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The Critical Role of the Oral-Systemic Link In Clinical Practice

A Peer-Reviewed Publication
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Abstract

The associations between periodontal disease and systemic diseases are widely accepted. The term “the oral-systemic link” refers to the connections between the two. Periodontal disease is an inflammatory disease process resulting from the interaction between bacterial attack and the host inflammatory response. Periodontal disease has been shown to result in inflammation in parts of the body beyond the oral cavity. It is this inflammation and the causative periodontal pathogens that have been implicated as contributing factors, through a variety of pathways, in a multitude of systemic diseases and conditions such as cardiovascular disease, diabetes, respiratory disease, hypertension, kidney disease, rheumatoid arthritis, pregnancy complications, and a variety of cancers. Research is ongoing to determine the exact mechanisms interconnecting systemic diseases to periodontal disease and the strength of the various interconnections.

Educational Objectives

At the conclusion of this educational activity participants will be able to:

1. Recognize the relationship between periodontal disease and cardiovascular disease, diabetes, rheumatoid arthritis, and other systemic diseases.
2. Identify the pathways through which the mouth can be a potential source of pathology affecting other systems and organs.
3. Differentiate the various types of associations by which periodontal disease may be linked to systemic diseases.
4. Describe the barriers that prevent medical professionals from acting on information regarding the connection between oral and systemic disease.

Author Profile

Kathryn Gilliam, RDH, BA, has presented courses based on her passion for the early detection of oral cancer and care for patients undergoing cancer treatment. Her articles have appeared in General Dentistry, RDH, Dentistry Today, and Hygiene Mastery Magazine. For additional information, Kathryn may be reached at k2gilliam@gmail.com.

Author Disclosure

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Abstract

The associations between periodontal disease and systemic diseases are widely accepted. The term “the oral-systemic link” refers to the connections between the two. Periodontal disease is an inflammatory disease process resulting from the interaction between bacterial attack and the host inflammatory response. Periodontal disease has been shown to result in inflammation in parts of the body beyond the oral cavity. It is this inflammation and the causative periodontal pathogens that have been implicated as contributing factors, through a variety of pathways, in a multitude of systemic diseases and conditions such as cardiovascular disease, diabetes, respiratory disease, hypertension, kidney disease, rheumatoid arthritis, pregnancy complications, and a variety of cancers. Research is ongoing to determine the exact mechanisms interconnecting systemic diseases to periodontal disease and the strength of the various interconnections.

Introduction

As more consumers learn that their oral health affects their overall health, it is imperative that dental professionals recognize their critical role in performing periodontal disease risk assessment and intervention to potentially prevent negative systemic sequelae and improve the oral and overall health of their patients. Approximately 70% of the U.S. population visits their dental office at least once a year according to data from the Centers for Disease Control and Prevention (CDC).¹ This is significantly more often than people visit their physician. The responsibility lies with dental professionals to protect not only the oral health of their patients but their systemic health as well.

Periodontal Disease

Periodontal disease is an inflammatory disease of the supporting tissues of the teeth caused by specific pathogenic bacterial microorganisms that trigger the inflammatory response, resulting in the destruction of the gingiva, periodontal ligament and resorption of alveolar bone. In all of its stages, as it progresses from gingivitis to periodontitis, periodontal disease has the potential to affect the

overall health of the host. Inflammation spreads throughout the body to distant points from the oral cavity by routes not completely understood as of this writing. Inflammation normally begins in a localized area, but depending upon the severity of the infection or wound, it can spread rapidly to the periphery. This systemic response is triggered by pro-inflammatory cytokines, particularly interleukin-1 (IL-1), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF- α), which are released in the circulation.² For example, some intracellular pathogens have evolved to replicate within immune cells. During an inflammatory response, immune cells are recruited to the site of infection, which inadvertently increases transmission and spread of the pathogen.³ The progression of this infection and resulting inflammatory response can have a variety of effects on many different organ systems in the body.⁴

In fact, periodontal disease has been identified as the body's most abundant source of chronic low-grade inflammation. This causes a decrease in the body's immune response, contributes to the total inflammatory burden of the body, and, eventually, causes irreversible damage to the immune system.⁵

According to the American Dental Association (ADA), over 47% of the U.S adult population over 30 has mild to severe periodontal disease and approximately 70% of adults in the U.S. over age 65 have moderate to severe forms of periodontal disease.⁶

Manifestations of periodontal disease in the oral cavity may be indicative of systemic disease; therefore, as the clinician determines the severity and extent of periodontal involvement in the oral cavity, the possibility of systemic involvement must be considered.² According to the 2000 U.S. Surgeon General's report *Oral Health in America*, oral examination can reveal signs and symptoms of more than 90% of the systemic diseases people experience including; immunologic diseases (rheumatoid arthritis), endocrine disorders (diabetes), hematologic conditions (anemia), systemic infections (HIV, HPV), and nutritional disorders (vitamin deficiencies, fungal infections).⁷ Identifying these early signs and symptoms may facilitate early diagnosis and treatment, potentially resulting in improved systemic health.

The 2000 Surgeon General's report states, “The past half-century has seen the meaning of oral health evolve from a narrow focus on teeth and gingiva to the recognition that the mouth is the center of vital tissues and functions that are critical to the total health and well-being across the life span. The mouth as a mirror of health or disease, as a sentinel or early warning system, as an accessible model for the study of other tissues and organs, and as a potential source of pathology affecting other systems and organs has been described in earlier chapters and provides the impetus for extensive future research.”⁸

The Relationships Between Periodontal Disease and Systemic Disease

At this point in time the relationships between oral disease and certain systemic health conditions have been revealed, along with the role of periodontal pathogens and inflammation in

both oral and systemic diseases. The overwhelming body of research has demonstrated the critical nature of the oral systemic interconnections, which are now recognized by healthcare professionals.

We now know that widespread systemic health effects may be associated with, exacerbated by or caused by periodontal disease.⁹ Scientific findings have pointed to a causal or bi-directional relationship between periodontal disease and certain systemic diseases or conditions. The ongoing inflammation associated with an infected periodontium may serve as a reservoir of gram-negative bacteria, bacterial by-products, antigens, cytokines and other pro-inflammatory mediators that can interact with many organ systems, contributing to disease conditions in other areas of the body.¹⁰

Periodontal disease may compromise the immune system, elevating the risk for systemic conditions. Infectious and opportunistic microbes responsible for periodontal infection may spread this bio-burden to the rest of the body. These microbes can also release metabolic by-products that elicit an inflammatory response.¹¹ Periodontal infections may increase blood viscosity as well as increase coagulation ability.¹² Elevated levels of leukocytes and fibrinogen are found with plaque and gingival inflammation. Some gram-negative periodontal pathogens bind to blood platelets, resulting in aggregation on heart valves. Research also demonstrates that the perio pathogen *Porphyromonas gingivalis* (Pg) activates platelets, resulting in the formation of platelet/white blood cell (WBC) aggregates that supports WBC activation, adhesion and transmigration through the arterial endothelium, which is critical for atherosclerotic development.¹³

A systemic immunological challenge is produced by periodontal pathogens that release bacterial endotoxins. Periodontal infection and the resulting inflammation create multifaceted challenges to the host body.¹⁴ According to Bik et al, it is estimated that 500 - 700 species of bacteria exist in the oral cavity with fewer than 5% of them being causative for periodontal disease.¹⁵ The nutrient rich and oxygen-poor environment of the gingival sulcus provides ideal conditions for the growth of oral bacteria. These bacteria are difficult to eradicate because they form multi-layered biofilms where they create channels for food supply and waste disposal. The most virulent bacteria are in the deepest layers of the biofilm.¹⁶ These appear to be the microbes that cause the most damage to the supporting structures of the teeth. When this biofilm is undisturbed by professional prophylaxis or thorough subgingival plaque removal with dental floss or other oral hygiene methods, the immune system attacks the bacterial invaders with neutrophils and the first signs of inflammation appear clinically, manifesting as redness and swelling.¹⁷ If the neutrophils are able to limit the bacterial assault, the result is gingivitis, a state of low-level inflammation. With more effective home care, the bacterial population may be diminished sufficiently to result in a return to health. If the bacteria advance into the gum tissues despite the presence of

the neutrophils, the immune system steps up its response by releasing macrophages, large white blood cells that phagocytize the bacteria and the dead and dying neutrophils and any other cellular debris found in the infected sulcus and surrounding tissues.¹⁸ The macrophages secrete fatty acids and interleukin-1 (IL-1), a primary inflammatory and immune response regulator, as well as tumor necrosis factor alpha (TNF- α), a protein that increases inflammation.¹⁹ Gingivitis may progress to periodontitis in a genetically susceptible individual. If progression occurs, the inflammation destroys the ligaments that anchor the teeth to the bone, and osteoclastic activity, driven by the patient's immuno-inflammatory response, causes alveolar bone loss. The patient now has periodontitis, potentially resulting in mobility and eventually, tooth loss.²⁰

Pathogenic bacteria, (which can cause epithelial cell death), initiate periodontal disease; however, most of the damage to the periodontium occurs as a result of the inflammatory response to the bacterial attack.²¹

The link to cardiovascular disease has been well established. In the arterial wall, atherosclerotic plaques are created by the macrophages engulfing low-density lipoprotein (LDL) cholesterol particles. When observed through a microscope, they appear foamy and are referred to as foam cells. Foam cells, cellular debris, smooth muscle cells, etc., aggregate in the arterial wall. This buildup, combined with ongoing inflammation, can expand the arterial wall, decreasing the size of the lumen, restricting blood flow.²² Sometimes the thin tissue layer covering the atherosclerotic plaque ruptures causing clots to form, often triggering a heart attack, stroke, or peripheral vascular event, depending on the artery involved. In a 2011 study, Fifer, et al., determined that "a strong relationship was observed" between periodontal inflammation and carotid artery plaques.²³

People with periodontal disease are 40% more likely to have other chronic health conditions than those with healthy gums.²⁴ Chronic, uncontrolled inflammation, with pro-inflammatory mediators leaking out of the gums and into the bloodstream adding to the total inflammatory burden, is being studied as a likely explanation for the link between periodontal disease and systemic illnesses. Another likely explanation is the microbial ecosystem in the mouth and the ability of virulent pathogens to travel through the bloodstream throughout the body. Researchers have found highly invasive oral pathogens in arterial plaque, synovial fluid, and intracranial aneurysms among others.²⁵

According to a 2014 study published in *Frontiers in Microbiology*, it is becoming evident that low-grade subclinical infections may be an underlying cause of many chronic inflammatory diseases and may contribute to secondary systemic diseases such as cardiovascular disease, diabetes, rheumatoid arthritis, and cancer.²⁶ Chronic low-grade infections, such as gingivitis, may be associated with an increased distribution of pathogens throughout the body, which can lead to potentially devastating systemic health conditions.²⁷ The traditional lack

of concern about gingivitis in patients because it's just "a little inflammation" could potentially lead to serious systemic consequences.

In many cases, the burden of proof of a causal relationship between periodontal disease and systemic disease is not yet met. Research is ongoing to determine if periodontal disease is a major or minor component in a variety of systemic diseases. Currently, there are three different relationships between periodontal and systemic diseases:

- An *association* means that a patient with periodontal disease could be at increased risk for systemic disease, but that periodontal disease does not cause the systemic disease.
- A *causal relationship* means that periodontal disease caused or initiated the systemic disease.
- A *bi-directional relationship* means that periodontal disease contributes to or causes the systemic disease and the systemic disease contributes to or causes the periodontal disease.

Conditions Linked to Periodontal Disease

The list of systemic conditions and diseases linked to periodontal disease seems to be ever increasing. The following have been linked in some way to periodontal inflammation:

Cardiovascular Diseases

(congestive heart failure, cardiac arrhythmias, coronary artery disease, atherosclerosis, myocardial infarction, valvular heart disease)

Periodontal pathogens including *Porphyromonas gingivalis* (Pg), *Fusobacterium nucleatum* (Fn), and *Aggregatibacter actinomycetemcomitans* (Aa) have been discovered in atherosclerotic plaques on the innermost walls of diseased arteries.²⁸

Oral viridans streptococci were detected in 78% of coronary artery thrombus samples analyzed by Pessi, et al. The authors concluded that dental infection and oral bacteria, especially viridans streptococci, may be associated with the development of acute coronary thrombosis.²⁹

Several mechanisms have been investigated to explain the association between periodontal disease and cardiovascular disease. The host response to the presence of periodontal bacteria may trigger the production of inflammatory mediators (C-reactive protein, TNF- α , prostaglandin-E2 (PGE2), interleukin-1 β (IL-1 β), IL-6, which can accelerate the production of atherosclerotic plaques.³⁰ Studies have demonstrated the ability of periodontal pathogens to increase blood viscosity while also increasing its coagulation ability and inducing platelet aggregation and the formation of atheromas.³¹

Assinger, et al., demonstrated that the presence of Aa and Pg is associated with a significant increase in factors associated with cardiovascular disease.³² A 2014 study published by Louhelainen, et al., concluded that oral bacterial DNA was detectable in pericardial fluid and an association was found

between the severity of coronary artery disease and the total amount of bacterial DNA in pericardial fluid.³³

The Oral Infections and Vascular Disease Epidemiology Study (INVEST) of 2013 was specifically designed to study the hypothesis that periodontal infections predispose to accelerated progression of carotid atherosclerosis and subsequent cardiovascular disease.³⁴ The findings reported that improvement in periodontal status is associated with diminished progression of carotid atherosclerosis. The authors stated that the findings emphasized; "the importance of primary periodontal care as a possible preventive health measure."

Cerebrovascular Accidents

There is evidence that periodontitis is associated with cerebral ischemia caused by atherosclerosis. Active periodontal inflammation may contribute to risk for strokes due to recurrent bacteremia, platelet activation, and elevated clotting factors. The three most common periodontal pathogens found in ruptured intracranial aneurysms are *Fusobacterium nucleatum* (Fn), *Treponema denticola* (Td) and *Aggregatibacter actinomycetemcomitans* (Aa).³⁵

Diabetes and Diabetic Complications

The relationship between diabetes and periodontal disease is considered to be bi-directional. Periodontal disease results in difficulty controlling glucose levels in the blood. Poor blood sugar control results in a greater prevalence and severity of periodontal disease.³⁶ Inflammation is a central feature of the pathogenesis of diabetes and periodontal disease. Periodontal disease creates a state of chronic systemic inflammation as demonstrated by increased levels of C-reactive protein, interleukin-6 (IL-6), and fibrinogen in patients with periodontitis. Periodontal infection may exacerbate insulin resistance.³⁷ Epidemiological data confirm that diabetes is a major risk factor for periodontal disease; susceptibility to periodontal disease is increased approximately threefold in people with diabetes.³⁸ The heightened periodontal destruction seen in patients with diabetes may be explained by a number of cellular and molecular alterations taking place in the periodontium. Elevated glucose concentrations induce non-enzymatic glycation and oxidation of proteins such as collagen and lipids, the result of which is accumulation of advanced glycation end products in diabetic tissues.³⁹ Various pathological changes cause an increased release of pro-inflammatory cytokines including tumor necrosis factor alpha (TNF α) and interleukin-1 beta (IL-1 β). TNF α and IL-1 β have been implicated in periodontal disease.⁴⁰ TNF α concentration may be elevated in periodontal inflammation due to stimulation of monocytes. The elevation of this cytokine affects insulin sensitivity causing worsening of the diabetic condition. Worsening of the diabetic status may lead to further periodontal breakdown. This is an example of the vicious cycle between periodontal disease and diabetes. In a 2014 study by Soorya, et al.,⁴¹ all patients demonstrated signifi-

cant improvement in periodontal status following periodontal treatment and they also demonstrated a reduction in TNF- α and HbA1c. This suggests that non-surgical periodontal therapy is effective in improving metabolic control in Type 2 diabetes mellitus patients. Given the predicted increase in diabetes prevalence over the next few decades, there will likely be a dramatic increase in incidence of periodontal disease. Controlling diabetes is expected to reduce the risk and severity of periodontal disease. Furthermore, evidence suggests the resolution of periodontal inflammation can improve metabolic control.⁴² People with poorly controlled diabetes must be considered at risk for periodontal disease. Prevention, early diagnosis, and periodontal therapy are fundamentally important to avoid the irreversible tissue loss that occurs in periodontitis. Periodontal therapy in patients with diabetes is associated with improvement in glycemic control that may be clinically relevant in the management of diabetes.⁴³ Collaboration between dental and medical practitioners is necessary for the management of patients with diabetes and periodontal disease.

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an autoimmune-mediated chronic inflammatory joint disease leading to functional disability. It has been found in multiple epidemiological studies to be associated with periodontal disease and to exhibit similar characteristics and pathogenesis to periodontal disease.⁴⁴ A significant increase in the incidence of periodontal disease has been observed in patients with chronic, active rheumatoid arthritis compared to healthy subjects and the prevalence of rheumatoid arthritis is higher in patients with periodontal disease compared to individuals without periodontal disease.⁴⁵ According to Kobayashi, et al.,⁴⁶ a bi-directional relationship exists between RA and PD and may be related to the host immune response as well as similar pathobiology. *Porphyromonas gingivalis* (Pg) is found in severe periodontal disease. Pg, *Tannerella forsythia* (Tf), and *Prevotella intermedia* (Pi) have been detected in synovial fluid samples in patients with RA,⁴⁷ indicating that bacterial DNA is transported from the periodontium to the synovium in the form of free DNA. According to a study by Ogresdik, gram-negative anaerobic bacilli may cause infections anywhere in the body and “periodontopathic bacteria are responsible for the etiopathogenesis of RA in a genetically susceptible host.” Levels of pro-inflammatory proteins (IL-1, IL-6, TNF) are similar in rheumatoid arthritis and periodontal disease.⁴⁸ Periodontal pathogens may cause or exacerbate rheumatoid arthritis by inducing citrullination, a process by which a protein undergoes a molecular change in structure. The immune system reacts to the protein as a foreign body mounting an attack against it by creating antibodies against it.⁴⁹ According to Payne, et al., it is currently recognized that both periodontal disease and rheumatoid arthritis, when sufficiently severe or after sufficient duration, are associated with systemic inflammation characterized by elevated circulating levels of

acute-phase proteins, C-reactive protein, (IL-6) and tissue destruction matrix metalloproteinase 9 (MMP-9).⁵⁰ Short-term clinical trials have demonstrated that non-surgical periodontal treatment can reduce RA disease activity and systemic inflammation.⁵¹ Subantimicrobial-dose doxycycline (SDD) has been shown to effectively treat both periodontal disease and rheumatoid arthritis.⁵² For patients with rheumatoid arthritis and periodontal disease a personalized medicine approach is recommended, (in conjunction with nonsurgical periodontal therapy) including adjunctive host modulation therapy with SDD either alone or in combination with an anti-inflammatory agent.⁵³

Pulmonary Diseases

(bronchitis, pneumonia, emphysema, chronic obstructive pulmonary disease, pulmonary abscess)

Increasing evidence points to poor oral health as a risk factor for respiratory diseases, especially in high-risk patients, i.e., hospitalized patients requiring ventilation, nursing home residents, and the elderly. The oral cavity serves as a reservoir for respiratory pathogens, is contiguous with the respiratory tract, and may be a pathway for pathogens that could be aspirated into the lungs.⁵⁴

Research findings suggest a possible link between respiratory diseases such as pneumonia, acute bronchitis, and chronic obstructive pulmonary disease and periodontal disease.⁵⁵

The presence of bacteria associated with periodontal disease, such as Pg, may increase a patient’s risk of developing or exacerbating respiratory infections. There is evidence that the neutrophil is a key cell in the inflammatory response of both periodontal disease and pulmonary disease.⁵⁶ Research suggests that proteases and reactive oxygen species can exacerbate inflammation and lead to destruction of connective tissues in both periodontal disease and respiratory disease. A 2013 study published in the *Journal of Periodontology* concludes that while existing research cannot determine causal association, it provides substantial evidence that periodontal disease is associated with chronic obstructive lung disease.⁵⁷

Alzheimer’s Disease Alzheimer’s disease, according to the Alzheimer’s Association, is the sixth leading cause of death in the United States affecting more than five million Americans.⁵⁸ Watts, et al.,⁵⁹ postulated that bacterial and viral infections commonly found in periodontal disease may impact the brain, either directly or via systemic signals to the brain, and contribute to the development of Alzheimer’s disease. Periodontal infections may result in harmful pathogenic products leading to systemic inflammatory responses. Elevated systemic inflammatory responses may contribute to the exacerbation of existing brain pathologies.⁶⁰ Infections may also contribute to vascular pathology with the potential to impact brain function.⁶¹ Periodontal disease and Alzheimer’s disease may also share common risk factors related to production of inflammatory mediators. Research is ongoing to identify the mechanisms by which periodontal inflammation

exacerbates cognitive and neurological pathologies linked with Alzheimer's disease and dementia.

Prosthetic Joint Infection and Failure

The culprit behind failed joint replacements may be pathogenic bacteria from oral infection. DNA testing of synovial fluid from the joints showed bacteria with the same DNA as the plaque from the patient's oral cavity.⁶² Researchers suggest that this might be the reason why aseptic loosening or prosthetic joint failure is observed within 10 years when no infection appears to be present.⁶³ Bacteria such as *Fusobacterium nucleatum* and *Serratia proteamaculans* found in patients with periodontal disease were present in the synovial fluid.⁶⁴ Research is on going to explore this link and to determine if treating periodontal disease will reduce the number of failures of prosthetic joints.

Infertility, Low Sperm Count, Increased Time to Conception

Numerous factors may explain the association between periodontal disease and infertility issues. They include endotoxins released from gram-negative bacteria, direct vascular endothelial infection by periodontal microorganisms, and systemic release of inflammatory mediators by oral bacteria.⁶⁵ Research is on going to discover the pathways through which periodontal disease may affect infertility and if treatment of periodontal disease can decrease the incidence of infertility problems.⁶⁶

Adverse Pregnancy Outcomes (preeclampsia, pre-term, low birth weight babies)

The etiology of pre-term birth is multifactorial, but inflammation is the common mechanism that leads to uterine contractions and cervical changes.⁶⁷ The presence of pro-inflammatory cytokines and prostaglandins is also a significant factor. The maternal and fetal immune response to oral pathogens is also theorized to contribute to the association between periodontitis and pre-term birth, as is the potential of bacteremia from oral infection.⁶⁸

Osteoporosis

Osteoporosis is a progressive bone disease that is characterized by a decrease in bone density and bone mass that can lead to an increased risk of fracture. In osteoporosis, bone mineral density is reduced, bone microarchitecture deteriorates, and the variety and amount of proteins in bone are altered. Several lines of evidence indicate a link between osteoporosis and periodontal disease but the mechanisms are not clear regarding the association between bone mineral density and periodontal disease.⁶⁹

Patients with low systemic bone mineral density may also have low oral bone mineral density, allowing periodontal pathogens to invade the host more easily.⁷⁰ Vitamin D and calcium supplementation may positively affect both periodontal disease and osteoporosis.⁷¹

Oral Cancer

A study published in *Cancer Epidemiology, Biomarkers and Prevention*,⁷² compared rates of periodontal disease in people with and without head and neck cancer. The results showed that each millimeter of bone loss due to periodontal disease was associated with a greater than fourfold increased risk of head and neck cancer. People with head and neck cancers were much more likely to have chronic periodontal disease than people without cancer. The link between periodontal disease and cancer was strongest among people with cancers of the mouth, followed by cancers of the oropharynx and larynx.⁷³ It has been suggested that metabolic by-products of periodontal disease, such as inflammatory cells, cytokines, chemokines, and prostaglandins might account for the relationship between the periodontal disease and oral cancer.⁷⁴

Cancers of the colon, lungs, kidneys, prostate, pancreas, breast, Hodgkin's lymphoma, and multiple myeloma, as well as complications of HIV/AIDS, organ transplants, bone marrow transplants, and stem cell transplants have all been the focus of interest in connection with periodontal disease. While the precise mechanism of the correlation between periodontal disease and various cancers, HIV/AIDS, and transplant complications is the subject of extensive ongoing research, much attention is focused on inflammation and the competency of the immune response. Poor oral health, especially periodontal disease, can be a risk factor for life-threatening systemic conditions.⁷⁵ Possible confounding factors affecting the association between periodontal disease and various cancer risks include smoking, socioeconomic status, ethnicity, age, gender, diabetes and genetics. Some studies also point to dietary factors because patients who have lost multiple teeth may be less able to include the most nutritious foods in their diets, eliminating their advantageous effects against cancer. The connection between periodontal disease and cancer may be carcinogenic metabolic by-products of periodontal disease. Nitrosamines have been linked to cancers of the stomach, pancreas, and esophagus. The presence of inflammatory cells and mediators such as chemokines, cytokines, and prostaglandins associated with tumors are key indicators of this connection. The link between periodontal disease and various cancers is the focus of ongoing research and numerous trials.⁷⁶

Brain Abscess

An uncommon but documented case exists in which an intra-oral focus of sepsis is thought to have resulted in brain abscess without the presence of a lung infection or cardiac disease.⁷⁷ The link between the oral cavity and brain abscess is supported by the isolation of two *Streptococcus viridans* species normally associated with periodontal disease in the brain abscess.⁷⁸ This is considered a rare risk of periodontal disease, but one of which practitioners should be aware.

Medical Practitioners Lack Oral Education

Traditionally, the fields of medicine and dentistry have been separate. But as the link between oral and systemic diseases continues to be researched and verified, this gap is beginning to narrow and medical and dental professionals are realizing a need to work together to treat the whole patient.

According to data from the CDC, 70% of the population visits a dental office annually, leaving 30% who do not regularly see a dentist.⁷⁹ A certain percentage of those people may see a physician; therefore education regarding periodontal disease and its systemic implications is imperative for medical professionals. Just as oral health professionals need to look beyond the oral cavity when they diagnose periodontal disease; there is a need for medical doctors to look at more than tonsils when they look in a patient's mouth. When a physician sees uncontrolled blood sugar, for example, she should not only prescribe medication, dietary information, and provide exercise guidelines but should refer that patient to a dentist for evaluation and treatment of periodontal disease.

In a study published in the journal *Pediatrics*,⁸⁰ 90% of pediatricians reported that they had an important role in identifying dental problems in their patients and educating families about dental care. However, half of the physicians reported that they had no oral health training in medical school or in their residency programs.

Another study showed similar findings in surveys of certified diabetes educators. They felt oral health was important for patient care and education but they also felt that they lacked sufficient knowledge themselves to provide oral health education for their diabetic patients.⁸¹ Even obstetricians, nurse practitioners, nurse midwives, and physicians' assistants who perform pre-natal exams report a lack of education and low rates of oral exam performance unless a patient reports an oral problem. Again, in this instance the practitioners did not feel competent to provide the education or oral examinations. In a survey of internal medicine residents at a teaching hospital in New York City, only 2% felt prepared to discuss periodontal disease and systemic disease, and 90% reported that they had not received any training about periodontal disease in medical school. This self-reported lack of education and knowledge of oral health on the part of medical practitioners highlights the critical need for dental providers to take primary responsibility for being aware of oral-systemic connections and to perform a systemic health risk assessment on every patient in whom periodontal inflammation is detected.

Routine collaboration between dental health care providers and physicians to detect and treat systemic conditions relating to periodontal disease is an idea that is gaining momentum. In 2010, The American Dental Hygienists' Association⁸² stated that dental hygienists are an integral part of the health care team performing assessments of periodontal health and determining protocols for treatment of periodontal disease and management of patients' home care routines. Dental hygienists work with

dentists and interface with medical professionals of various disciplines. Inter-professional collaboration between health care providers would improve outcomes, as all aspects of the patients' health would be addressed. Studies have shown, for example, that it is difficult to control blood sugar in the presence of periodontal disease. Therefore, to medicate a patient without controlling periodontal pathogens would be addressing only part of the patient's health needs. The new paradigm is to treat the whole patient in order to achieve better health.

Turning Awareness into Action

According to Dhadse, et al.,⁸³ "It seems from the scientific evidence gathered so far that interventional periodontal care remains invaluable not only for oral health but for general health as well." Despite the fact that many respected dental and medical opinion leaders encourage dental practitioners to treat periodontal disease with an increasing focus on total body wellness, this philosophy has not yet been incorporated into the majority of dental practices.⁸⁴ Studies show that dentists and dental hygienists are more likely to assess and discuss potential links between a patient's periodontal health status and his glycemic control, for example, than to actually perform a finger stick blood test with a glucometer to evaluate the glucose levels. It is increasingly recommended to evaluate a variety of blood tests to assess the status of the systemic condition when treating periodontal disease.

Barriers in Clinical Practice

Dental health care providers pointed to a variety of barriers to implementing research evidence into practice. Some of the barriers found by the study published by Bell, et al.⁸⁵, are as follows:

- Lack of awareness of available research
- Time constraints
- Insufficient authority to change practice protocols
- Inadequate skills in critical appraisal
- Lack of support
- Patient's objection to fees
- Lack of reimbursement from third-party providers
- Concern over legal risk
- Concern about the dental board's perception of unauthorized practice of medicine

According to this study, another factor that influences dental hygiene care is the hygienist's philosophy of practice, their own expectations of professionalism, and the expectations of their employers and patients. It is compelling that physician Charles Whitney wrote; "Periodontal inflammation and infection is a medical disease of the mouth that physicians cannot treat." Dental professionals are the leaders in treating this "medical disease of the mouth." In order to do so, dentists and dental hygienists must expand their practice to include protocols beyond the traditional treatment for periodontal disease. In particular, dental hygienists, who regularly assess the peri-

odontal health status of their patients, are frontline health care providers for assessing oral-systemic risks and managing those risks, according to Bell, et al.⁸⁶ In light of growing evidence regarding the connection between oral and systemic health, and the fact that people visit dental health care providers far more regularly than they see medical health providers, it is apparent that dentists and dental hygienists must elevate their roles as health care providers to include a comprehensive approach to total body wellness. As additional evidence emerges about the oral systemic link, expectations will change and patients will expect more comprehensive care from dental professionals.

Conclusion

There is a growing movement among individual practitioners, as well as professional organizations, for a revolution in health-care. Collaboration between physicians, dental hygienists and dentists is critical and the time has come to incorporate the systemic health needs of the dental patient into every dental care appointment.

Author Profile

Kathryn Gilliam, RDH, BA, has presented courses based on her passion for the early detection of oral cancer and care for patients undergoing cancer treatment. Her articles have appeared in *General Dentistry*, *RDH*, *Dentistry Today*, and *Hygiene Mastery Magazine*. For additional information, Kathryn may be reached at k2gilliam@gmail.com.

Author Disclosure

Kathryn Gilliam, RDH, BA, has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course.

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Questions

- The term "the oral-systemic link" refers to:**
 - The association between the oral cavity and the respiratory system
 - The association between oral disease and the digestive system
 - The association between oral disease and systemic diseases
 - All of the above
- Which of the following oral diseases is implicated most in systemic diseases?**
 - Dental caries
 - Periodontal disease
 - Oral cancer
 - None of the above
- Why should dental professionals be knowledgeable regarding a link between periodontal disease and systemic health?**
 - Approximately 70% of the US population visits a dental office at least once a year
 - Periodontal risk assessment may reduce negative systemic consequences of periodontal disease
 - Periodontal treatment may reduce negative systemic consequences of periodontal disease
 - All of the above
- Periodontal disease is:**
 - An inflammatory disease of the supporting tissues of the teeth
 - Caused by pathogenic bacterial microorganisms
 - A disease that results in destruction of the periodontal ligament and resorption of the alveolar bone
 - All of the above
- Periodontal disease is:**
 - The body's most abundant source of chronic, low-grade inflammation
 - An autoimmune disease
 - The result of a developmental defect
 - None of the above
- People with periodontal disease are:**
 - 20% more likely to have chronic, systemic health conditions than those with healthy gums
 - 40% more likely to have chronic, systemic health conditions than those with healthy gums
 - 60% more likely to have chronic, systemic health conditions than those with healthy gums
 - None of the above
- Oral examination can reveal signs and symptoms of many systemic diseases including:**
 - Immunologic diseases
 - Endocrine disorders
 - Hematologic conditions
 - All of the above
- One of the factors medical practitioners cite as preventing them from educating patients about oral disease is:**
 - Lack of adequate education
 - Lack of experience
 - Lack of interest
 - All of the above
- Obstetricians, nurse practitioners, midwives and physicians assistants who perform pre-natal exams reportedly do not perform oral examinations because:**
 - Pregnant patients shouldn't have dental care
 - Pregnancy doesn't have any connection to oral disease
 - Practitioners feel incompetent to perform oral exams
 - None of the above
- In an ideal situation, which of the following would examine, evaluate and provide care for patients?**
 - Physicians and obstetricians
 - Dentists, dental hygienists and physicians would collaborate
 - Pediatricians and pharmacologists
 - All of the above
- Research indicates which of the following relationships between periodontal disease and systemic diseases?**
 - Causal
 - Bi-directional
 - Association
 - All of the above
- Which components of periodontal disease are believed to be contributing factors in systemic diseases?**
 - Inflammation
 - Pathogenic bacteria
 - Edema
 - a & b
- Patients diagnosed with periodontal disease may be at higher risk for systemic conditions due to:**
 - Fatigue
 - Compromised immune system
 - Poor circulation
 - All of the above
- Periodontal infection creates multi-faceted challenges to the host body including:**
 - Periodontal pathogens release bacterial endotoxins
 - Gram negative periodontal pathogens bind to platelets
 - Opportunistic microbes spread bio-burden to host body
 - All of the above
- Which of the following systemic conditions have been linked to periodontal disease in some way?**
 - Alzheimer's disease
 - Cardiovascular disease
 - Rheumatoid arthritis
 - All of the above
- Which of the following systemic diseases is believed to have a bi-directional relationship with periodontal disease?**
 - Pulmonary abscess
 - Osteoporosis
 - Diabetes
 - None of the above
- An association means that a patient with periodontal disease could have an increased risk for systemic disease and that periodontal disease:**
 - Did not cause the systemic disease
 - Caused the systemic disease
 - Had no impact on the systemic disease
 - None of the above
- Which of the following systemic conditions have a relationship to periodontal disease?**
 - Stroke
 - Rheumatoid arthritis
 - Chronic obstructive pulmonary disease
 - All of the above
- Periodontal infection may exacerbate:**
 - Insulin resistance
 - Acid reflux
 - Syncope
 - None of the above
- How is cardiovascular disease related to periodontal disease?**
 - Periodontal pathogens have been discovered in the atherosclerotic plaques
 - Periodontal pathogens may trigger the production of inflammatory mediators
 - Periodontal pathogens may increase blood viscosity
 - All of the above
- Poor oral health is a risk factor for respiratory disease in which high-risk population?**
 - The elderly
 - Residents of nursing homes
 - Hospital patients requiring ventilation
 - All of the above
- A bi-directional relationship means that:**
 - Periodontal disease does not contribute to or cause systemic disease
 - Systemic disease has no impact on periodontal disease
 - Periodontal disease and systemic disease contribute to, or cause each other
 - None of the above
- Which of the following periodontal pathogens have been found in the synovial fluid of patients with prosthetic joints?**
 - P. gingivalis*
 - T. forsythia*
 - Both a & b
 - None of the above
- The relationship between periodontal disease and oral cancer involves:**
 - Inflammatory cells
 - Cytokines and chemokines
 - Prostaglandins
 - All of the above
- A study of periodontal disease in people with head and neck cancer found that each millimeter of alveolar bone loss was associated with a higher risk of head and neck cancer by which of the following multiples?**
 - Two-fold
 - Four-fold
 - Eight-fold
 - None of the above
- The link between periodontal disease and cancer is strongest among people with cancer of the:**
 - Mouth
 - Stomach
 - Colon
 - All of the above
- Which of the following are barriers to implementing knowledge of the oral-systemic link into the practice?**
 - Lack of awareness of research
 - Time constraints
 - Inadequate skills in critical appraisal
 - All of the above
- The relationship between diabetes and periodontal disease is considered to be:**
 - Uni-directional
 - Bi-directional
 - Mutually exclusive
 - None of the above
- Rheumatoid arthritis (RA) is:**
 - An autoimmune-mediated acute inflammatory joint disease associated with periodontal disease
 - An autoimmune-mediated chronic inflammatory joint disease associated with periodontal disease
 - An autoimmune-mediated joint disease with no association to periodontal disease
 - None of the above
- In light of growing evidence of the connection between oral and systemic health, dental care must now include:**
 - A comprehensive approach to periodontal disease
 - A focus on the potential effects of periodontal disease on overall health
 - Consideration of systemic issues in every patient interaction
 - All of the above

The Critical Role of the Oral-Systemic Link In Clinical Practice

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Educational Objectives

At the conclusion of this educational activity participants will be able to:

1. Recognize the relationship between periodontal disease and cardiovascular disease, diabetes, rheumatoid, arthritis, and other systemic diseases.
2. Identify the pathways through which the mouth can be a potential source of pathology affecting other systems and organs.
3. Differentiate the various types of associations by which periodontal disease may be linked to systemic diseases.
4. Describe the barriers that prevent medical professionals from acting on information regarding the connection between oral and systemic disease.

Course Evaluation

1. Were the individual course objectives met?

Objective #1: Yes No Objective #2: Yes No
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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

- | | | | | | | |
|--|---|-----|----|---|---|---|
| 2. To what extent were the course objectives accomplished overall? | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Please rate your personal mastery of the course objectives. | 5 | 4 | 3 | 2 | 1 | 0 |
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| 5. How do you rate the author's grasp of the topic? | 5 | 4 | 3 | 2 | 1 | 0 |
| 6. Please rate the instructor's effectiveness. | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Was the overall administration of the course effective? | 5 | 4 | 3 | 2 | 1 | 0 |
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