



PERIODONTAL DISEASE & SYSTEMIC HEALTH

EMERGING INNOVATIONS SHAPING PREVENTION, DIAGNOSIS, AND TREATMENT

The connection between oral health and systemic health is well-established and ever-evolving. As research and advances in technology continue to shape our understanding of periodontal disease, *Inside Dentistry* investigates where we stand and what the future might hold in terms of prevention, diagnosis, treatment, and management for a disease-burdened, growing, and aging population.

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THE DATA ARE STRIKING, IF NOT ALARMING. Forty-seven percent of US adults who are age 30 or older—an estimated 64.7 million Americans—have either mild periodontitis (8.7%), moderate periodontitis (30%), or severe periodontitis (8.5%). As the population ages, the prevalence rises, with 70% of individuals over the age of 65 exhibiting some level of periodontitis. Considering that more than 10,000 people reach the age of 65 each day and that by 2030, it is estimated that the number of people older than 70 years of age will double from 35 million to 71 million, periodontitis is proving to be a major health risk among Americans.



It's no secret that we're living longer, but Americans are living with more chronic disease and taking more medications than ever. This puts them at high risk, as indicated by the most recent National Health and Nutritional Examination Survey conducted by the US Centers for Disease Control and Prevention (CDC) in 2012," explains

Donald S. Clem, DDS, a leading periodontist practicing in California.

With nearly one out of every two Americans older than the age of 30 affected by them, periodontal diseases are common conditions with strong correlations between disease prevalence and known risk factors, such as age and smoking. According to John vanDyck, head of North American marketing for Nobel Biocare USA, periodontal diseases are among the reasons that more than half of the adult population in North America—an estimated 178 million people—are missing one or more teeth.

Interestingly, there also seems to be a direct correlation between the regions of the United States with the greatest concentration of periodontitis cases and those that have a high incidence of cardiovascular disease and diabetes, particularly areas along the Mississippi Delta and the US-Mexico border. These findings also indicate that periodontitis is more common in ethnic minorities, individuals with limited access to dental care, and those of lower socioeconomic status, notes Terrence Griffin, DMD, President of the American Academy of Periodontology.

"As we continue to learn more about the mechanisms behind periodontal disease's links to other ailments, it's become clearer that a healthy mouth is key to a healthy body," Griffin emphasizes. "There is growing evidence that supports the perio-systemic link, and although a direct cause-and-effect link is still being established between periodontal diseases and other systemic diseases, inflammation is often a shared culprit."

In fact, Louis F. Rose, DDS, MD, editor-in-chief of *Compendium of Continuing Education in Dentistry*, explains that evidence shows that inflammation is a pathway for chronic diseases, and organisms can migrate to other sites of the body, causing problems. These studies have demonstrated a direct association between periodontal diseases and systemic diseases as well as the effects that each can have on the others.

"Therefore, according to Clem, it behooves dental professionals not to think of periodontitis as strictly a plaque-induced disease. He says that although it is true that the primary cause of periodontitis is bacterial plaque, a complex microbiome is responsible for gingivitis (ie, the first stage of periodontal disease); bacterial plaque causes gingivitis in 100% of patients where it is allowed to accumulate, but not all gingivitis progresses to periodontitis. From a clinical perspective, hygienists and dentists see this every day. There are patients who have significant amounts of plaque and gingivitis who don't seem to progress to periodontitis, and there are also patients who have minimal amounts of plaque and are faithful to regular dental visits, but continue to breakdown and experience bone loss associated with periodontitis.

Betsy Reynolds, RDH, MS, notes that in the early days of scaling and root planing therapy to treat periodontal diseases, the objective was to destroy, remove, and kill all of the bacteria in the oral cavity—a goal she acknowledges is unachievable. Today's approaches address the different roles played by various species of bacteria in the mouth. Now, some efforts focus on propagating a beneficial colony in the oral cavity, which can prevent or lessen the opportunity for more severe pathogens to take hold.

"The use of probiotics will likely play a significant role in the future of periodontal disease therapy," Reynolds speculates.

"For gingivitis to progress into periodontitis, a shift in the components of the plaque and a susceptible host whose inflammatory response is genetically predetermined are required," Clem elaborates. "This is one of the reasons why many conditions are now classified as chronic inflammatory diseases of aging."

For example, patients with cardiovascular disease, diabetes, respiratory disease, arthritis, and periodontitis all exhibit similar elevations in inflammatory mediator production (ie, molecules released by immune cells). It is postulated that these inflammatory mediators are largely responsible for individual responses to disease susceptibility and progression.

"Some would have us believe that all periodontal diseases are the same, can be treated the same way, and respond equally to standardized treatments with devices pushed largely by industry. Clearly, this is an oversimplification of a complex situation," Clem asserts. "We must not



forget that there is a significant genetic component to periodontal diseases and their progression. As patients age, their genetic predisposition to inflammation can be expressed in the face of bacterial challenges.” In July 2015, the *Journal of the American Dental Association* published an extensive systematic review (Smiley CJ, et al.) of the effectiveness of root planing with and without adjunctive therapies, including a variety of lasers. With regard to assorted adjunctive therapies reviewed, there were only minimally improved clinical results and only moderate to low levels of evidence. If the elimination of plaque and bacteria was the only therapy needed to treat periodontitis, these adjunctive therapies would surely show greater efficacy in controlling the disease. Unfortunately, they do not.

According to Kenneth Kornman, DDS, precision approaches to controlling periodontal diseases incorporate an understanding of how genetic variations in individuals who are predisposed to chronic diseases are regulated by environmental factors. In some individuals, inflammatory agents are overproduced in the presence of certain stimuli. But because the genetic variations reside in the regulatory part of the gene—including for periodontal diseases—that variation can be down regulated to have a minimal effect on an individual’s life should he or she develop various chronic diseases.

Revisiting Perio-Systemic Associations

Citing the work of Robert Genco and colleagues, Rose reiterates that periodontal disease is not restricted to

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the oral cavity. Through inflammatory processes, it interacts with the host to trigger a host response. For example, if a patient has diabetes and periodontal disease, their diabetes almost always worsens. Because the host responds dramatically to infections, in this case, periodontal disease could actually be considered a risk factor for poor glycemic control, Rose elaborates. This concept contributes to our understanding of how periodontal disease can be an independent risk factor for systemic diseases, including—but not limited to—cardiovascular disease, stroke, upper respiratory disease, and neurological conditions, among others.

“If you consider that patients with periodontitis have high levels of oral bacteria, it is not surprising that associations between periodontitis and pneumonia and chronic bronchitis have been made in the literature. Aspiration of high levels of bacteria from the oral cavity is a real concern,” Clem says. “This can become a significant problem, especially among elderly patients in long-term care facilities. One must remember that respiratory disease is the 4th leading cause of death in the United States.”

In addition, Clem cautions that the association between respiratory disease and periodontitis goes beyond an infectious etiology. Due to the effects of inflammatory changes in the oral and lung mucosa that occur during the disease process, it is incumbent upon physicians and dentists to do everything they can to minimize these inflammatory changes, starting with establishing a healthy mouth.

“Interestingly, associations have also been made in literature regarding sleep disorders. Patients with

complicated by interaction with other diseases. Among the tools being researched to help determine the particular disease path that a patient is on are salivary biomarkers.

“Although salivary biomarkers currently are not routinely available, the evidence is excellent that they will be very useful in helping to monitor a patient’s response to treatment,” Kornman says.

According to Rose, this type of precision approach to the prevention and treatment of periodontal disease accounts for variability in a patient’s genes, environment, and lifestyle. Because it is more personalized to the individual, it results in more accurate treatment planning as well as improved outcomes for the patient.²

Further facilitating and enhancing today’s treatments for periodontal disease are digital technologies, including digital radiology, which produces a more detailed image than a traditional radiograph. Older radiology techniques were dependent on exposure settings, the type of developer used, and the quality of the film. They also exposed patients to higher levels of ionizing radiation and required extended time to develop.

“Now, with digital radiography, images are obtained instantaneously and can be enhanced or enlarged with the use of computers for greater clarity,” Griffin remarks. “We can also now see and diagnose problems on a microscopic level, greatly adding to our ability to visualize root fractures, endodontic lesions, and bone defects associated with periodontal disease. The use of 3-dimensional (3D) imaging allows us to more predictably avoid anatomic landmarks when placing implants and also to

make the surgery much more predictably successful.”

Although advances in digital imaging and software have revolutionized the treatment planning of many oral procedures, most specifically implant therapy, Morelli cautions that the profession still needs to develop a way to capture high-quality 3D radiographic images for periodontal diagnosis with considerably less radiation exposure to patients. Current intraoral scanners allow dental clinicians to capture colored images with high resolution and accuracy. He says that the development of intraoral ultrasound devices—to be used in combination with scanned intraoral images—could allow dental providers to not only collect clinical data more accurately, but also have a precise tool to integrate the digital information and establish a detailed periodontal diagnosis on which to base treatment.

Today’s Approaches to Treating Periodontal Disease

“The outdated concept of a “perio recall” or “perio prophylaxis” appointment is largely ineffective in managing these diseases,” Clem admits. “From a financial perspective, dental disease results in lower attendance for workers and students, lost wages, and lost productivity. Furthermore, the loss of teeth can be a very expensive condition to correct.”

Fortunately, although the prevalence of periodontal diseases is high, treatment—particularly in the more moderate stages—is very effective.

medically diagnosed sleep apnea demonstrate higher levels of cardiovascular disease, greater instances of fatal cardiovascular events, and among other conditions, higher levels of periodontitis,” Clem says. “The thinking behind this finding is that as oxygen levels in these patients are compromised, components of whole body inflammation rise, and the patient becomes more susceptible to these diseases.”

Although Jukka H. Meurman, MD, PhD, Dr. Odont, a professor in the Department of Oral and Maxillofacial Diseases at the University of Helsinki and Helsinki University Hospital, says the associations between periodontal and systemic diseases are statistical by nature, not causal, he notes that it does seem that the link between periodontal and cardiovascular diseases—such as heart infarction and stroke—is fairly strong. This means that lifelong maintenance of good oral health is important, as are diagnosing and treating oral infections.

However, to ascertain the possible effect of periodontal treatment on major cardiovascular diseases—such as stroke—a large clinical trial that is statistically powered to detect such an effect is needed, explains Souvik Sen, MD, Chair of Neurology at the University of South Carolina and Palmetto Health Richland Medical Center. Such research is needed because, as Sen says, although studies suggest an association between periodontal disease and stroke, that association can largely be explained by common risk factors or cofounders.¹

The need for further research does not negate what Rose sees as a need for dentists and physicians to co-manage patients and a need for dentistry’s medical colleagues to understand the link between oral and systemic health. In addition to cardiovascular disease, stroke, and diabetes, strong connections to periodontal disease also have been observed with rheumatoid arthritis and low birth weight babies.

Therefore, he believes it would be good practice for physicians to routinely recommend that their patients have a thorough dental examination. Likewise, he says that because dentists are often the first to observe changes in a patient’s oral health, it is their responsibility to be informed about all of the patient’s medical conditions.

“For this reason, I recommend that every patient complete a medical history form indicating their current health issues and medications,” Rose explains. “Patients with current health issues may be placed on a more aggressive preventive protocol than those without systemic problems. Alternatively, an otherwise orally healthy patient who presents with a sudden increase in bleeding or inflammation may be referred to their physician for evaluation of a possible systemic cause.”

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Preventing and Diagnosing Periodontal Diseases

Historically, periodontists have been the dental specialists most involved in periodontal disease prevention. From the early days of the specialty to the present, a large aspect of periodontal treatment has centered on teaching patients how to care for their mouths and prevent dental conditions such as periodontal disease and caries.

“When we can educate patients and engage them in effective home care, it sets the stage for more effective and comprehensive therapy,” Reynolds explains. “As a profession, we understand more about the role of nutrition in oral health, the differences between electric toothbrushes and manual toothbrushes, and the dynamics of biofilm. All of these require active patient education and participation tactics, which are extremely vital in preventing, treating, and managing periodontal diseases.”

But in order to prevent periodontal disease, understanding disease progression and, most importantly, diagnosing it with precision is a necessity, explains Thiago Morelli, DDS, MS, a clinical assistant professor in the Department of Periodontology at the University of North Carolina at Chapel Hill School of Dentistry. The development of new methods for classifying periodontal disease according to the risk for further progression helps clinicians to better develop preventive methods that are based on each individual patient’s risk for developing disease.

“It’s difficult to measure financially, but recent studies have shown that a better understanding of gene biomarkers associated with well-defined risk factors and a stratification method based on a quantitative risk for disease progression and tooth loss may be imperative to creating a personalized preventive plan for each individual patient,” Morelli says.

In particular, biomarkers and microbiological tests are helping dentists identify specific disease entities and better treat them, Griffin elaborates. They also enable the determination of which types of antibiotics, antivirals, and other medications will elicit the best response for individual patients.

“New forms of precision medicine are being introduced at a rapid pace and have been a tremendous aid in both helping us recognize certain types of periodontal diseases and giving us effective weapons to fight them,” Griffin observes. “Microbiological targeting, for example, allows us to battle specific types of periodontal infections with enhanced speed and success.”

According to Kornman, precision medicine essentially enables clinicians to approach the treatment of patients with periodontitis differently, depending upon whether or not their disease resulted from environmental factors or genetically-based factors or is



Considering the aging population, periodontal disease has the potential to become the most prevalent dental disease of the coming decade; therefore, it is incumbent upon dentists to incorporate a comprehensive periodontal examination for all adults age 30 or older, Clem adds.

When Griffin first began his career as a periodontist, much of his work centered on resective surgery—basically, removing diseased tissue and bone to enhance the patient's ability to clean his or her teeth and prevent further damage. Throughout the years, the prevailing treatment philosophy has shifted to favor procedures that are regenerative in nature. Now, the emphasis is on saving or even increasing levels of soft tissue and bone to retain teeth and their supporting structure, he observes.

"When it comes to biomaterials and what dentists are attempting to achieve with them, it's essentially about trying to restore a measure of health, function, and form to the patient's mouth," explains Ronald Frezel, Vice President of Marketing for Geistlich Pharma. "Historically and biologically, the best material to do this has been from a homogenous source, but that's not always practical and often requires a second procedure."

Regenerative materials evolved with the development of allografts and xenografts (ie, graft materials from human and animal sources, respectively) that closely mirrored the biological responses within the human body, but successful outcomes depended upon the material's quality and its ability to mimic human tissue responses. If manufactured in an unnatural way, the patient would experience an unfavorable response.

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"If regenerative materials are designed to mimic the human body's natural properties, then patients respond more naturally and their bodies heal more effectively, and appear more natural after recovery," Frezel says. "However, it's important to understand that ultimately, the procedures, techniques, and experience of the clinician are the most important components to successful regenerative therapies."

Frezel adds that although innovations within regenerative biomaterials can help increase the likelihood of success and improve periodontal outcomes, even the best materials will fail if clinicians lack the proper training, education, and experience in performing the requisite procedures. However, in skilled hands, clinically researched biomaterials that are produced through consistent manufacturing processes can demonstrate a great degree of success, he says.

"New regenerative products have made both bone and soft-tissue augmentation and repair much more predictable and easy," Griffin says. "The advent of all of these products has also made regenerative procedures less invasive and less painful because we no longer need to obtain graft material from the patients themselves and can use sterile synthetic or animal products that are completely safe and achieve even better results."

Morelli notes that in the development of new materials for scaffolds, the trend has been to reduce the cost and improve the efficacy of this treatment option and that new reports have described the use of personalized 3D scaffolds for periodontal regeneration. Although the use of personalized scaffold materials for periodontal regeneration is a promising therapy,

interest. For elderly patients with other chronic diseases of aging, the level of risk posed by periodontitis must be considered on a case-by-case basis, and general dentists must decide if that elevated risk warrants involving a periodontist on the team, Clem advises. Clearly, when half of the US population is still affected with periodontitis despite decades of research and treatments, something is still missing, and unrealistic expectations of adjunctive therapies cannot replace the effectiveness of a team approach involving dentists, periodontists, and physicians.

Therefore, the key for general dentists in managing periodontal disease is incorporating a risk assessment. For those patients who are unresponsive to initial therapy, elderly, have other confounding systemic diseases, or are taking medications that make periodontal management more challenging, partnership with periodontists and physicians may be the key. Although it may be a daunting task for some general dentists, such consideration requires talking to the physicians of patients with elevated risk on a regular and routine basis.

According to Clem, that means it is no longer sufficient to simply have patients check a box on the medical history to indicate that they have heart disease. Instead, dentists need to ask: What form of cardiovascular disease do patients have? What medications are they on? How stable are they? What is their inflammatory profile? What is their Body Mass Index? Are they on anti-inflammatory therapy? Can their inflammatory status be co-managed with the cardiologist?

"There needs to be an effort to link primary care physicians with dentists," Sen believes. "Primary care physicians should be able to recommend dental and oral screenings and refer patients to the dentist. On the flip side, dentists should routinely review risk factors—such as hypertension, diabetes, cholesterol, smoking, diet, and exercise—and confer with or refer patients to their physicians."

In hospital settings, collaboration between physicians and dentists is already the norm, Meurman says. Patients with severe systemic diseases should be and are routinely referred for dental check-ups. Unfortunately, this isn't the case everywhere. Problems involving physician/dentist collaboration have been observed, particularly among outpatients who are not listed in hospital registers. These patients can include those with malignancies, those undergoing immunosuppressive treatments, or those undergoing major elective surgery.

"Because periodontal health has such a stake in overall health, collaborative care is key," Griffin asserts. "In the future, periodontists may even incorporate in-office tests for diabetes as part of their comprehensive periodontal examinations, which is one way of identifying, anticipating, and meeting a patient's needs before disease can advance."

Note: For more information about the CDC data cited in this article, as well as information about risk profiles, perio-systemic links, and The Comprehensive Periodontal Examination, please refer to the American Academy of Periodontology's website at: www.perio.org.

References

it requires further validation regarding its long-term success and predictability.

Alternatively, the use of lasers to treat chronic periodontitis has been occurring for more than 10 years, and the evidence regarding its predictability is increasing. Morelli indicates that soon, the profession should be able to better evaluate the long-term efficacy of this treatment option.

"Lasers are being used more commonly now, but science has yet to prove that they are any more effective than conventional methods of periodontal therapy," Griffin adds.

Specifically, hygienists' use of lasers in periodontal therapy has risen significantly, particularly as an adjunct prior to performing standard scaling and root planing techniques, explains Skylar Urban, Global Product Manager at DenMat Holdings, LLC. Lasers are used to clean periodontal pockets, kill bacteria to prevent and/or minimize their spread into other pockets, and help to reduce pocket depths. Similar to the manner in which magnification loupes have helped to elevate the precision with which patient care is provided, Urban sees lasers becoming more and more of a standard in periodontal therapies based on the benefits they provide to patients.

"Patient comfort is a significant benefit of using laser technology for periodontal therapy," Urban elaborates. "Additionally, reducing pocket depths and recession has longer-term implications for cost savings to patients because they can avoid and prevent the need for more invasive and expensive treatments or procedures."

Among the scenarios that could lead to more invasive or costly procedures is tooth loss due to periodontal disease, the results of which can be potentially devastating.



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In addition to negatively affecting an individual's general health, appearance, and self-esteem, missing teeth pose other serious consequences. These include bone loss, gingival tissue loss, and shifting and misalignment of the teeth adjacent to and/or opposing the open spaces, vanDyck explains.

"For individuals who have lost all or most of their teeth as a consequence of periodontal disease, a modern dental solution supported by dental implants can be the best alternative," vanDyck believes. "Depending on the patient's specific dental situation, as few as two to four dental implants can stabilize a denture or provide a full set of fixed teeth in a cost-efficient and graftless solution on the day of surgery (eg, All-on-4®, Nobel Biocare). With proper care and good oral hygiene, a dental implant restoration will last many years, even an entire lifetime."

Concluding Thoughts on Collaboration

As with most diseases, delaying the treatment of periodontal disease until the advanced stages results in treatment that is more expensive, more complex, and less predictable. Clem has seen many cases that could have been treated more conservatively if he had been consulted earlier in the disease process.

Patients who have primarily plaque-induced, early-to-moderate periodontitis with little confounding systemic issues may not need to see a periodontist unless the inflammation is difficult to control. However, for patients who respond poorly to the initial therapy, or for whom the therapy is only marginally effective, a team approach involving a periodontist may be in their best