



**waterpik®**

**EMERGING  
TRENDS LINKING ORAL  
AND SYSTEMIC HEALTH**

## COURSE DESCRIPTION

This course will provide the dental team with changing trends and current evidence on the link between oral and systemic health and provide talking points for patient discussions and recommendations.

## LEARNING OUTCOMES

- Understand the difference between association and causation
- Assess the strength of the science supporting oral systemic relationships
- Discuss the oral systemic relationships for cardiovascular disease, adverse pregnancy outcomes, diabetes, dementia, and cancer
- Develop talking points for patient discussions
- Evaluate professional and self-care for managing periodontal disease in at-risk patients

## INTRODUCTION

The first *Report of the Surgeon General: Oral Health in America* in 2000 stated that oral health is integral to general health.<sup>1</sup> Emerging around this same time frame were studies<sup>2,3,4</sup> demonstrating links between periodontitis and adverse health conditions such as cardiovascular disease<sup>2,3</sup> (CVD) and preterm low birth weight babies.<sup>4</sup> Dental professionals, who had long observed that poor periodontal health was often associated with poor general health, welcomed the information, hoping that it might help patients place greater value on good oral health.

In the years since these studies, hundreds of research articles have been published examining links between periodontitis and CVD, adverse pregnancy outcomes, diabetes, and several types of cancer. Although information on the associations between periodontitis and various health issues is abundant, clear-cut answers on the validity and causality of these associations are lacking.<sup>5,6,7,8,9</sup> A 2017 systematic review by the Cochrane Oral Health group found low-quality, insufficient evidence to support or refute whether periodontal therapy can prevent the reoccurrence of CVD. There was no evidence of the primary prevention of CVD.<sup>5</sup> Similarly, a 2017 systematic review, also by the Cochrane Oral Health group, found lower quality evidence that periodontal treatment can prevent preterm births or reduce incidences of low birth weight.<sup>6</sup>

## ASSOCIATION VERSUS CAUSATION

Findings of weak or insufficient evidence of oral systemic links, particularly with CVD, can be confusing and frustrating to dental practitioners. More research is needed to confirm a causal relationship because the diseases share common risk factors, which makes it difficult to confidently determine the exact correlation between the two.<sup>10</sup>

Understanding the difference between association and causation can help clarify what seems to be doublespeak. An association is a statistically dependent relationship between an exposure or variable and a disease. In other words, the presence of one influences the probability of *observing* the presence of the other. Associations are a condition of establishing causation, but not all associations are causal.<sup>11</sup> By comparison, causation is demonstrated when the exposure or variable has been shown to *cause* the effect.<sup>11</sup>

Associations can occur by chance or bias or may be a result of confounding factors. For example, in the past some epidemiologic studies<sup>12</sup> indicated that coffee consumption could be a risk factor for lung cancer. It is well known that coffee drinking is associated with cigarette smoking. When newer studies controlled for the confounding factor of tobacco, a well-established risk factor for lung cancer, coffee did not appear to be a risk factor for lung cancer.<sup>12</sup>

The Bradford Hill criteria is often used to determine whether an association between a risk factor and a disease is causal.<sup>11,13</sup> Established in 1965, Hill's nine "aspects of association" criteria are still considered valid today.<sup>11,13</sup> Although debate continues regarding limitations and application of these criteria in today's scientific environment, the criteria are meant to be a flexible guideline rather than a rigid checklist.<sup>13</sup> The nine guiding principles are outlined in **Table 1**.

The relationship between periodontitis and cigarette smoking is one example of how the Bradford Hill criteria may be applied. A systematic review of 28 studies found that smoking increased the risk of periodontitis by 86% (strength and consistency).<sup>14</sup> About 90% of people who smoke start before age 18 (temporality).<sup>15</sup> The more someone smokes, the more likely that person is to have increased periodontal disease severity (biological gradient).<sup>16</sup> People who smoke develop immunosuppression of the acute inflammatory process countered by an overproduction of the inflammatory mediators produced in the chronic disease state, which leads to the loss of connective tissue and alveolar bone (biological plausibility).<sup>17</sup> The biological effect of smoking on the initiation and progression of periodontal disease is consistent with what is known about the etiology of periodontitis (coherence). Smoking cessation has been shown to arrest periodontal disease; after smoking cessation, the risk becomes comparable to the risk of people who never smoked (experiment).<sup>18</sup> Specificity is difficult to apply as smoking causes numerous diseases/conditions and there are multiple causes of periodontitis.

By comparison, determining a causal relationship between periodontitis and adverse health conditions such as CVD has been more complicated. For example, with CVD, although there is a preponderance of evidence showing that the two conditions are strongly associated, proving causality remains elusive.<sup>10</sup>

Strength of association	The larger the association, the more likely it is to be causal. <sup>13</sup> Odds ratios of four or greater are considered strong. <sup>11</sup>
Consistency	Multiple studies in different locations with a variety of subjects and varying methodologies must produce consistent results. Repetition is necessary because it is highly unlikely that a single study can prove causation. <sup>13</sup>
Specificity	An association is more likely to be causal if the exposure only causes one disease. <sup>13</sup>
Temporality	The exposure must precede the effect or disease. <sup>13</sup>
Biological gradient	This is also known as the dose-response effect. The association is more likely to be causal if the response varies based on the dose. <sup>13</sup>
Plausibility	The relationship between exposure and outcome must have scientifically supported biological pathways regarding the etiology and mechanism of disease. <sup>13</sup>
Coherence	The relationship between exposure and outcome should not conflict with established knowledge of the natural history or biology of the disease. <sup>13</sup>
Experiment	The removal of the exposure reverses or leads to a slower progression of the disease. <sup>13</sup>
Analogy	Analogy has been interpreted to mean that when one causal agent is known, similar factors may also be considered. The standard of evidence for a similar factor may be lower. <sup>13</sup>

An association between periodontitis and CVD is a biological plausibility because bacteria from periodontal disease has been shown to invade endothelial cells and because periodontal disease increases systemic inflammation.<sup>19</sup> Study findings have been inconsistent. A 2017 investigation of almost 9,000 subjects compared bleeding upon probing (BOP), the number of deep pockets, and the number of teeth to myocardial infarction (MI), stroke, and heart failure. The results showed that having BOP or deep pockets was not significantly associated with any of the cardiovascular conditions. Subjects with the fewest teeth were more likely to have an MI or heart failure but not a stroke.<sup>20</sup> Intervention studies are also mixed.<sup>5,21</sup> A systematic review that evaluated the effect of periodontal therapy on cardiovascular risk parameters found that periodontal treatment reduced levels of C-reactive protein, tumor necrosis factor-alpha (TNF $\alpha$ ), and interleukin-6 (IL-6) and improved fibrinogen levels.<sup>21</sup> However, a systematic review by the Cochrane Oral Health Group determined that the evidence was insufficient to support or refute the supposition that periodontal therapy can prevent the recurrence of CVD over the long term in patients with chronic periodontitis.<sup>5</sup>

Proving that periodontal disease is a causative factor for adverse health conditions like CVD will be challenging. Many chronic conditions, including CVD and periodontitis, may have multiple risk factors. Adding to the challenge is that periodontitis shares risk factors such as cigarette smoking with other adverse health conditions, including CVD, diabetes, and many types of cancer.<sup>22</sup> Preventive dental services have been shown to help maintain the oral health of adults with chronic health conditions<sup>10,23</sup>; however, periodontal therapy has not been shown to modify, reduce, or prevent chronic health conditions.<sup>9,10</sup>

## ASSOCIATION IS IMPORTANT

The lack of definitive evidence to support a causal relationship between periodontitis and systemic health conditions does not mean that no relationship between the conditions exists. Findings by the AHA indicated a strong association between periodontitis and CVD. This means that the two conditions are likely not related by mere coincidence.<sup>10</sup>

Periodontal disease is a multifactorial, biofilm-associated inflammatory disease.<sup>24</sup> Periodontal pathogens trigger the body's chronic immune response, which starts a cascade of pro-inflammatory mediators, including interleukin 1 $\beta$  (IL-1 $\beta$ ), which leads to connective tissue and bone loss.<sup>25</sup> Treatment of periodontal disease reduces inflammatory mediators not just orally, but *systemically* as well.<sup>10</sup>

Several studies on older Japanese adults have found that periodontitis and/or tooth loss contribute to higher medical costs and worsening health.<sup>26,27,28</sup> A 2016 study found a significant association between periodontitis and higher medical expenditures over a 33-month period.<sup>26</sup> Studies have also shown an independent relationship between tooth loss and increased medical costs related to stroke.<sup>27</sup>

Periodontal disease has been shown to negatively affect the duration and quality of life.<sup>28,29,30</sup> A 2018 study with 322 older adults found that maintaining a healthy and functional dentition into later life was important for preventing the frailty of older people.<sup>28</sup> Severe periodontal disease had the largest compromising effect on function and esthetics.<sup>29</sup> With regard to longevity, a 2017 study of 57,000 postmenopausal women found that both being edentulous and having periodontal disease were associated with a higher mortality rate.<sup>30</sup>

Heart disease is the leading cause of death in the US. More than 40% of the US population has periodontal disease.<sup>31</sup> A consensus statement from the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) recommends that practitioners be aware of the emerging evidence of the association between periodontitis and CVD and that they advise patients of this potential risk.<sup>32</sup>

## EMERGING TRENDS IN THE ORAL SYSTEMIC LINK

Numerous studies continue to be conducted in an effort to understand and validate the association between periodontal disease and numerous adverse health conditions. Whereas early efforts focused on links to CVD<sup>2,3</sup> or preterm low birth weight,<sup>4</sup> newer works have looked at relationships between periodontal health and the incidence of cancer,<sup>33</sup> chronic kidney disease,<sup>34</sup> liver disease,<sup>35</sup> erectile dysfunction,<sup>36</sup> and dementia.<sup>37</sup>

### Cardiovascular disease

One of every four deaths in the US is from heart disease.<sup>38</sup> Well-established risk factors for CVD include age, family history, hypertension, hyperlipidemia, smoking, excess body weight, physical inactivity, and diabetes. Periodontitis shares many of these same risk factors. This confounds the relationship between the two, making it difficult to determine causality.<sup>10</sup> However, studies do indicate that the association between periodontal disease and CVD may be independent of smoking because the relationship exists in both smokers and never smokers.<sup>10</sup>

Biologically, there are numerous potential pathways by which periodontal disease may increase the risk for CVD. Periodontal inflammation induces systemic inflammation, including C-reactive protein, TNF $\alpha$ , IL-1 $\beta$ , IL-6, and IL-8. Another potential mechanism is through the expression of autoantibodies to periodontal bacterial lipopolysaccharides and heat shock proteins leading to endothelial damage. Not to be overlooked is bacterial biofilm. The total surface area of the pockets in a patient with periodontitis is estimated to be between 8 and 20 cm. The bacteremia that occurs through daily activities such as toothbrushing and chewing allows the pathogens to enter the bloodstream. Periodontal bacteria has been found in human atheromatous plaque.<sup>10</sup>

A 2017 meta-analysis of 22 observational studies that included 129,630 participants found that periodontal disease was associated with a onefold increase in the risk of myocardial infarction. However, the relationship was not strong enough to establish causality.<sup>39</sup> Similarly, a study of 32,504 adults with treated periodontitis found that individuals over the age of 60 with severe treated periodontitis had a 1.26-fold increased risk of a major cardiovascular event compared with those with a mild form of periodontitis. Those under age 60 did not have an increased risk of a cardiovascular event regardless of the severity of periodontitis.<sup>40</sup> A study of 57,001 community-dwelling postmenopausal women ages 55 to 89 with no history of CVD found no association between a reported history of periodontitis and the incidence of CVD. This group did have a 17% higher mortality rate than those without periodontal disease. The study also observed edentulous woman and found they had an increased risk of CVD and mortality.<sup>41</sup>

Studies have also examined the relationship between periodontitis and hypertension.<sup>42,43</sup> A 2016 systematic review found that severe periodontal disease was associated with a higher risk of hypertension.<sup>42</sup> Data from the medical and dental records of more than 3,600 people indicated that those with good periodontal health had lower blood pressure and responded better to blood-pressure-lowering medications than those with periodontal disease. Specifically, those with periodontitis were 20% less likely to reach healthy blood pressure ranges.<sup>43</sup>

Endothelial function is one of the earliest expressions of CVD. Studies that have examined the impact of periodontitis on endothelial function have had mixed results.<sup>44,45,46</sup> In a study with 120 patients, endothelial function was impaired in those with chronic periodontitis compared with healthy patients. The impairment was similar to those with a history of myocardial infarction.<sup>44</sup> Similar results were found in a study of 47 people.<sup>45</sup> However, a randomized controlled clinical trial of 69 patients with stable coronary disease and severe periodontitis found that nonsurgical periodontal treatment did not improve endothelial function.<sup>46</sup>

### Adverse Pregnancy Outcomes

Nearly one in 10 babies in the US is born prematurely. Premature birth is the largest contributor to infant death and a major cause of long-term health issues in those who survive.<sup>47</sup> While there are several contributors to a preterm birth, including tobacco and/or alcohol use, even women without known risk factors can give birth prematurely.<sup>47</sup> Intra-amniotic levels of prostaglandin E<sup>2</sup> (PGE<sup>2</sup>) and TNF $\alpha$  increase throughout pregnancy until a critical threshold is reached, triggering labor, cervical dilation, and delivery.<sup>49</sup> Periodontitis is also associated with elevated levels of PGE<sup>2</sup> and TNF $\alpha$ . Thus, it is biologically plausible that the periodontal infection is a contributor to preterm birth.<sup>49</sup>

In 1996 Offenbacher et al. conducted one of the first studies on periodontitis and premature birth. This case-controlled study of 124 pregnant or postpartum women found that those with severe periodontal disease were significantly more likely to give birth prematurely than mothers with a healthy periodontium.<sup>4</sup> Since that time, most studies on periodontal disease and preterm birth have found that those who give birth prematurely generally have poor oral health.<sup>48</sup> Overall, however, the additional studies have found mixed results on the association between actual periodontitis and adverse pregnancy conditions.<sup>49,50,51</sup> A 2017 cross-sectional study of 3,500 postpartum women found that periodontitis did not contribute to adverse pregnancy outcomes.<sup>49</sup> Conversely, a 2010 study in France found that periodontitis was associated with an increased risk of premature birth related to preeclampsia.<sup>50</sup> A 2013 systematic review found a modest yet independent association between periodontitis and preterm birth, low birth weight, and preeclampsia.<sup>51</sup>

In 2006 Michalowicz et al. conducted an intervention trial to determine whether scaling and root planing (SRP) provided before week 21 of pregnancy could prevent preterm births.

The results showed that SRP improved the clinical measure of periodontitis and was not associated with adverse medical events. SRP did not, however, significantly reduce preterm births.<sup>52</sup> Several systematic reviews have analyzed the data on the numerous intervention studies.<sup>6,48,53</sup> The Cochrane Group found low-quality evidence to determine whether periodontal therapy affected adverse pregnancy outcomes.<sup>6</sup> Similarly, two other reviews concluded that SRP did not reduce preterm births.<sup>48,53</sup>

### Diabetes

Periodontal disease is a well-established complication of diabetes. A 2018 systematic review found that the presence of diabetes increases the risk or progression of periodontal disease by 86%.<sup>54</sup> Diabetes alters the immune response by impairing neutrophil function, decreasing chemotaxis, and reducing phagocytosis. At the same time, there is evidence of a hyper-responsive monocyte/macrophage phenotype leading to increased production of destructive pro-inflammatory mediators such as IL-1 $\beta$ .<sup>55</sup>

Some researchers have postulated that periodontitis may increase the risk of developing diabetes. An 11-year follow-up study of more than 2,000 subjects found no association between baseline probing depths and clinical attachment levels (CAL) and the development of diabetes.<sup>56</sup> Josphipura et al. reached a similar conclusion in a study of 941 people over a three-year period.<sup>57</sup>

The treatment of periodontal disease has been shown to have a modest and limited impact on the improvement of glycemic control as measured by A1c. A systematic review of 35 studies and 2,565 subjects by the Cochrane Group found that periodontal therapy demonstrated a 0.29% reduction in A1c for three to four months posttreatment. At six months, the A1c had approached baseline.<sup>7</sup> A 2017 systematic review of seven studies and 940 subjects with type 2 diabetes found a reduction in A1c of 0.53 at the end of treatment and a reduction of 0.48 at 3 months. They concluded that there is a significant reduction in A1c from periodontal therapy.<sup>58</sup> This review did not report on the A1c at six months.<sup>58</sup>

### Cancer

A 2018 study published in the *Journal of the National Cancer Institute* found that the risk for cancer, particularly lung and colorectal cancer, was increased in those with edentulism or periodontitis, including never smokers. Total cancer mortality was also elevated with severe periodontitis or edentulism. The associations were stronger among whites than blacks except in the case of colorectal cancer.<sup>33</sup> The study included 7,466 participants from the Atherosclerosis Risk in Communities (ARIC) study. Participants were followed for a median length of 14.7 years. A dental exam was conducted at visit four (1996-1998). The study also showed a higher risk of pancreatic cancer. However, due to the small number of cases, the results for pancreatic cancer were not statistically significant. No associations were observed for breast, prostate, hematopoietic, and lymphatic cancers.<sup>33</sup>

The findings from the ARIC study align with the findings from a meta-analysis on periodontitis, tooth loss, and cancer risk. This review found that periodontal disease increased the risk for oral, lung, and pancreatic cancer.<sup>59</sup> The Women's Health Initiative Study of more than 65,000 women ages 54 to 86 also found that periodontal disease increased the risk of cancer irrespective of smoking.<sup>60</sup> The Nurses' Health Study, with more than 77,000 participants, found that people with periodontal disease and tooth loss were at greater risk for colon cancer. The findings were not modified by smoking, alcohol consumption, or body mass.<sup>61</sup>

### Cognitive Decline

Chronic inflammatory diseases have been associated with increased systemic inflammation and increased cognitive decline in Alzheimer's patients.<sup>62</sup> A six-month observational cohort study of 60 community-dwelling subjects with mild to moderate Alzheimer's disease found that periodontitis was associated with a sixfold increase in the rate of cognitive decline.<sup>62</sup> Likewise, Iwasaki et al. reported that severe periodontal disease and periodontal inflammation were associated with mild cognitive impairment in older, community-dwelling individuals.<sup>37</sup> A cohort study from the Taiwan National Health Insurance Research Database found that people who had severe periodontitis and did not receive periodontal treatment were at a greater risk of developing dementia.<sup>63</sup>

Chronic conditions such as **liver disease**,<sup>35</sup> **kidney disease**,<sup>34</sup> and **erectile dysfunction**<sup>36</sup> have also been associated with periodontitis. A Finnish study found that people with periodontitis were more likely to have chronic liver disease independent of alcohol use, smoking, metabolic factors, lifestyle, dental hygiene, and socioeconomic status.<sup>35</sup> A systematic review of 17 studies found that the odds of having chronic kidney disease were 60% higher among people with periodontitis.<sup>34</sup> A meta-analysis of five studies found that periodontitis was associated with an increased risk of erectile dysfunction.<sup>36</sup>

## TREATMENT IMPLICATIONS AND RECOMMENDATIONS

Although periodontal disease has been associated with multiple adverse health conditions, scientific data showing that treating someone's periodontal condition can modify, reduce, or even prevent systemic disease are lacking.<sup>9</sup> Thus promoting periodontal care as a means of improving a specific chronic condition is unfounded and misleading.<sup>9</sup> This is not to imply that good oral health is not important or that it does not contribute to overall health. It does. However, it is too soon to say that good oral health can improve heart health, reduce premature births, improve diabetes status, and reduce the risk of cancer or any other chronic ailment.<sup>9</sup>

Periodontal disease is one of the most common chronic diseases in adults.<sup>31</sup> Most periodontal disease is preventable. Early detection, treatment, and modification of risk factors can help stop or slow the progression of the disease, including reducing the risk of tooth loss. Counseling patients to stop smoking or improve their control of blood sugar can help them achieve periodontal stability and reduce the risk of tooth loss.<sup>18,54</sup>

Preventing and controlling gingivitis is believed to be a primary mechanism for the prevention of periodontitis.<sup>64</sup> The American Academy of Periodontology defines periodontal health as a "state free from inflammatory periodontal diseases."<sup>65</sup> Inflammation is a common denominator of periodontal disease and many chronic conditions.<sup>10,49,55,62</sup> Regular dental visits in addition to daily self-care are essential. While most people do brush on regular basis, the use of dental floss is often "forgotten." Many people believe that string floss is the gold standard for interdental cleaning; however, the scientific evidence does not support this belief,<sup>66,67</sup> likely because of technique and compliance. Tedesco et al. found that while people have confidence in their ability to brush their teeth, they have very low confidence in their ability to use string floss, and the result is that they often "forget to floss."<sup>68</sup> Lang et al. found that string floss is difficult for many people to use, with only 22 percent exhibiting the skills needed to achieve an oral health benefit.<sup>69</sup>

Fortunately, there are many alternatives that people can use for interdental cleaning. These include floss holders, wooden sticks, interdental brushes, and water flossers. The key is finding the product that the patient likes and feels confident using.

A 1990 *Journal of Dental Hygiene* study concluded that both traditional flossing and flossing with a floss holder product were equally successful in removing plaque and reducing gingivitis.<sup>7</sup> A 2008 systematic review of wooden sticks found that wooden sticks were not better at plaque removal than other products, but they did provide a greater reduction in bleeding.<sup>71</sup> A 2013 systematic review by the Cochrane Group found insufficient evidence to determine whether interdental brushes removed more plaque than string floss. There was some evidence to show they did provide better gingivitis reduction.<sup>72</sup>



Figure 1: Waterpik® Ultra Professional Water Flosser

The Waterpik® Water Flosser (Figures 1 & 2) has been shown to be an effective tool for reducing gingivitis and bleeding.<sup>73-81</sup> In a University of Nebraska study, the water flosser was paired with a manual or a power toothbrush, and both were compared to traditional manual brushing and flossing. Regardless of toothbrush type, adding a water flosser once daily with plain water to either a manual or power brushing routine was a more effective alternative to string



Figure 2: Waterpik® Cordless Advanced Water Flosser®

floss for the reduction of bleeding, gingivitis, and plaque.<sup>74</sup> Similarly, Rosema et al. found the water flosser to be twice as effective as string floss at reducing bleeding.<sup>75</sup>

The biofilm-removing capabilities of the water flosser were evaluated in a study conducted at the University of Southern California Center for Biofilms. Eight teeth were extracted from a patient with advanced periodontal disease. Pretreatment scanning electron microscopy (SEM) images of the teeth indicated that

they were colonized by a luxuriant biofilm appearing to be several micrometers thick (Figure 3). The teeth were water flossed for three seconds at a medium pressure (70 psi) setting. Post-SEM images indicated that water flossing removed up to 99.9% of plaque biofilm (Figure 4). The researchers concluded that the shear hydraulic forces produced by a water flosser with 1,200 pulsations per minute at medium pressure can significantly remove biofilm from tooth surfaces.<sup>82</sup> A single-use plaque study found that people who added a water flosser to manual tooth brushing removed 74% of whole mouth plaque compared with 56% for manual brushing and flossing, making the water flosser 29% more effective.<sup>83</sup>



Figure 3: Before treatment with the water flosser, Gorur et al.<sup>5</sup>

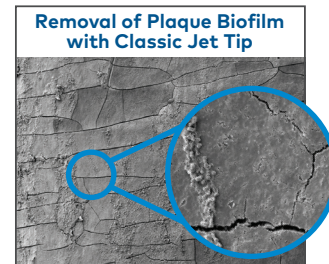


Figure 4: Tooth surface after a 3-second treatment with the Water Flosser, Gorur et al.<sup>5</sup>

A study by Genovesi et al. evaluated the difference between SRP followed by the local delivery of minocycline and SRP followed by daily water flossing for 30 days. The results demonstrated that both treatments effectively reduced bleeding on probing and improved pocket depth and clinical attachment at 30 days. There were no statistical differences between the groups, indicating that the water flosser is an effective alternative to subgingival antibiotics for periodontal maintenance patients over a 30-day period.<sup>81</sup>

Several six-month studies were conducted during the 1990s on periodontal maintenance patients.<sup>77-80</sup> Findings from these studies consistently showed that the water flosser improved the oral health of this demographic. Flemmig et al. found that water

flossing reduced BOP by half over the six-month time frame,<sup>79</sup> and Newman et al. showed that those with the most BOP had the greatest reductions.<sup>78</sup> In a different study, Flemmig et al. found that water flossing was more effective than rinsing with 0.12% chlorhexidine for reducing BOP.<sup>77</sup>

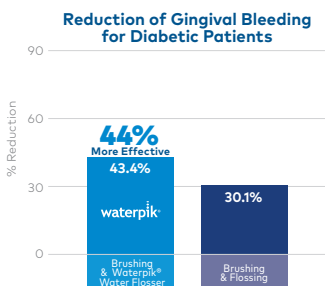


Figure 5: Bleeding reductions in patients with diabetes and periodontal disease, Al-Mubarak et al.

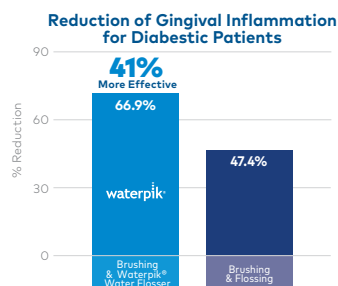


Figure 6: Reduction in gingival inflammation in patients with diabetes and periodontal disease, Al-Mubarak, et al.

Diabetes has been shown to increase the risk for developing periodontal disease. A study at the University of Buffalo looked at how the water flosser improved the periodontal health of people with diabetes. The results indicated that the addition of the water flosser to routine oral hygiene was more effective at reducing bleeding (44%) and gingival inflammation (41%) than routine oral hygiene alone<sup>76</sup> (Figures 5 & 6).



Figure 7: Waterpik® Sonic-Fusion®

There is a new entry to the self-care market that has added a water-flossing function to the toothbrush handle. Waterpik® Sonic-Fusion® is a flossing toothbrush that combines a sonic toothbrush with the efficacy of water flossing (Figure 7). This new tool allows patients to add water flossing to toothbrushing with the touch of a button. A recent four-week study found that the Waterpik® Sonic-Fusion flossing toothbrush was twice as effective as string floss for removing plaque and reducing bleeding and gingivitis.<sup>84</sup> Sonic-Fusion® has earned the ADA Seal of Acceptance.<sup>85</sup>

The water flosser is supported by more than 70 published scientific studies and over five decades of use by the public. Both countertop and cordless models have earned the ADA Seal of Acceptance<sup>85</sup> (Box 1). Despite this, skepticism about product safety and efficacy still persists.<sup>86</sup> Some dental professionals believe the product cannot be used at higher settings; others feel it increases probing depth or destroys the attachment.

Box 1: ADA Seal Statement on Waterpik® Water Flosser

"The ADA Council on Scientific Affairs Acceptance of the Waterpik® Water Flosser is based on its findings that the product is safe and has shown efficacy for removing plaque along the gumline and between teeth and helping to prevent and reduce gingivitis, when used as directed."

A recent study by Goyal et al. evaluated the effect of the water flosser on gingival and epithelial tissue at multiple pressure settings, including the highest settings at nine and ten. One hundred and five subjects were assigned to one of three groups: 1) manual brushing and water flossing, 2) manual brushing and flossing, and 3) manual brushing only. In the manual brushing and water-flossing group, subjects increased the pressure setting on the water flosser over the course of the six-week study (Table 2). The primary outcome measured was clinical attachment levels (CAL) as assessed by the cemento-enamel junction and probing pocket depth (PPD). At six weeks, those in the water flosser group showed an improvement in CAL and a reduction in PPD. These changes exceeded those in the manual-brushing-and-flossing group and the manual-brushing-only group. All subjects received oral examinations at baseline, two weeks, four weeks, and six weeks. All subjects were negative for oral lesions, trauma, or any other abnormal findings at each visit. The investigators concluded that the water flosser is safe to use, and the results should alleviate concerns, especially that water flosser pressure settings may negatively impact gingival health or epithelial tissue.<sup>86</sup>

Table 2: Water Flosser Pressure Settings at Specific Time Points<sup>86</sup>

Day	Pressure
1 & 2	4
3, 4, 5	5
6, 7, 8	6
9, 10, 11	7
12, 13, 14	8
15-28	9
29-42	10

The findings from Goyal et al. support the conclusions of a 2015 literature review, which found no data suggesting that the water flosser is detrimental oral health. The review looked at a wide range of studies and covered topics such as trauma to soft tissue, penetration of bacteria into the sulcus, probing depth, and bacteremia.<sup>87</sup>

## SUMMARY

Poor periodontal health has been associated with numerous chronic conditions. Despite the fact that the evidence remains elusive for a causal relationship, people with poor oral health often have poor general health. Helping patients prevent gingivitis and periodontal disease is essential for maintaining a healthy dentition and reducing the risk of tooth loss.

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# POST TEST FOR COURSE #19-31: Emerging Trends Linking Oral and Systemic Health

- 1. An association is a condition of establishing causation but not all associations are causal.**
  - a. True
  - b. False
- 2. An association may occur by:**
  - a. Chance
  - b. Bias
  - c. Confounding Factors
  - d. All of the above
- 3. Which is true regarding causality:**
  - a. The exposure must precede the disease
  - b. The disease severity is impacted by the amount of the exposure
  - c. The removal of the exposure reverses or slows the progression of the disease
  - d. All of the above
- 4. Periodontal therapy has not been shown to modify, reduce, or prevent chronic health conditions**
  - a. True
  - b. False
- 5. A meta-analysis of 22 studies and 129,630 participants found that periodontal disease was associated with how much increased risk for a myocardial infarction?**
  - a. 1 fold
  - b. 2 fold
  - c. 3 fold
  - d. 4 fold
- 6. People with good periodontal health have been found to:**
  - a) Respond better to blood pressure medication
  - b) Have lower blood pressure
  - c) Both A & B
  - d) None of the above
- 7. Scaling and root planning provided before week 21 of pregnancy was found to:**
  - a. Reduce the rate preterm birth
  - b. Not significantly reduce the incidence of pre-term birth
  - c. Increase the rate of pre-term birth
  - d. None of the above
- 8. The treatment of periodontal disease in people with diabetes has been shown to significantly improve glycemic control for up to two years post-treatment**
  - a. True
  - b. False
- 9. Which statement is true about the relationship between diabetes and periodontitis?**
  - a. Periodontitis is a well-established complication of diabetes
  - b. Diabetes increases the risk and progression of periodontitis by 86%
  - c. Having periodontitis does not increase the risk for developing diabetes
  - d. All of the above
- 10. The risk of lung and colorectal cancer is decreased in people with periodontal disease or who are edentulous.**
  - a. True
  - b. False
- 11. In people with mild to moderate Alzheimer's disease, periodontal disease increased the rate of cognitive decline by?**
  - a. 2 fold
  - b. 4 fold
  - c. 6 fold
  - d. 8 fold
- 12. Which chronic conditions have been shown to be associated with periodontitis?**
  - a. Liver disease
  - b. Kidney disease
  - c. Erectile dysfunction
  - d. All of the above
- 13. Promoting periodontal care as a means to improve a specific systemic general health condition is unfounded and misleading.**
  - a. True
  - b. False
- 14. The Waterpik® Water Flosser has been shown to significantly reduce:**
  - a. Plaque
  - b. Bleeding
  - c. Gingivitis
  - d. All of the above
- 15. It is safe to use a Water Flosser at the highest setting.**
  - a. True
  - b. False

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