

A String around Your Finger: Do We Really Need to Floss?



2
CE CREDIT HOURS

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Introduction – Hidden Sugars

A String around Your Finger: Do We Really Need to Floss? will review current literature on the effectiveness of flossing and other interdental cleaning in the age of “Flossgate,” the August 2016 assertion in the Associated Press that there is scanty research supporting flossing as a method to improve oral health outcomes. This course will look at the 2011 Cochrane systematic review upon which the government based its decision to omit the recommendation to floss from the 2015-2020 Dietary Guidelines for Americans as well as the broader literature and scientific rationale behind flossing and interdental cleaning. Finally, this course will evaluate the current best evidence for oral hygiene methods to prevent caries and periodontal disease.

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Overview

Controversies about the utility of flossing were thrust into the spotlight in 2016 in a controversy known amongst dental professionals as “Flossgate. As a part of the update to the 2015-2020 Dietary Guidelines for Americans, the federal government omitted a recommendation for flossing previously included in the guidelines in 2000, 2005, and 2015.¹ Citing the reasons for the omission, the Dietary Guideline Advisory Committee (DGAC) stated they focused on food and nutrient intake (e.g., added sugar) and cited the 2011 Cochrane systematic review,² which concluded there is currently a lack of strong evidence to support the use of floss as a preventative measure for caries and periodontal diseases, although the systematic review does acknowledge evidence that flossing results in a reduction in gingival inflammation and interdental plaque. The Surgeon General, Centers for Disease Control (CDC), the Department of Health and Human Services, and other federal and state health agencies continue to publish materials

that support the importance of flossing and interdental cleaning, and that advice is available to the public through the National Institute of Dental and Craniofacial Health (NIDCR),³ CDC’s Division of Oral Health,⁴ and Healthy People 2020.⁵

The appropriateness of floss as an interdental cleaning aid for all individuals was further questioned with the release of the European Federation of Periodontology’s (EFP) statement regarding flossing efficacy in individuals with periodontal diseases. Iain Chapple, PhD, BDS, an EFP spokesperson, stated that the use of floss demonstrates utility in healthy patients without diastema and may prevent the development of periodontal diseases and gingival inflammation, but that in patients with gingivitis or periodontitis, evidence suggests that adjunctive floss use for interdental cleaning is not useful in reversing disease. He stated that interdental brushes are advocated for use in those patients.^{6,7} Dr. Chapple indicated that dental healthcare providers should consider changing our behavior and recommendations based upon the current evidence.^{6,7}

Despite the support of governmental agencies and numerous nonprofit groups, this messaging has created confusion in the lay media and the public with regards to the role of patient-administered oral hygiene for the prevention of oral diseases. Interdental cleaning continues to be an essential part of oral hygiene to maintain a healthy oral environment.⁸ There are 700+ identified species of bacteria and up to 1,500 putative pathologic microorganisms found in dental biofilm.⁹⁻¹¹ Many of these organisms as well as other factors including bacterial nutrients, food debris, molecules that facilitate bacterial adhesion and invasion, and other extrinsic factors in the environment and the body’s own immune response contribute to diseases of the teeth and gingival tissues.^{12,13} Current recommendations from the American Dental Association (ADA) include brushing for two minutes twice daily and cleaning between teeth to maintain a healthy mouth and smile, but these may be tailored to individuals based upon risk factors and their current oral health!¹⁴

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Address questions generated by patients related to media coverage of the omission of flossing recommendations from the 2015-2020 U.S. Dietary Guidelines and other statements in the press about the utility of flossing.
- Apply the current scientific literature about the benefits, if any, of flossing and other interdental cleaning aids in addition to tooth brushing in their practice for patient benefit.
- Discuss with patients the optimal strategies and rationale for oral hygiene, including interdental cleaning.
- Develop home care recommendations that focus on evidence-based strategies for oral health and emphasize individualized patient care recommendations based upon patient needs.
- Discuss the importance of preventive strategies for oral diseases including maintaining good oral hygiene in order to promote oral and overall well-being with a wide range of interdisciplinary colleagues and patients.

Introduction

Dental biofilm contains over 700 species of microbes that include both non-disease and disease-producing organisms. In health, these organisms co-exist in a symbiotic state, however, if a dysbiosis of the oral microbiome occurs, the pathogenic microbes take over and play a role in the initiation of both dental caries and periodontal disease, the two most prevalent oral diseases. As an integral part of the prevention and treatment of caries and periodontal diseases, patients become co-practitioners with their oral health providers and their sustained daily maintenance of oral hygiene becomes critical to the success of professional oral health interventions. However, patient levels of home care vary considerably and are often suboptimal. Despite recommendations from the ADA that individuals brush for two minutes twice daily,¹⁵ the average individual performs 45-70 seconds of toothbrushing daily.¹⁶ Additionally, patient compliance with regular daily use of dental floss has been estimated to be as low as

2%.¹⁷ In a survey from the American Academy of Periodontology (AAP), more than 35% of respondents stated they would rather perform an unpleasant task, like filing their tax return or cleaning their toilet, than floss.¹⁸ This certainly indicates that flossing is considered a chore and not elevated to necessary self-care to prevent oral disease.

Given the public's reticence and/or inability to adequately perform oral hygiene measures and, in particular, to floss regularly,¹⁸ there was a large amount of public interest in August 2016 when the U.S. government released a statement that discussed the rationale for the omission of references to oral hygiene from the 2015-2020 Dietary Guidelines for Americans.¹⁹ The text included in the 2015-2020 Dietary Guidelines for Americans omitted statements that had been included in previous guidelines that advocated for: 1) consumption of fluoridated water, 2) reduction of sugary food and beverage consumption, and 3) tooth brushing and flossing as effective methods to reduce the risk of dental caries.¹ In response to a government Freedom of Information Act (FOIA) request, it was reported by the Associated Press (AP) that the flossing recommendation was excluded due to a lack of definitive scientific evidence stating flossing prevents dental caries.²⁰ The government's rationale cited a 2011 meta-analysis that concluded some scientific evidence currently exists to support interdental cleaning for the prevention and treatment of gingivitis, but more studies may be needed to demonstrate a definitive causative benefit for the prevention of dental caries and periodontitis.²

It is also important to note that the EFP's 11th European Workshop, held in Spain in 2014, also reviewed data on flossing's therapeutic value in patients with periodontal and peri-implant diseases and concluded that floss is optimal for the primary prevention of gingival inflammation. However, in patients who may have established gingivitis and/or periodontitis, the use of interdental brushes, where interproximal space allows for their use without tissue impingement, improve the removal of biofilm and the reduction of interdental gingival inflammation when compared with flossing.^{6,7}

It is understandable that there would be heightened public interest regarding a change in paradigm with regard to oral hygiene recommendations. The EFP statement^{6,7} in combination with the omission of oral health references from the 2015-2020 Dietary Guidelines for Americans for the first time since 1979,¹⁸ have heightened public interest in flossing's utility and alternative interdental cleaning methods. There has also been an increase in technologies that can be used for adjunctive interdental cleaning that are of keen interest to patients and practitioners alike. It is therefore critical for dental healthcare providers to be able to review the current scientific evidence and recent recommendations from government and non-profit groups to make individualized recommendations for their patients, to allow for optimal implementation and compliance for oral self-care in their patients.

Epidemiology and Etiology of Caries and Periodontal Disease in a U.S. Population

Caries

Dental caries result from the breakdown of the hard tissues of the tooth (enamel, dentin, and cementum). This disease is initiated by the acid by-products caused by the bacterial metabolism of simple carbohydrates on a susceptible tooth surface.^{21,22} Overall acidity within the mouth, the buffering capacity of the saliva, the hardness of tooth enamel, and available mineral content for remineralization of the hard tissues influence the rate and severity of the progression of carious lesions.¹² A patient's risk of developing caries is influenced by many factors, including conditions and medications that affect salivary flow, intraoral pH, poor oral hygiene, dietary carbohydrate and acid content, and fluoride availability.¹³

Tooth minerals exposed to the oral environment are constantly undergoing remodeling through a demineralization-remineralization process.²³ As pH within the oral cavity or at a local intraoral site drops, demineralization occurs and as the pH increases, remineralization of those tissues occurs. The net resultant mineral exchange over

relatively longer periods ultimately determines caries development and progression.²³

Given these mechanisms for caries formation, oral healthcare professionals (OHCPs) seek multiple avenues to reduce caries formation and/or to remineralize incipient carious lesions. Fluoride availability within the oral cavity allows for remineralization to incorporate fluoride, forming fluorapatite. The presence of fluorapatite in tooth minerals results in an increase in acid-resistance in the resulting remineralized tooth tissues.²⁴ Fluoride exposure is combined with recommendations to limit exposure to acids and sugar substrate, which can result in acid formation after metabolism. Acid from dietary, intrinsic, and extrinsic sources may decrease pH and facilitate the demineralization process.^{23,24}

To accomplish these goals, current guidelines for optimal oral health and hygiene recommend limiting sugar intake and between-meal snacking to decrease the amount of time that intraoral pH drops below a demineralization threshold.^{14,15} Further, exposure to fluoride in dentifrice (toothpaste) and mouthrinses as well as public health efforts aimed at water fluoridation and fluoride varnish application in elementary school children have been deemed important to reduce caries rates.^{14,15} In fact, community water fluoridation has proven to be one of the most cost-effective methods for reducing overall caries rates in the population with every \$1 spent on water fluoridation returning from \$5-32 in decreased healthcare costs within the community!²⁵

Dental caries is a highly prevalent disease in both children and adults, despite declining rates of both treated and untreated caries since the 1970s. Approximately 13% of US children ages 2-19 years had untreated caries in 2015-2016, and the total incidence of caries (treated and untreated) amongst this group was 48.5%.²⁶ Untreated decay is also highly prevalent among US adults; nearly 32% of US adults ages 20-44 years have untreated caries²⁷ and 92% of dentate adults have decay in a permanent tooth.²⁸ The average adult has 3.28 decayed, missing, or filled teeth and tooth loss

and decay are more prevalent in some groups of individuals, including: children and older adults, individuals with lower socioeconomic status, Hispanic ethnicity, and non-Hispanic blacks.²⁸ Patients' quality of life is negatively affected by poor oral health and high caries and edentulism rates with the impact being significant in both children and adults.²⁹ It has been reported that dental caries result in 5 million restricted activity days, more than 1.6 million days in bed, and more than 1.7 million missed school days in children under 18 years old.³⁰ Additionally, children with poor oral health demonstrated higher levels of dental pain and lower scholastic performance than children with higher levels of oral wellness.^{31,32} It is also well-established that disability due to dental caries is not limited to children. In fact, a recent survey reported that US adults miss more than 243 million hours of work productivity annually due to oral health problems and that such lost productivity results in a loss of \$45 Billion each year.³³ The impact of this lost time and its impact on decreased worker productivity, impacted scholastic achievement, and emotional well-being highlights the critical importance of professional dental care and adequately delivered oral hygiene and home care for the management and prevention of dental caries (Figure 1).

Periodontal Disease

Periodontal diseases include inflammatory diseases of the supporting structures around the teeth, gingiva, periodontal ligament, alveolar bone, and cementum.³⁴ Research shows all individuals are susceptible to gingivitis, a reversible form of gingival inflammation, and may be the precursor to more serious, irreversible forms of periodontal diseases.³⁵ Gingivitis is caused by a dysbiotic dental biofilm and, in general, gingivitis severity is related to the amount and type of bacteria that have accumulated at and around the gingival margins throughout the mouth. Additionally, the oral modifying factors for gingivitis, including local (dental biofilm retentive factors and oral dryness) and systemic factors (smoking, metabolic factors, nutritional factors, pharmacologic agents, sex steroid hormone elevation, and hematologic conditions) are contributing factors.^{7,35,36} Removal of biofilm and local etiologic factors results in the reversal of gingivitis symptoms and reduces local and systemic levels of inflammatory markers in patients with gingivitis.^{7,11,35}

Periodontitis is a chronic multifactorial inflammatory disease of the hard and soft tissues supporting the teeth associated with a dysbiotic dental plaque biofilm. This

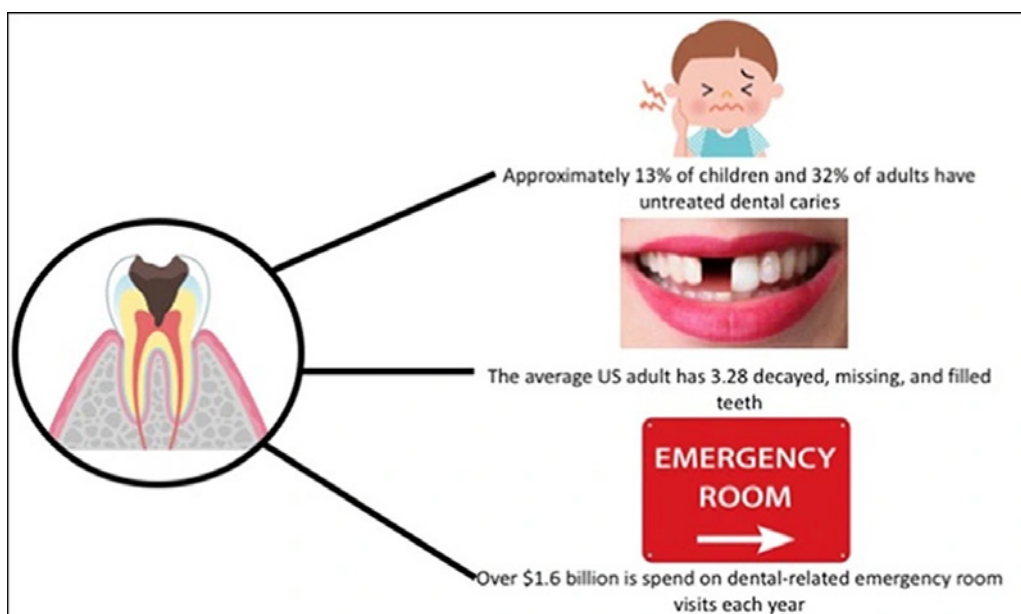


Figure 1. Impact of caries in children and adults.^{26-28,112}

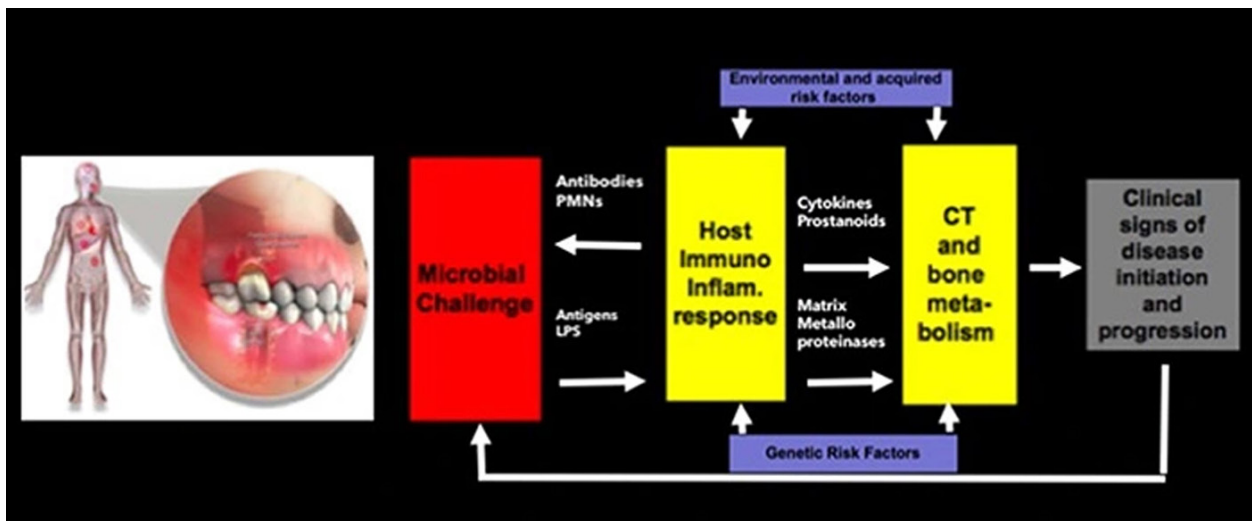


Figure 2. Pathogenesis of periodontitis.³⁶

dysbiotic biofilm then initiates a host immunoinflammatory response that, over time, may result in progressive destruction of the periodontal ligament and alveolar bone if not adequately resolved.^{34,37} Average progression of periodontal disease demonstrates a slow to moderate rate of disease progression with approximately 0.1mm of attachment loss and 0.2 teeth lost annually.³⁸ Groups with fastest and slowest disease progression differed considerably with accelerated attachment loss associated with access to comprehensive dental care as well as local and/or systemic factors.³⁸ In an updated classification system from the American Academy of Periodontology (AAP) and European Federation of Periodontology (EFP), individuals are classified with a Stage and Grade to characterize disease severity and risk of future disease progression.^{37,39} Periodontitis Stage is assigned as I-IV and is assessed by patients' current disease presentation, including attachment, bone, and tooth loss, and the case complexity.^{37,39} Periodontitis Grade is defined as A-C and is based upon risk and evidence of the rapidity of disease progression over time.^{37,39} The prevalence of periodontitis has been estimated to be over 42% of U.S. adults over 30 years of age.⁴⁰ Of those individuals, 7.8% had severe periodontitis and severe periodontitis was most prevalent among adults 65 years or older, Mexican Americans, non-Hispanic blacks, and smokers.⁴⁰ These statistics suggest that the prevalence of periodontitis among US adults is nearly 4-fold greater than that of diabetes

mellitus⁴¹ and over 6-fold greater than that of coronary artery disease.⁴² Periodontitis is extremely prevalent and after initiation by bacteria and bacterial virulence factors, disease progression and tissue destruction occurs through host-mediated inflammatory pathways,³⁶ which may vary based upon genetic and other risk factors.^{43,46} The result is a chronic immune-inflammatory disease that may pose a significant systemic burden for individuals⁴⁷ (Figure 2).

Because both gingivitis and periodontitis are associated with a dysbiosis of microbial biofilm, the removal of bacteria and their food sources from hard and soft tissues in the oral cavity is critical for the prevention, control, and management of periodontal disease.

Is Flossing Necessary?

Oral hygiene recommendations have long included interdental cleaning, particularly flossing as the most commonly employed form of interdental oral hygiene. However, recent guideline changes and further investigation of the literature have created confusion over the utility of flossing—and in fact all forms of interdental cleaning—amongst dental healthcare professionals and the public alike. It is often cited that individuals who floss live, on average, 6.4 years longer than those who do not.⁴⁸ What is not totally clear from the current data is whether individuals who floss also engage in other healthy habits or if flossing

alone can convey such a benefit by reducing risks of periodontitis, tooth decay, and tooth loss. It has been established that in older individuals oral hygiene habits were correlated with longevity.⁴⁹ Toothbrushing at night before bed, using dental floss every day, and visiting the dentist were significant contributing factors for longevity among adults 65 years of age and older, while never flossing increased risk of death by 30%.⁴⁹ Given these findings, fully evaluating the current scientific literature regarding flossing and the prevention and/or decreased disease progression of oral diseases is warranted.

“Flossgate”

The United States’ federal government published an update to the 2015-2020 Dietary Guidelines for Americans omitting their previous recommendation of daily flossing and other references to oral health that had been in place since 1979.¹⁸ The **omitted** paragraphs are as follows:

Drinking fluoridated water and/or using fluoride-containing dental products helps reduce the risk of dental caries. Most bottled water is not fluoridated. With the increase in consumption of bottled water, Americans may not be getting enough fluoride to maintain oral health.

During the time that sugars and starches are in contact with teeth, they also contribute to dental caries. A combined approach of reducing the amount of time sugars and starches are in the mouth, drinking fluoridated water, and brushing and flossing teeth, is the most effective way to reduce dental caries.

In response to this omission, the Associated Press [AP] submitted a Freedom of Information Act [FOIA] request and was told the flossing recommendation was excluded due to a lack of definitive scientific evidence stating flossing prevents dental caries.¹⁹ In the AP’s publication, it is argued that due to the lack of randomized controlled trials demonstrating efficacy in dental caries reduction, flossing should be considered “unnecessary.”¹⁹ It is important to note that lack of scientific evidence is not proof of absence of effect and, as such, the conclusion of this article

may be misinterpreted and hyperbolic. Based upon the underlying scientific discourse, what can reliably be said is that further evidence is necessary to demonstrate flossing’s efficacy for the prevention and/or treatment of caries and periodontitis. Nevertheless, the initial AP headline was repeated manifold in the lay press and garnered significant amounts of attention. It should be noted that there were counterbalances to this initial report. For example, in his response to the AP article, “Flossing and the Art of Scientific Investigation,” the *New York Times’* Jamie Holmes points out the pitfalls of performing the definitive studies on flossing, including securing funding for such studies and the ethical challenges of randomization based upon known benefits of flossing.⁵⁰ *Media publications and sensational headlines often do not comport with the nuances of scientific interpretation* and the coverage of the omission in the Dietary Guidelines for Americans in the lay press resulted in confusion for members of the public. It is therefore important to understand the underlying science and challenge the assumption that flossing should be considered worthless, while continuing to critically evaluate emerging data to provide person-centered dental healthcare.

The Cochrane review meta-analysis, which is cited in the U.S. government’s justification for the omission of oral health and hygiene references in the 2015-2020 Dietary Guidelines for Americans, states that current scientific evidence does not allow for the conclusion that flossing results in decreased rates of caries and periodontitis.² Specifically, the review states, “*There is some evidence from twelve studies that flossing in addition to toothbrushing reduces gingivitis compared to toothbrushing alone. There is weak, very unreliable evidence from 10 studies that flossing plus toothbrushing may be associated with a small reduction in plaque at 1 and 3 months. No studies reported the effectiveness of flossing plus toothbrushing for preventing dental caries.*”² The review also suggests further long-term interventional trials that would allow for conclusive data on the efficacy of flossing.² However, there are several roadblocks to the performance of such studies. First, there are ethical dilemmas in performing a long-term randomized controlled trial where the

intervention would require a lack of flossing for long periods of time and observations about the development of caries or periodontitis, particularly as these are irreversible conditions. Secondly, there are randomized controlled trials that demonstrate flossing and other interdental cleaning methods are effective as an adjunct to toothbrushing in removing plaque, the primary etiology of both dental caries and periodontal disease and in reducing levels of gingival bleeding and inflammation.^{2,51-54} As with the study of many conditions, plaque removal and/or gingival inflammation may be considered intermediate outcomes measures that are correlated to the development of caries and periodontal diseases. Finally, in observational trials, there is evidence, albeit less definitive than in randomized controlled studies, that interdental cleaning frequency is associated with lower rates of dental caries, periodontal disease, and increased overall longevity.⁵⁵⁻⁶⁰

It is widely accepted by a vast array of experts, including the U.S. Surgeon General,⁶⁰ the CDC,⁴ the National Institutes of Health (NIH),³ the ADA,^{8,14,15} the Academy of General Dentistry (AGD),⁵⁹ and the AAP⁶⁰ that interdental cleaning is an essential part of optimal oral hygiene. As dental healthcare providers, an awareness of the impetus for the changes to the Dietary Guidelines for Americans and the overall evidence for the performance of oral hygiene measures is important to convey to our patients so that they can do their part to prevent and treat the two most prevalent oral diseases: dental caries and periodontal disease.

European Federation of Periodontology Statement on Flossing

In 2014, the EFP held its 11th European Workshop and reviewed data on flossing's therapeutic value in patients with periodontal and peri-implant diseases. The findings from this conference stated that for healthy individuals flossing was effective as an adjunct to toothbrushing in preventing the development of gingivitis.^{6,7} They further concluded that while a role continues to exist for floss in the dental patient's home care armamentarium, stronger evidence existed to support the use of interdental brushes in

patients with periodontitis and gingivitis for the removal of plaque and the reduction of interdental gingival inflammation.^{6,7} It is also interesting to note that this group also found that the standard 2 minutes of toothbrushing may be inadequate in individuals with periodontitis and those patients may require longer and more targeted forms of many oral hygiene methods.^{6,7}

Patient Attitudes and Practices Towards Oral Home Care

Patient compliance with overall oral hygiene recommendations has been shown to be fairly low. Only 60.5% of children ages 3-15 report brushing their teeth (or having their teeth brushed) twice daily⁶² and only 51% of adults reported brushing twice daily.⁶³ Furthermore, 23% of Americans have gone two or more days without brushing their teeth in the past year and 37% of adults ages 18 to 24 have gone that long without brushing.⁶³ Even when individuals do brush, they may not be following the recommended time or methods. It has been reported that the average individual performs 45-70 seconds of toothbrushing daily, far below the ADA's recommended two minutes twice daily.¹⁶ Additionally, while the most recommended method of toothbrushing by dental healthcare professionals is the Modified Bass technique,⁶⁴ patients often employ other techniques, notably the scrub brush technique, and distribute the brushing unevenly throughout the mouth, which may lead to decreased efficiency of biofilm removal during toothbrushing.⁶⁵

Interdental cleaning is also not universally employed by individuals. Despite evidence to suggest that daily flossing reduces bacteremias associated with dental biofilm and inflammation,⁶⁶ patient compliance with regular and sustained daily use of dental floss for interdental cleaning has been estimated to be as low as 2%.¹⁷ While nearly all US adults (93%) report that they consider oral health to be very or extremely important to overall health,⁶⁷ reporting of flossing prevalence varies considerably; a 2014 national public opinion poll, the 2014 Delta Dental Oral Health and Well-Being Survey reported that 41% of Americans floss at least once daily, and 20%

never floss.⁶³ And amongst individuals with risk factors for periodontitis, female gender, higher income, and non-smoking status were associated with an increase in daily flossing.⁶⁸ Additionally, individuals report they dislike flossing. In a survey from the AAP, more than 35% of respondents stated they would rather perform an unpleasant task, like filing their tax return or cleaning their toilet, than floss.¹⁸ Due to the low adherence of individuals to flossing recommendations, a critical assessment of oral care recommendations and best practices for interdental cleaning is important for dental healthcare professionals and patients.

Review of Literature Demonstrating the Effectiveness of Oral Hygiene Methods

Oral Home Care Overview

Microbial biofilm begins to form within seconds of thorough debridement of tooth surfaces and owing to the complexity of bacterial biofilms, biofilm associated infections are a challenge

to treat.^{69,70} Well-organized biofilms grow within hours after cessation of oral hygiene measures and biofilm must be completely removed at least every 48 hours in experimental settings to prevent inflammation.⁷¹ Current ADA recommendations^{14,15} for oral hygiene include:

- Toothbrushing for at least 2 minutes twice daily with a fluoride-containing dentifrice.
- Clean between teeth daily
- Eat a balanced diet and limit between-meal snacks.
- Visit your dentist regularly for professional cleanings and oral exams.

Several methods for interdental biofilm removal will be reviewed, along with evidence of their effectiveness. It should be noted that all of the interdental cleaning methods presented here should be combined with effective toothbrushing and are not stand-alone therapies. Because individual patients demonstrate differences in dexterity, motivation, and intraoral anatomy, coaching



Figure 3. Oral Hygiene Recommendations.

provided by dental healthcare providers should seek to evaluate current toothbrushing methods, frequency, and duration and their effectiveness in plaque removal for each patient to allow for delivery of an individualized oral home care plan to optimize oral health and hygiene efforts.

Proper toothbrushing with both manual and power brushes, is effective for plaque removal on tooth surfaces, but may be limited in the removal of interproximal plaque.^{72,73} Toothbrushing duration in periodontally healthy individuals is associated with a significantly greater amount of biofilm removal up to approximately two minutes.⁷⁴ It has also been suggested that for patients with periodontal disease, longer toothbrushing duration may be necessary.⁷ Patients generally brush for significantly less time than the recommended two minutes, even in instances where they are asked to brush for a full 120 seconds.^{75,76} Selection of toothbrushes is important for optimal biofilm removal. While patients' reported perception indicates that harder toothbrush bristles and increased brushing force are more effective, in reality, the use of toothbrushes with softer toothbrush bristles results in superior plaque removal both subgingivally and interproximally due to increased bristle flexibility.^{77,78} Softer toothbrushes also result in less gingival recession and abrasion to oral soft tissues than hard toothbrush bristles.^{77,78} Patients should be counseled that excessive force can cause trauma to hard and soft tissues in the mouth and is not required for optimal biofilm removal.⁷⁶ Finally, regular replacement of toothbrushes improves clinical outcomes. Even normal use over a period of 9 weeks can decrease the efficacy of biofilm removal!⁷⁷

Power toothbrushes are often considered as a part of the oral hygiene armamentarium and can be equally effective as manual toothbrushes when both are used properly.^{79,80} Power brushes with oscillating rotating action have been shown in several systematic reviews, to remove significantly more plaque and reduce gingival bleeding than manual toothbrushes.^{79,80}

Further, long term studies have demonstrated that use of powered toothbrushes were associated with decreased mean whole mouth probing depths and mean clinical attachment loss.⁸¹ The use of powered toothbrushing was also associated 22% less gingival recession and 18% decrease in dental caries incidence over an 11-year study period compared with manual toothbrushes.⁸¹ When comparing oscillating-rotating toothbrushes to manual toothbrushes or powered sonic toothbrushes, patients using oscillating rotating powered brushes demonstrated 7.4-times and 1.8-times increased likelihood of achieving gingival health (<10% bleeding sites), respectively.⁸⁰ Acceptance of powered toothbrushes among patients of all ages has been reported to be high,⁸² and thus recommending a power toothbrush to patients may lead to improved delivery of oral hygiene. Powered toothbrushes have also been shown to improve gingival health and biofilm removal when compared to manual brushes for 1) children and adolescents, 2) children with physical or mental disabilities, 3) hospitalized patients, including elderly adults with caregiver-delivered oral hygiene, and 4) patients with motivation and/or dexterity impairments and 5) patients with fixed orthodontic appliances.⁸³ Novel technologies, including the use of so-called "smart toothbrushes" that employ continuous feedback on brushing technique via a mobile application have also demonstrated increased efficacy in plaque removal, particularly in vulnerable populations, like children.^{84,85}

While no randomized controlled studies demonstrate that toothbrushing itself is effective in caries prevention, observational studies demonstrate that biofilm accumulation is associated with increased rates of caries and proper toothbrushing has been shown to reduce these biofilms and improve gingival health.^{2,56,71,72}

Floss

Dental floss remains an almost universally recommended tool for removing dental plaque from proximal tooth surfaces.⁸⁶ Consistent flossing and toothbrushing has been demonstrated to decrease interproximal plaque and gingival inflammation over

toothbrushing alone.⁷² Additionally, lower caries rates and gingival inflammation are observed in individuals who report frequent flossing when compared with those who do not floss.⁵⁶ In a matched twin cohort, supervised flossing and toothbrushing decreased visible plaque, gingival bleeding, and altered the subgingival flora to reduce the proportions and amounts of bacterial species associated with periodontal disease when compared to toothbrushing alone.^{87,88} Those twins who flossed demonstrated fewer detectable bacterial species associated with both caries and periodontal diseases within the plaque present, including reductions in *T. denticola*, *P. gingivalis*, *T. forsythia*, *P. intermedia*, *A. actinomycetemcomitans*, and *S. mutans*.⁸⁸ Current studies do not exist to confirm if the observed increased biofilm removal and shift towards a less dysbiotic microbial species results in lower caries rates in patients who floss, it is well-established that decreased plaque scores are associated with decreased decayed, missing, and treated (DMT) scores in both adults and children.^{2,89,90}

In patients seeking to prevent gingival inflammation, flossing provides a distinct benefit. Flossing even 2-4 days per week was associated with a modestly lower prevalence of periodontitis.⁹¹ Furthermore, flossing has been associated with decreased bleeding upon probing, including further reductions beyond what is seen with toothbrushing alone.^{92,93} And even when used alone, flossing has been determined to be effective at preventing gingival inflammation and reducing plaque levels.⁹⁴ Interestingly, it is also recommended that flossing or other forms of interdental cleaning be performed prior to toothbrushing for maximal biofilm removal.⁹⁵

Flossing efficacy has demonstrated its adjunctive benefit in reducing gingival inflammation, bleeding upon probing, and plaque/biofilm deposits as an adjunct to toothbrushing, particularly in patients with periodontal health. It should, however, be noted that the evidence to support the use of floss to treat patients with established periodontitis remains equivocal and, for these individuals, where possible, the use of other

interdental cleaning aids may provide additional benefit.^{6,7} Nevertheless, for many patients, flossing is economical, effective when performed correctly, and aids in removal of plaque and food debris interproximally, but there are limitations to its use. At interproximal sites with deep probing depths, diastema, incomplete papillary fill, radicular grooves/concavities floss may not provide adequate plaque removal.⁸³ It is also noted that flossing habits are difficult to establish. It is reported only 8% of teenagers floss daily and the number of all individuals who floss daily may be as low as 2%.^{17,96,97} Increasing patients' willingness to floss and their ability to sustain the habit over time requires motivation and alteration of patient behaviors. This requires the treating dental healthcare professional to employ effective behavior modification techniques and engage in long-term coaching to achieve sustained behavioral changes. In conclusion, while floss is the most widely recommended and used interdental cleaning aid,⁸⁶ it can be difficult to use properly and adherence may be low.^{96,97} In patients for whom flossing results in inadequate plaque/biofilm removal or those who cannot adhere to a flossing regimen, additional interdental cleaning aids may be beneficial.⁹⁸

Interdental Brushes

Interdental brushes remove more biofilm interproximally when compared to floss and have demonstrated similar reductions in interproximal probing depths and gingival bleeding in numerous studies.⁹⁸⁻¹⁰⁰ Interdental brushes may be especially advantageous at root concavities, such as the mesial of the maxillary first premolars, diastema, and areas of incomplete papillary fill. In patients who have received previous periodontal care interdental brushes have been shown to be more effective than floss overall.^{6,7,83,101,102} This may be due to a higher likelihood of open embrasure spaces which allows for improved access for interdental brushes or the increased penetrance of the bristles of interdental brushes subgingivally. A systematic review found that in adult patients with adequate interdental space to utilize interdental brushes, biofilm removal was superior with toothbrushing and interdental brush use when compared to other oral hygiene regimens including: 1)

toothbrushing alone, 2) toothbrushing and flossing, or 3) toothbrushing and interdental wood sticks use.¹⁰³ Furthermore, patient preference for the use of interdental brushes over flossing is evident.¹⁰¹⁻¹⁰³ It is sensible, therefore, to recommend interdental brush use in patients with a history of periodontitis and/or in other anatomic areas where their use may be beneficial. Nevertheless, their use may be contraindicated at some sites and in periodontally healthy individuals because their comfortable use requires decreased papillary fill and more interdental space when compared to floss.⁹⁷

Toothpicks/Interdental Stimulators

Triangular wooden tips and/or interdental stimulators may be inserted in interproximal areas and can remove some plaque interdentally. While these tools may be better accepted by patients than flossing, they demonstrate no overall reduction in plaque or gingival index when compared to toothbrushing alone.¹⁰⁴ Their use is associated with a reduction in BOP that is similar to that seen with flossing.¹⁰⁴ In patients with established gingivitis or mild periodontitis, the use of an interdental toothpick and toothbrushing use was less effective than flossing and toothbrushing in reducing plaque and bleeding scores.¹⁰⁴ For these reasons, use of toothpicks as a sole method of interdental cleaning cannot be recommended.

Interdental Irrigation/Powered Flossers

Powered flossers, including both water flossers, air flossers, and powered manual flossers, when use adjunctively with toothbrushing, decrease interdental biofilm deposits and gingival bleeding when compared to toothbrushing alone.^{83,102,107} The magnitude of this reduction is variable and may be dependent upon the type and design of powered flosser.⁸³ It has also been noted that in patients with dental implants, the emergence profile and circular cross-section of dental implants may demonstrate additional benefit from the use of powered flossers.^{106,107} Powered flossers may also be advantageous in patients who lack the dexterity to perform other forms of interdental cleaning or who have not demonstrated adherence with an

interdental cleaning regimen in the past.⁸³ In such patients, powered flossers may allow improved access to interdental cleaning and may provide motivation.⁸³

Standards of Care for Oral Hygiene and Oral Hygiene Instruction

Current Oral Hygiene Recommendations

Dental healthcare professionals, including many dental professional and advocacy groups, have long advocated for an emphasis on the effective delivery of oral home care and the role of the patient as a co-practitioner in the prevention and treatment of dental diseases, including caries and periodontal diseases. The importance of patient-delivered oral hygiene, including effective interdental cleaning, in the control of both dental caries and periodontal disease has been reiterated by the ADA,¹⁵ the World Dental Federation,¹⁰⁸ the EFP,⁵⁷ and the European Organisation for Caries Research (ORCA).⁵⁷ To achieve optimal oral hygiene and impact the health of both individual patients and the public overall, current home care habits are required and population and individual-based interventions must be employed and reinforced.

Patient-centered Behavior Management

Manual toothbrushing alone is inadequate in the treatment of gingivitis. However, even in the presence of gingival inflammation, toothbrushing coupled with interdental biofilm removal has been shown to reduce rates of interdental caries and signs of gingival inflammation.^{56,89} Despite the established importance of interdental cleaning for oral health, most patients are not following recommendations for ideal cleaning protocols. It is then imperative upon members of the dental healthcare team to instruct patients on the importance of such interdental cleaning and the best strategies for its implementation in based upon their clinical presentation. Optimal effectiveness of oral hygiene measures requires multiple rounds of oral hygiene instruction and reinforcement over time.¹⁰⁸ Given patients' low reporting of daily flossing and other forms of interdental tooth cleaning and the suboptimal performance oral hygiene measures overall,^{17,96,97} effective communication and targeting of patients to improve oral

hygiene is of critical importance for all dental healthcare professionals.¹⁰⁹ Psychological interventions, such as social cognition models, cognitive behavioral therapy, and motivational interviewing, have been shown to have an improved effect on patient performance of oral hygiene measures.¹⁰⁹

Individualized, person-centered care, including encouraging goal-setting and accountability, has been shown to increase the longevity of effectiveness of oral hygiene instructions and to demonstrate clinically superior outcomes.¹⁰⁹⁻¹¹¹ An individualized approach may increase appointment time, but could also result in ultimate cost savings if improved patient-delivered oral home care results in a decreased incidence of oral diseases and their sequelae.

Summary

As dental healthcare professionals, patients rely on us to understand the current scientific literature and be able to filter the important take-home messages for their oral health. Particularly when inconsistent or incomplete messages are present in the lay media, dental healthcare providers must be resources to inform and coach patients to establish best practices for their oral health. The confusion associated with the changes in the 2015-2020 Dietary Guidelines for Americans and its reporting in the lay media caused many unsubstantiated conclusions that were not supported by current research.^{18,19} While the “Flossgate” controversy resulted in some splashy headlines and sensational news segments, the underlying science is less titillating. We currently lack the randomized, longitudinal studies necessary to make definitive conclusions about the effectiveness of flossing as a preventative measure for dental

caries and periodontitis.² There are, however, data to suggest that biofilm removal through toothbrushing and interdental cleaning improves oral health outcomes, including the reduction of caries and periodontal diseases.

Furthermore, evidence also suggests that for patients with periodontitis, the use of interdental brushes, where feasible, may provide additional benefit beyond that of toothbrushing and flossing alone.^{6,7}

Caries and periodontal disease are prevalent, serious diseases that represent a huge burden to the health and well-being of the population as well as a cost burden on society. While professional dental prophylaxis has been shown to improve plaque levels and gingivitis in the short-term, these improvements cannot be maintained without subsequent optimization of home care by the patients themselves.

Clinical Recommendations:

- Both dental caries and periodontal disease are mediated by a microbial dysbiosis and adequate patient-delivered biofilm control is the primary method of prevention for both diseases. Careful evaluation and diagnosis of patients as well as coaching patients to perform adequate oral hygiene and limit sugar intake is critical to disease prevention and management.
- Individualized risk-assessment and oral health and hygiene recommendations should be designed for each patient to insure optimal oral hygiene outcomes. Ongoing evaluation of gingival inflammation and plaque/biofilm control is critical to the continuous improvement and/or maintenance of a patient’s oral hygiene.
- Oral hygiene education should utilize psychological interventions that tailor approaches to patients’ needs and desires.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/ce-courses/ce691/start-test

- 1. The American Dental Association recommends brushing for at least 2 minutes, twice daily. What is the average time that an US adult brushes per day?**
 - A. 30 seconds
 - B. 45-70 seconds
 - C. 90-120 seconds
 - D. 240 seconds
- 2. Approximately what percentage of U.S. adults floss daily and consistently?**
 - A. 2%
 - B. 15%
 - C. 35%
 - D. 50%
- 3. Caries result from acid erosion of hard surfaces of the teeth due to metabolic acids produced from the metabolism of simple sugars.**
 - A. True
 - B. False
- 4. Community water fluoridation has been considered one of the most effective public health endeavors ever undertaken. The return on investment for each dollar spent on water fluoridation is up to:**
 - A. \$3
 - B. \$5
 - C. \$12
 - D. \$32
- 5. _____ of US adults ages 20-44 years have untreated dental caries and _____ of dentate adults have decay in a permanent tooth.**
 - A. 15%, 63%
 - B. 15%, 92%
 - C. 32%, 78%
 - D. 32%, 92%
- 6. Dental caries result more than 1.7 million missed school days in children under 18 years old. Children with poor oral health demonstrated similar scholastic performance to children with higher levels of oral wellness.**
 - A. Both statements are true.
 - B. The first statement is true, the second statement is false.
 - C. The first statement is false, the second statement is true.
 - D. Both statements are false.
- 7. On average, patients with periodontitis demonstrate ____ mm/year of attachment loss.**
 - A. 0.01
 - B. 0.1
 - C. 0.5
 - D. 1.0

8. The prevalence of periodontitis has been estimated to be over ____% of US adults?
- A. 26
 - B. 34
 - C. 42
 - D. 63
9. Periodontal disease is bacterially initiated, and disease progression is propagated by inflammatory host factors.
- A. True
 - B. False
10. In older individuals, toothbrushing at night before bed, using dental floss every day, and visiting the dentist were contributory factors for longevity among adults 65 years of age and older and never flossing increased risk of death by ____%.
- A. 10
 - B. 30
 - C. 50
 - D. 75
11. All of the following individuals/organizations have issued recent statements reaffirming the importance of interdental cleaning for oral health EXCEPT:
- A. The Office of the Surgeon General
 - B. The American Dental Association
 - C. The Department of Health and Human Services
 - D. The Committee on Dietary Guidelines for Americans
12. According to 2014 Delta Dental Oral Health and Well-Being Survey 41% of Americans floss at least once daily and ____% never floss.
- A. 20
 - B. 30
 - C. 45
 - D. 58
13. Current ADA recommendations for oral hygiene include all of the following EXCEPT:
- A. Toothbrushing for at least 2 minutes twice daily with a fluoride-containing dentifrice.
 - B. Clean between teeth daily.
 - C. Visit your dentist regularly for professional cleanings and oral exams.
 - D. Use of alcohol-containing mouthrinse daily.
14. Due to their superior bristle flexibility, toothbrushes with soft bristles are associated with greater subgingival and interproximal biofilm removal.
- A. True
 - B. False
15. Flossing even 2-4 days per week was associated with a _____ prevalence of periodontitis.
- A. Lower
 - B. Similar
 - C. Higher

- 16. Interdental brushes have been shown to remove _____ biofilm interproximally when compared to floss and have demonstrated _____ reductions in interproximal probing depth and gingival bleeding.**
- A. more; greater
 - B. more; similar
 - C. less; similar
 - D. less; greater
- 17. In patients who have received previous periodontal care interdental brushes have been shown to be _____ than floss overall.**
- A. more effective
 - B. similarly effective
 - C. less effective
- 18. Manual toothbrushing alone is adequate in the treatment of gingivitis.**
- A. True
 - B. False
- 19. Improvement in effectiveness of oral hygiene measures requires multiple rounds of oral hygiene instruction and reinforcement over time.**
- A. True
 - B. False
- 20. Psychological interventions that have shown an improved effect on patient performance of oral hygiene measures include all of the following EXCEPT:**
- A. Social cognition models
 - B. Cognitive behavioral therapy
 - C. Motivational interviewing
 - D. Authoritarian model

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Additional Resources

- No Additional Resources Available

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