The Link between Cardiovascular Disease and Periodontal Disease: A Literature Review

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Abstract

Cardiovascular disease is the leading cause of death in the United States. According to the American Academy of Periodontology, one half of people over the age of thirty, approximately 64.7 million Americans, have periodontal disease. The purpose of this literature review is to examine existing studies that document a link between cardiovascular disease and periodontal disease in order to determine if the connection extends beyond shared risk factors. To further support the relationship of the heart and oral environment, research was reviewed to determine if the treatment and subsequent improvement of periodontal status would improve cardiovascular health. Research supports the relationship between the two conditions, although there is no evidence that has established a causal connection. Patients with periodontal disease have higher serum levels of inflammatory markers implicated in cardiovascular disease as compared to patients who are periodontally healthy. Elevated salivary amounts of periodontal pathogens have been found in patients with coronary artery disease when compared to patients without cardiovascular concerns. Nonsurgical treatment of periodontal disease has been shown to decrease the amount of inflammatory markers circulating in the bloodstream and to reduce the thickness of the coronary arteries. The systemic improvement from periodontal therapy is not permanent and supports the current standard of care, calling for long-term interventions. The established link between systemic and oral health adds urgency to the prevention, diagnosis, treatment, and maintenance of periodontal disease.

Introduction

According to the Centers for Disease Control and Prevention, cardiovascular disease is the leading cause of death in the United States. Many of the patients seen in dental offices have some type of cardiovascular disease, which require consideration in determining appropriate treatment. In recent years the interrelationship between the environment in the oral cavity and systemic diseases has become more heavily disputed in an effort to give patients the best chance at controlling both conditions. This established link is of great importance to healthcare providers and patients and influences the standard of care that is currently accepted. The significance of this topic is that by discovering how diseases affect each other, scientists may be able to develop treatment protocols that improve the prognosis for these conditions.

For the purposes of this research, cardiovascular disease will include any conditions that affect the heart or blood vessels. Periodontal disease is defined as "The inflammation and tissue destruction result in degradation of the attachment apparatus of the teeth, causing tooth loss" (Berent et al.. 2009, p. 127). Periodontal disease is thought to be initiated by bacterial plaque and is impacted by the host immune response.

The purpose of this review is to examine the existing research on the relationship between periodontal disease and cardiovascular disease. The following research questions will be addressed:

- Does the evidence support a connection that is more than shared risk factors?
- Is there research that identifies a connection between the management of periodontal disease and improvements in the cardiovascular health of the subjects?

The independent variable in this study is periodontal disease. It will be evaluated for an effect, if any, on cardiovascular disease. Cardiovascular disease is the dependent variable as the research will indicate to what extent it is modified by the treatment of periodontal disease. The review will be organized first to address studies that provide data on the link between the conditions. Research that identifies the management of periodontal disease as a factor in the improvement of conditions that affect the heart and blood vessels will then be evaluated and listed to support the conclusions that a link does exist.

Discussion

In a study conducted by Kodovazenitis et al.. (2011), the connection between periodontal disease and cardiovascular disease was investigated. The purpose of the study was to analyze the effect that periodontal disease had on C-reactive protein (CRP) levels found in patients with acute myocardial infarctions. CRP is an inflammatory marker that is not found in healthy individuals, circulates in the bloodstream, and appears in response to inflammation, infection, or injury. Increased levels of CRP lead to a greater risk of cardiovascular complications. The study subjects were selected from a group of 204 consecutive patients diagnosed with acute myocardial infraction (AMI) and 102 consecutive subjects without AMI at the First Cardiology Clinic of the Hippokration Hospital, University of Athens. The researchers excluded participants based on:

- diabetes mellitus
- hepatitis or HIV infection
- immunosuppressive therapy
- current pregnancy or lactation
- periodontal therapy in the preceding 6 months
- antibiotic therapy for 3 months prior to study entry
- tobacco use

The use of these exclusion criteria adds validity to the research by limiting the effect of common risk factors for cardiovascular disease. The state of the patients' periodontiums was evaluated by one periodontist using criteria accepted widely across the dental profession. Using one specialist to examine patients provides measurements that are considerably more reliable when being compared. The subjects were required to complete questionnaires with regard to their medical and dental history. Periodontal disease was identified as being systemic in exposure when more than 30% of the sites examined had both clinical attachment loss greater than 3mm and probing depths above 4mm, these measurements illustrate how much damage has occurred to the supporting structures of the teeth. The data relating to the presence and amount of inflammatory markers for cardiovascular disease was gathered from blood samples collected from patients when they were admitted. The results showed that the contribution of periodontal disease to CRP elevations was strong, independent of other risk factors and consistent amongst a spectrum of PD measures evaluated. A strong correlation between the presence of periodontal disease and elevated levels of CRP was found in the analysis portion of the results. The findings showed that AMI patients had significantly higher mean CRP levels. The conclusions drawn by the researchers in this study support a connection between periodontal disease and inflammatory markers, specifically CRP.

The sampling method used provided a random way of selecting the study group and eliminated participants with risk factors that could have produced conflicting results. The analysis of the data showed definite significance in the relationship between the two variables and effectively supports a connection between the conditions.

An earlier study attempted to assess if a patient's perception of their oral health status could be useful in determining if indicators for cardiovascular disease were present. A cross-sectional baseline sub study was conducted by Mochari et al.. (2008). The purposes of this study were to "determine if self-reported oral health status is independently associated with inflammatory markers and if oral health assessment as part of CVD (cardiovascular disease) risk screening can identify at-risk individuals without traditional CVD risk factors" (Mochari et al., 2008, p.1509). The participants were already taking part in a study conducted by the National Heart, Lung, and Blood Institute's Family Intervention Trial for Heart Health. The participants were eligible if they were family members or cohabitants of patients hospitalized with CVD, were aged 20-79 years, did not have CVD or diabetes, and spoke either English or Spanish. There were 421 subjects in this study whose oral health condition was evaluated based on the answers they provided to questionnaires with regard

to their oral health status which were designed to be predictive of clinical attachment loss and periodontitis. Questionnaires addressing dietary assessments and physical health were included further to screen the participants. BMI and blood pressure screenings were conducted by trained examiners using automated equipment. Blood specimens were taken and analyzed at the Columbia University Clinical and Translational Science Award Center. The data was collected using standardized forms and double entered, to prevent contamination based on human error, into a Microsoft Access Database. The results showed a statistically-significant difference in the amount of inflammatory markers for CVD, particularly Lp-Pla2 in patients with periodontal disease. According to Mochari et al. (2008),"The data supports a possible independent association between oral health and inflammation, suggesting that inflammation may be the factor in the relationship between oral health and CVD" (p. 1512). This association is shown by the increased amount of inflammatory markers found the blood samples obtained from patients with periodontal disease. The research showed that women were more likely than men to have increased levels of Lp-Pla2, while men had a higher likelihood of having elevated amounts of CRP. The research also disproved a connection between age, education level, and having health insurance with elevated levels of either inflammatory marker studied.

The results of this study are dependent on self-reported periodontal disease. This is a noteworthy limitation, as the true state of the participants' oral health is not documented or quantified by any measurable standard. The participants in this study may not be indicative of the population as they were volunteers and may have characteristics unlike those of the rest of the population, such as an increased access to care.

The identification of shared risk factors for cardiovascular disease and periodontal disease has allowed researchers to eliminate or attempt to reduce the impact of these factors in the design of their studies. The ability to limit these variables, such as smoking and diabetes, provides research that more accurately measures the link between the conditions being evaluated. Berent et al.. (2009), conducted a prospective epidemiologic study of patients undergoing coronary angiography, which is a procedure used to assess cardiovascular disease (CVD), including 466 patients in the research. The participants were admitted to the General Hospital in Wels by recommendation of their physicians to evaluate the presence and extent of CVD using scores to measure the amount of vascular stenosis, the narrowing of blood vessels that can restrict blood flow. Blood samples were collected from the participants and analyzed for inflammatory markers, specifically CRP. The periodontal health of the participants was evaluated using radiographs, and an examination by a dentist using the Community Periodontal Index of Treatment Needs (CPITN). This screening index was designed by the World Health Organization to assess the treatment needs of a community; scores of three (3) or above indicate the presence of periodontal disease. The participants were also interviewed with regard to their oral health behaviors at home by the dentist conducting the screenings. The results confirmed a significant association between periodontal disease and CVD, although it did not draw a correlation between measurable signs of periodontal disease and the severity of CVD. The results showed that the number

of patients with confirmed CVD showed a higher prevalence of periodontal disease than those participants without CVD. According to Berent et al (2009), "CPITN scores of at least 3 were observed in 38% of patients with CHD and 27% of patients without CHD"(p. 130).

This study made adjustments for shared risk factors, namely diabetes, smoking, and age. These confounding variables had the potential to interfere with the data, adjusting for them strengthens the validity of the findings. The extensive data collection process and standardized tests and indices used to quantify the presence and extent of disease also add a measure of reliability to the study. The aim of this study was to determine a correlation between CVD and PD, the method and treatment succeeded in demonstrating a link. The authors' suggestion that further research be done to determine the effect of periodontal therapy on CVD status was a logical next step and increases the usefulness of this research.

Periodontal pathogens, microbes implicated in periodontal disease, have been identified and studied. Research to determine if these microbes are involved in cardiovascular disease helped to strengthen the link between oral and systemic health. Hyvarinen et al.. (2012), described the purpose of the study they conducted at the Helsinki University Central Hospital, as investigating the "association between angiographically verified coronary artery disease (CAD) and salivary levels of four major periodontal pathogens" (p. 478). Periodontal pathogens are a group of bacteria with disease-causing potential and when present are the primary etiologic factors for the loss of supporting structures in the oral cavity. The participants were randomly selected from a group of patients enrolled in the Parogene study between June 2006 and March 2008. These participants were having a procedure, coronary angiography, done to diagnose coronary artery disease and the study group was made up of 492 patients. The methods used to acquire the necessary data included: coronary angiography to determine coronary artery disease; detailed periodontal evaluation including radiographs and full mouth probing with bleeding points to assess the extent of periodontal involvement; salivary sample and blood samples to evaluate for the presence and prevalence of major periodontal pathogens. According to Hyvarinen et al (2012), the results showed "that high salivary A. actinomycetemcomitans (Aa) levels are strongly associated with the risk of angiographically confirmed stable CAD" (p.482). Aa has been shown to be strongly associated with moderate-severe periodontal disease, and this study supported those findings. This study was not able to show a significant relationship between the other three major periodontal pathogens and CAD.

This research supports the theory that oral health is connected to cardiovascular status beyond shared risk factors because the bacteria responsible for periodontal disease were evaluated and measured. The results have an added measure of validity as they confirm previously-documented connections between periodontal pathogens and the severity of destruction clinically visible in the oral environment. This study has implications for the clinical management of periodontal disease as it supports the need to treat the condition to improve systemic health. The treatment of periodontal disease decreases the number of pathogens present, which leads to a suppression of the inflammatory response; the reduction

of inflammation has a positive effect on cardiovascular health. Treatment protocols for periodontal disease should be implemented with an eye to the systemic benefit.

Cardiovascular and periodontal diseases have an inflammatory component. During periods of active periodontal disease, inflammation exists in the oral tissues, which triggers a systemic reaction. Blum et al.. (2007) investigated the connection between periodontal conditions and systemic inflammation as it relates to cardiovascular disease using a prospective case-controlled pilot study. The purpose of this study as stated by Blum (2007) was, "to determine whether periodontitis could be an infectious trigger to systemic inflammation, and whether conservative treatment could cure the local infection and reverse systemic inflammation"(p. 114). Participants were selected from patients referred to the Outpatient Dental Clinic of the Hospital where the study took place in Galilee, Israel. The study group was comprised of nine out of fifty patients who met the criteria of the study. Exclusion criteria included:

- history of smoking
- risk factors for cardiovascular disease particularly hypertension
- diabetes
- family history of cardiovascular conditions
- chronic inflammatory conditions
- cancer

The study group underwent a medical history review and physical examination by a team comprised of a periodontist and cardiologist. This information served as the baseline for the experiment and follow-up measurements were made after intervention with systemic antibiotics, Amoxicillin and Metronidazole, advanced oral hygiene instruction, and two to four sessions of scaling and root planing. Scaling and root planing is a nonsurgical procedure that employs manual and power instruments to free tooth and root surfaces from debris and bacteria. A control group of nine participants was used in this study and included participants not diagnosed with periodontal disease and deemed to be healthy. The results of this research showed that there were elevated levels of CRP in participants with periodontal disease as compared to those without evidence of periodontal disease. According to Blum et al.. (2007), "periodontitis was improved in all 9 patients that completed 3 months of treatment" (p.114). The results also showed a reduction in the levels of CRP post-treatment. Although there was a reduction in the inflammatory markers for cardiovascular disease with the treatment, the levels seen are still higher than those seen in healthy patients such as those in the control group. Blum et al.. (2007), also drew the conclusion that treating periodontal disease, "may inhibit systemic inflammation and could be used as an important prevention tool" (p. 116). The results of this study help to support current treatment regimes that include oral hygiene instruction, instrumentation and chemotherapeutics to improve periodontal health.

This study used methods to increases the significance of the results by testing both a study and a control group and by using the same demographics and exclusion criteria for each. The results agree with previous research supported by the American Dental

Association. The clinical application of this study supports the treatment of periodontal disease using nonsurgical interventions. Improvements seen in the periodontal status and systemic health of participants receiving treatment supports current treatment protocols.

Dental professionals believe that improving oral care practices will improve patients' health. If these improvements impact systemic health as well as the oral cavity, then motivation and urgency to treat and maintain oral health will be increased. Frisbee et al.. (2010), conducted a cross sectional convenience sample study of 115 subjects. The research hypothesis stated that better dental hygiene practices and more frequent preventive dental care would be associated with more favorable levels of systemic inflammation. The data for the analysis of inflammatory markers for cardiovascular disease was collected via blood samples taken from the subjects. The participants were required to complete a structured questionnaire that detailed their health and lifestyle focusing on their oral hygiene practices, dental health, and routine preventive dental care. Those participants who indicated better general oral health showed lower levels of CRP according to Frisbee (2010). Interestingly, the study also found a correlation between specific oral hygiene practices and cardiovascular disease risk factors. The statistics showed, "Less frequent brushing was associated with elevated total cholesterol and less frequent flossing was associated with elevated mean arterial pressure" (Frisbee, 2010, p.179). Self-reported oral hygiene practices demonstrated an impact on important markers for cardiovascular disease and the analysis of the data provided support for the hypothesis. According to Frisbee et al.. (2010), "Better self-reported, overall dental health was associated with lower levels of CRP" (p.180). The conclusions drawn support from previous studies that have documented a relationship between CRP, aggressive, and localized periodontitis. It is also interesting to note that this study dealt with the non-clinical aspects of periodontal disease and that the increased levels of cardiovascular inflammatory markers were present at that point, before the clinical signs and symptoms of the disease were evident. Further research to pinpoint the stage at which cardiovascular health becomes affected may help develop better preventive strategies to reduce the negative systemic influence of periodontal disease.

This study used methods to analyze the data, specifically a multiple linear ordinary least squares regression, to allow the correlation strength of the data to be tested. One significant limitation of this study is that the oral hygiene status and practices were self-reported. The reliability of the participants' responses on the questionnaires was assumed to be accurate and true with no criteria in place to test the amount or extent of their periodontal disease status. The volunteers used as the participants in this study are a possible source of bias as they may have characteristics unlike the rest of the population, such as increased health literacy. Further research is necessary to determine whether the systemic inflammation related to periodontal disease begins before the onset of clinically detectable disease, and if so at what point.

Further research conducted by Xu, F. and Lu, B. (2011), attempted to determine if periodontal disease had a higher prevalence in patients with cardiovascular disease. The research technique was a multistage cluster design study of 3,661 participants over the

age of thirty who had received a periodontal examination from NHANES III mortality follow-up sample. The participants were classified as having moderate or severe periodontal disease using examination procedures obtained on the CDC website which are based on a numeric value for the amount of attachment loss present in the mouth. The stated purpose of the study was to evaluate the relationship of periodontal disease to cardiovascular disease. The study used data collected from the National Death Index records to determine the cause of death. The results of the data analysis showed that "men with severe PD still have an increased risk for CVD and all-cause mortality compared to men without PD in the younger group" (Xu & Lu, 2011, p.539). The results failed to show a relationship between periodontal disease and cardiovascular disease in older men and women.

The information gained through this study is limited as it was taken from post-mortem examinations of the participants. Periodontal disease has periods of activity and remission, the use of information from death certificates does not permit the distinction between current disease activity and the damage to the periodontium seen from disease potentially in a state of remission. The data contained in death certificates is also subject to error and this may impact the results of this study. The findings listed by Xu and Lu (2011), support the results of many other studies. The validity of this work is supported by comparison to research conducted by Kodovazenitis et al..(2011), which also documented an increase in the amount of CRP in participants with periodontal disease.

Current research has not proven that the connection between cardiovascular disease and periodontal disease encompasses all aspects of the disease process. Sridhar et al.. (2009), conducted a study to evaluate the relationship between periodontitis, cardiovascular disease and serum lipid levels. The study included 120 participants who were divided into 4 groups sharing common traits. Group A were periodontally healthy patients without a diagnosed cardiovascular condition and served as the control group for the study. Group B consisted of participants with chronic periodontitis and no documented cardiovascular concerns. Group C participants displayed chronic periodontitis and coronary heart disease (CHD). Group D included those participants with CHD but no measurable signs of periodontitis. The inclusion criteria used for this study included subjects between 40 and 60 years of age, a minimum of 14 natural teeth present, clinical attachment of at least 1mm on 30% of teeth present, and CHD diagnosed with a coronary angiogram. Sridar et al.. (2009), listed the exclusion criteria as:

- other systemic diseases
- non-ambulatory CHD patients
- use of drugs for hyperlipidemia(high cholesterol)
- antibiotic treatment for 4 weeks before the start of the study
- dental treatment 6 months before the start of the study
- tobacco use

Serum levels were measured from blood samples taken at fasting levels for all participants and evaluated for total cholesterol, low and high density lipoprotein, as well as triglyceride levels. The periodontal status was evaluated by an intra-oral examination which included

Gingival Index, Oral Hygiene Index, Periodontal Disease Index scores, and attachment loss measurements. The results did not show a correlation between periodontitis and serum lipid levels, and the presence of elevated levels of triglycerides did not have an adverse effect on the attachment levels of the subjects. The results also concluded that there was not a significant difference in the serum levels of LDL levels in periodontally healthy patients as compared with patients with documented disease.

The use of indices accurately to diagnose participants used in this study adds to the validity of the results and the use of standard tests to measure serum levels of lipids also contributes to the reliability of the data collected by providing consistency. While this study did not show a correlation between periodontitis and serum lipid levels it did not disprove a link between cardiovascular disease and periodontitis. The use of a greater number of participants and evaluating other aspects of cardiovascular disease could further document the correlation between the two conditions.

During dental procedures, oral tissues are manipulated and bleeding frequently occurs. The impact that treating dental disease has on the systemic health has been studied. Minasslan et al.. (2010), conducted a self-controlled case series to investigate whether invasive dental treatment affected the number of vascular events. Minasslan et al.. (2010), stated the null hypothesis, which implies that two aspects in a study are not related, as "rates of vascular events remain constant from day to day and are not affected by exposure to invasive dental treatment" (p. 500). Stating a research goal in terms of a null hypothesis, encourages the study design to attempt to prove that theory. The participants were selected from the Medicaid database and included 1,152 patients admitted for hospitalization for ischemic stroke or myocardial infarction over the age of twenty years. The database listed the disease conditions using the International Classification of Diseases, Ninth Revision, Clinical Modification, classification system. The study collected data for twenty-four weeks before the first cardiovascular event and included only those subjects that had invasive dental treatment and a cardiovascular event during the observation period. Exclusion criteria used for this study included:

- history of diabetes
- hypertension
- coronary artery disease
- participants with prescriptions for antiplatelet or salicylate drugs

The information regarding invasive dental treatment was collected based on the Current Dental Terminology coding system and included procedures such as, periodontal therapy, invasive dental surgery, simple extractions, and complicated extractions. Each procedure was followed by twenty-four weeks of observation. The results demonstrated a significant increase in the number of vascular events in the four weeks following invasive dental procedures. The results also showed that the increased risk of cardiovascular complications following invasive dental procedures declined and reached baseline levels within six months. The data supports findings that periodontal therapy has the potential to increase the systemic inflammatory response, which can impair the function of the blood vessels for

a significant (approximately one week) period of time before returning to baseline levels as previously documented.

One notable limitation of this study is the use of the Medicaid population as these participants may have characteristics that may not be representative of the entire population, such as low socioeconomic status and a heavy proportion of disabilities. Another concern for the reliability of this study is that the use of over-the-counter medications with the potential to affect the cardiovascular system was not considered or addressed. The validity of the study is strengthened by the large number of participants, the length of the study, the uniform coding of the disease status for the participants as well as the outcome of their events.

The effect that treating periodontal disease has on cardiovascular disease is an important aspect of this link that has been evaluated. This research is significant because it attempts to justify the current treatment protocols accepted as standard of care in the dental profession. Piconi et al..(2009), attempted to "verify possible correlations between periodontal disease and atherosclerosis in the clinical setting" (p. 1197). The participants of this longitudinal study were thirty-five otherwise healthy subjects, with a mean age of 46.21 years, who were diagnosed with mild to moderate periodontal disease. The study took place at the Dental Clinic of the Luigi Sacco University Hospital in Milan, Italy. All participants were screened for medical conditions that could be confounding variables. Exclusion criteria for this group included:

- acute infectious diseases
- respiratory disease
- cardiovascular disease
- metabolic conditions
- kidney disease
- tumors
- antibiotic treatment in the previous 6 months

Baseline data was collected to determine the amount of inflammatory markers for cardiovascular disease present using blood samples and Echo-Doppler cardiography of the carotid artery. Periodontal status was evaluated using the Periodontal Screening and Recording Index (PSR), plaque scores, and bleeding points. The numbers and types of periodontal pathogens were measured by collecting and analyzing the crevicular fluid using paper points inserted into four sites per participant. The participants underwent periodontal therapy that included anti-infectives and non-surgical debridements that were completed by the fourth week. Data was then collected again at one, six, and twelve month intervals and compared. The results showed that the treatment applied to the participants caused a significant reduction in the total number of periodontal pathogens present. The treatment also resulted in a decrease in the amount of inflammatory markers for cardiovascular disease in the blood as well as the adhesion and activation proteins. The thickness of the intima-media, a measurement of the innermost two layers of the arterial wall, was also decreased

after treatment. A reduction is a positive finding because the thicker the arterial wall, the more blood flow is reduced which contributes to cardiovascular complications.

This research further supports the link between periodontal pathogens that cause inflammation in the oral cavity and increased systemic inflammation that contributes to cardiovascular disease. Of concern is that the positive effects of treating periodontal disease are time-limited, as the levels of periodontal pathogens gradually increase within the twelve month period studied and indicate the necessity to provide continuous treatment to maintain improvements. The longitudinal method used in this research is verified by repeated observation of the variable over a long period of time. Using exclusion criteria to limit confounding variables strengthens the validity and the applied therapy was standardized and the measurements taken were reliable. This is notable because limiting the effect of shared risk factors for these diseases strengthens their relationship beyond common characteristics.

Conclusion

While a causal relationship between periodontal disease and cardiovascular disease has not been documented, a relationship does exist. Helfand et al.. (2009) state, "Our review and meta-analyses suggest that periodontal disease is an independent, though relatively weak, risk factor for CHD" (p. 502). Cardiovascular and periodontal disease are both prevalent conditions with multifactorial etiologies. The value of assessing and treating periodontal disease is supported by this literature review as the correlation between periodontal disease and cardiovascular disease needs to be of concern for patients and healthcare practitioners. Luciak et al.. (2007), suggest that early treatment might have a positive effect on the health of those at risk for periodontal conditions. The use of screening methods to detect periodontal conditions was found to be beneficial in this study. Nonsurgical treatment of periodontal disease has been shown to improve not only the oral health of patients but also their systemic health. According to Pickett (2012), treatment can reduce the clinical signs of the disease and decrease the systemic inflammatory response. The alteration of inflammatory markers with periodontal therapy is a significant finding and supports the need to address the condition. Lockhart et al.. (2012), state that several cohort studies and randomized clinical trials have reported improvements in endothelial function and associated markers for inflammation among subjects who have undergone nonsurgical periodontal therapy, with or without systemic antibiotics. Of great concern for dental providers is the return to baseline levels of the bacterial burden and inflammatory markers over time. Long-term interventions need to be incorporated into treatment protocols to maintain the improvements seen with initial therapies. Kuo et al.. (2007), support the treatment of periodontal diseases to improve systemic health. According to Kuo et al.. (2007), prevention and management of periodontal diseases can have a significant impact on the improvement of cardiovascular function at a public health level.

The diseases reviewed here are complex and have many shared characteristics and a connection between periodontal disease and cardiovascular disease is supported. The data does not infer a causal relationship, merely a relationship that extends beyond shared risk factors. The treatment and management of periodontal disease has been shown to improve both systemic and oral health, having an impact on inflammatory markers for cardiovascular disease and decreasing the destructive bacteria that is harbored in periodontal pockets. The value of properly identifying and treating periodontal disease should not be understated, as it is a significant factor in the progression of cardiovascular disease, which is the leading cause of death in the United States. Current standards of treatment aim to reduce the presence and extent of periodontal disease and need to be continually updated with evidence based protocols. The management of periodontal disease needs to include long-term and continuous interventions to maintain improvements.

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