and anticipated treatment outcomes. Grading also incorporates individual client risk factors into the diagnosis. [28] [34] [45]

Stage I to IV is based on severity (primarily periodontal breakdown with reference to root length and periodontitis-associated tooth loss), complexity of management (pocket depth, infrabony defects, furcation involvement, tooth hypermobility, masticatory dysfunction), and additionally described as extent (localized or generalized).

Grade estimates the progression rate in three categories: slow, moderate, and rapid progression (Grade A, B, C). [45]

Necrotizing periodontal diseases

Necrotizing periodontal diseases are painful and infectious conditions diagnosed primarily based on its typical clinical features, which includes interdental papilla necrosis, gingival bleeding, pseudomembrane formation, halitosis, lymphadenopathy, fever, and sialorrhea. They are strongly associated impaired host immune response. Necrotizing periodontal diseases can occur in children and adolescents. In children, pain and halitosis are observed less frequently, whereas fever, lymphadenopathy, and sialorrhea (hypersalivation) are more frequent. [29] [46] [47]

Forms of necrotizing periodontal diseases include necrotizing gingivitis, necrotizing periodontitis, necrotizing stomatitis, and noma. [47]

Children and adolescents are at increased risk of developing periodontal diseases during orthodontic treatment. Orthodontic appliances may retain plaque, increasing the risk of necrotizing gingivitis. Adolescents experiencing stress (e.g., during school examinations) or who smoke are at increased risk. Smoking is a known risk factor for necrotizing gingivitis and periodontal diseases in general. Psychological stresses can alter immune response and behaviours (e.g., reduced oral self-care, unhealthy eating), which can contribute to necrotizing periodontal disease development. [46] [48]

Management of necrotizing gingivitis includes debriding plaque and calculus, addressing risk factors, providing tailored oral hygiene and dietary advice, and possibly prescribing antimicrobial therapies. Follow up appointments after treatment are necessary to ensure disease resolution. [48]

Higher risk of necrotizing gingivitis is observed in children with severe malnutrition, living in extreme living conditions (e.g., substandard accommodations, limited access to potable water, poor sanitary disposal system), poor oral health and infected with severe viral infections (e.g., HIV/AIDS, measles, chicken pox, malaria). In these children,

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necrotizing gingivitis can rapidly progress to noma, a life-threatening condition that destroys the soft and hard tissues of the mouth and skin of the face. [29] [46] [49]

Periodontitis as manifestations of systemic conditions
Several systemic disorders and conditions, such as diabetes, connective tissue disorders, and immunological disorders, along with certain medications, can affect the progression of periodontal diseases or negatively impact the periodontium independent of dental biofilm-induced inflammation. In some cases, periodontal problems may be the first signs of the disease. Systemic diseases and medications should be considered when diagnosing and planning treatment. Classification of these conditions is based on the primary systemic disease. Consultation with the client's medical provider may be necessary when managing clients at-risk. [29] [34] [50]

Diabetes can affect younger age groups, mainly type 1, but a small proportion have type 2 diabetes. Diabetes is an important modifying factor of periodontitis, and should be included in a clinical diagnosis of periodontitis as a descriptor. According to the AAP classification of periodontitis, the level of glycemic control in diabetes (measured by HbA1c) influences the grading of periodontitis (i.e., a grade modifier).[19] [33] [50]

	Grade modifier [45]
	HbA1c
Grade A	No diabetes diagnosis
Grade B	HbA1c <7%
Grade C	HbA1c ≥7%

Research shows periodontitis may be an early sign of type 2 diabetes and may serve as a valuable risk indicator for screening diabetes in oral healthcare. [51] [52]

Tobacco smoking is a well-documented risk factor for periodontitis and should be incorporated in the risk factor assessment when grading periodontitis in the younger age groups. For example, when grading periodontitis, smoking <10 cigarettes per day will automatically modify the grade to B and smoking ≥10 cigarettes per day will modify the grade to C. [33] [45] [50]

<u>Other conditions affecting the periodontium</u>
Other conditions affecting the periodontium include conditions such as periodontal abscesses and endodontic-periodontal lesions.

Periodontal abscesses
Periodontal abscesses are defined as acute lesions characterized by localized accumulation of pus within the gingival wall of the periodontal pocket, initiated by either bacterial invasion or foreign body impaction. Signs and symptoms may include pain,

[19] HbA1c or glycated hemoglobin A1c is an important indicator of long-term glycemic control measured via a blood test. It indicates the average level of blood glucose levels over the past 2 to 3 months.

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tenderness, and swelling of the gingiva, bleeding and suppuration on probing, deep periodontal pocket, bone loss observed radiographically, and increased tooth mobility. The most prominent sign during the oral examination is usually presence of an ovoid elevation in the gingiva along the lateral part of the root. [29] [46]

Pediatric clients can experience periodontal abscesses as they can occur in healthy sites from impaction of foreign bodies (e.g., dental floss, orthodontic elastic, popcorn hulls), harmful habits (e.g., nail biting, clenching), inadequate orthodontic forces or cross bite, gingival enlargement, and root surface alterations (e.g., enamel pearls, iatrogenic perforations, vertical root fracture, external root resorption). [29] [47] [46]

Nonsurgical periodontal therapy
Most pediatric clients diagnosed with periodontal disease will be restored to periodontal health with nonsurgical therapy and not require surgical intervention. Nonsurgical therapy includes client and/or caregiver education on good oral self-care; professional scaling, and other therapies such as caries control, replacement of defective restorations, orthodontic tooth movement, and cessation of confounding habits (e.g., tobacco use). [34]

Oral self-care
Good oral hygiene is the primary factor that can prevent the onset of gingivitis (and therefore periodontitis) and is usually obtained with appropriate mechanical procedures to control the bacterial biofilm and an adequate diet. [33]

Periodontal specialist referral
Considerations for a referral to a periodontist may include:
- Periodontal pocket depths greater than 5 mm.
- Extent of the disease (generalized or localized periodontal involvement)
- Presence of short-rooted teeth
- Teeth hypermobility
- Difficulty in scaling and root planing deep pockets and furcations
- Lack of resolution of inflammation after thorough plaque biofilm removal and excellent scaling and root planing
- Systemic diseases and other conditions that compromise the host response
- Drug-influenced gingival enlargements requiring surgical interventions
- Age of the client. Younger clients (systemically healthy or compromised health) with extensive clinical attachment loss are more likely to have aggressive forms of periodontitis (e.g., Stage II, III or IV, Grade C)
- Early loss of primary teeth and bone loss visible on posterior bitewing radiographs, which are indicators of aggressive forms of periodontitis [34]

Take home messages
- Dental caries are a multifactorial chronic noncommunicable disease that affects all ages worldwide and are the single most common chronic childhood disease.
- Adequate exposure to fluoride is crucial to prevent dental caries.

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- Maintaining open communication with parents and caregivers who are fluoride hesitant or resistant will help them make optimal preventive oral care decisions for their children.
- Pediatric clients should receive a periodontal assessment as part of their routine oral health visits. Early diagnosis of periodontal diseases helps ensure successful treatment by reducing etiological factors, establishing appropriate therapeutic and homecare measures, and developing effective periodic maintenance schedules.
- It is essential that oral health practitioners are able to identify children and adolescents with initial periodontitis who can be treated in a general oral health practice (typically Stage I, Grade A) and those who would benefit from a referral to a periodontist (typically as Stage II, III or IV, Grade B or C) to help ensure comprehensive treatment.

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Client Resources

Canadian Dental Care Plan (CDCP)
Applications open for children under the age of 18
Learn more about the Canadian Dental Care Plan.

Oral Health for Children – A Parent's Guide, ODHA factsheet
https://odha.on.ca/wp-content/uploads/2016/08/ODHA-Factsheet-children.VFS23.2-2.pdf

Pit and Fissure Sealants
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- AppStore: https://apps.apple.com/gb/app/perio-brain/id1567282977
- Google Play Store: https://play.google.com/store/apps/details?id=com.sho_me.perio&hl=en_CA

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