

Periodontal Disease in Cardiovascular Risk Assessment

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ABSTRACT

Evidence for a potential link between periodontal disease and coronary heart disease (CHD) has accumulated in recent years, suggesting that the chronic inflammatory component of periodontal disease may be a significant cardiovascular risk factor. Some researchers believe that the risk associated with periodontal disease may be comparable to that of cigarette smoking, hypercholesterolaemia and hypertension. Currently, the American Heart Association is developing a summary on the inclusion of periodontal screening with previously established measures for risk assessment of CHD. Establishment of a routine periodontal screening record, which accounts for various indicators of poor dental health, could alert clinicians to patients at increased risk of heart disease.

INTRODUCTION

Periodontal disease is an inflammatory response to bacteria that reside in the gum tissue (periodontal ligament) surrounding the teeth that, if left untreated, may result in recession of the gums, resorption of bone, tooth loosening and eventual loss of teeth. This disease is postulated to place individuals at increased risk of cardiovascular disease and is globally underestimated. A reasonable argument may be made for the inclusion of routine dental health assessment in the maintenance of optimal cardiovascular health.

In response to a government-sponsored survey revealing an association between poor dental health and cardiovascular disease, a study performed by a Finnish group led by Matilla and colleagues concluded that dental health was significantly worse in patients with myocardial infarction compared to controls.¹ After adjusting for traditional risk factors including smoking, hypertension and dyslipidaemia, those who suffered from periodontal disease demonstrated a significantly higher incidence of coronary heart disease (CHD), stroke and premature death.²

Periodontal Health and Cardiovascular Disease

A risk factor can be defined as a characteristic which places an individual at increased risk for developing a disease. Conventional risk factors or conditions documented in the literature which are known to accelerate the progression of atherosclerosis include diabetes mellitus, cigarette smoking, hypertension, a family history of ischaemic heart disease, hyperlipidaemia, obesity, elevated plasma homocysteine, elevated C-reactive protein (CRP), male gender, menopause,

nephrotic syndrome and hypothyroidism.¹ However, these factors traditionally associated with CHD fail to account for all of the clinical and epidemiological features of the disease.

It has been well documented that CRP is a potentially valuable marker in assessment of cardiovascular risk.^{3,4} Findings in a recent study of 27,939 healthy women suggest that high-sensitivity CRP (hs-CRP) is a stronger predictor of risk than low-density lipoprotein (LDL) cholesterol and contributes additional prognostic information to traditional risk scoring.⁵ Additionally, CRP appears to be strongly associated with periodontal disease. Researchers from the Atherosclerosis Risk in Communities Study of 5,552 subjects reported a significant correlation between periodontal disease and increased CRP.⁶ CRP levels were approximately one-third higher in people with extensive pockets of disease in their gums than those with minimal disease after controlling for age, sex, cigarette use and diabetes mellitus. The protein appears to provoke damage to the walls of major vessels in the brain, heart, legs and other areas by various means including the formation of fatty plaques. This can eventually result in blockage of these vessels and in turn lead to myocardial infarction or stroke. The authors estimated that the cardiovascular risk associated with periodontal disease is approximately the same as that of obesity and interestingly, these two factors appear to be associated.

Large case control studies have also identified an association between dental infection, acute myocardial infarction and chronic CHD. A link between missing teeth and CHD was revealed in a recent 14-year follow-up of 9,760 subjects correlating periodontal disease to an increased

incidence of CHD.¹ The proposed aetiological mechanism behind this association was attributed to the effect of oral bacteria on the cells taking part in the pathogenesis of atherosclerosis and thrombosis. Researchers elsewhere have reported an increase risk of CHD in male subjects with fewer than ten teeth as a result of periodontal disease, compared to those with twenty-five or more teeth.⁷ The authors estimate that the cardiovascular risk associated with periodontal disease may be comparable to that of cigarette smoking, hypercholesterolaemia and hypertension.

Microbial and Inflammatory Aetiology

Recently cleaned teeth almost immediately become coated with a layer of salivary glycoproteins (pellicle). Gram-positive bacteria from the saliva bind to the pellicle via adhesin molecules. Within a few days, Gram-negative bacteria follow suit and become tightly adherent to the Gram-positive bacteria. It is understood that these plaques have all of the features of biofilms, which are matrix-enclosed bacterial populations adherent to each other and to surfaces or interfaces.⁸

Periodontal infection and inflammation are caused by a relatively small group of mostly Gram-negative bacteria. The disease is manifested as inflammation of the supporting tissues of the teeth resulting in destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both. Bacteria are an essential feature but alone are insufficient to cause disease. A susceptible host is essential and host factors are determinative.⁹

In individuals who are not susceptible to the disease and where normal host defences are sufficient to fight off pathogenic attack, the gingival and junctional epithelium may remain undisturbed. However, in susceptible individuals or those lacking adequate oral hygiene, the biofilm may enter the gingival sulcus and disrupt the union between the coronal portion of the junctional epithelium and the tooth. Pocketing becomes apparent, allowing for greater access of bacteria and their products, such as lipopolysaccharide (LPS), to the connective tissue and blood vessels. Pro-inflammatory cytokines are found in high concentrations in periodontally diseased tissues. Microcirculatory vessels become inflamed, engorged and highly permeable to cytokines. Subsequently, the periodontium may

serve as a spillover reservoir of these mediators into the circulation. It is postulated that significant doses of bacteria, LPS and other soluble bacterial products may enter the connective tissues and circulation with relative ease.

High levels of inflammatory cells migrate chemotactically through the junctional and pocket epithelia to the subgingival biofilm. LPS and other substances released from the biofilm can then activate the epithelial cells directly or indirectly to release inflammatory mediators, such as interleukin-8 (IL-8), IL-1 β and tumor necrosis factor (TNF- α). In turn, TNF- α and IL-1 β stimulate the release of IL-6, which signals increased production of acute phase reactants, specifically CRP and serum amyloid A (SAA), from the liver.¹⁰ Both CRP and IL-6 have been implicated in the pathogenesis of atherosclerosis, providing a proposed aetiological link between periodontal health and coronary heart disease.¹¹

The interplay between microbial challenge and various disease modifiers gives rise to the clinical picture of periodontal disease. These disease modifiers may be hereditary or environmental. Many have been implicated, including tobacco smoke, systemic disease, stress, advanced age, ethnicity, male gender, previous history of periodontal disease, compromised host defences and poor oral hygiene.¹² Recent studies suggest that the presence of bacteria alone accounts for only approximately 20 percent of the risk of developing severe periodontal disease and that tobacco smoking is equally or more important as a disease determinant.¹³

Periodontal disease is often a chronic bacterial infection which involves inflammatory processes, such as cardiovascular disease. As described above, periodontal disease stimulates immune mediators which affect the cardiovascular system. Similar pathology is evident in both diseases and it is reasonable to expect some form of interaction between their pathogenic processes. This association can perhaps be put into the context of an innate or acquired hyper-inflammatory response trait that results in a more powerful inflammatory response to LPS challenges from periodontal infections. This hyper-inflammatory response may promote the formation of atheromatous plaques and promote thromboembolic events.⁶

The notion of a connection between periodontal health and circulatory health and the idea that

dental interventions may help in reducing cardiovascular related mortality holds special appeal, in particular because periodontitis is a disease which can be cured.¹⁴ However, it is argued that periodontal disease in itself is not an individual risk factor. One researcher suggests that periodontal disease, heart disease and lung disease may all have an additive effect.¹⁵ The fact that atherosclerosis is most likely to be present to some extent in a majority of individuals implies that proving periodontal disease as a causative factor of atherosclerosis is perhaps less relevant than proving it to be an attenuating factor in an already important disease.

CONCLUSIONS

Should periodontal disease be established among currently accepted risk factors for cardiovascular disease, a new spectrum of disease modifiers, screening and treatment options becomes apparent. The American Heart Association is currently developing a report on whether CRP levels should be routinely screened to diagnose CHD or used to monitor progress of treatment.

A simple routine periodontal screening record which finds poor periodontal health could assist clinicians in identifying high-risk patients and allow for new opportunities to educate them of postulated links to heart disease.

Researchers are still unable to conclusively determine whether periodontal disease is an initiating factor in the pathogenesis of atherosclerosis or simply a factor contributing to its progression. Even if periodontal disease does nothing but exacerbate the already present inflammatory components, its association with cardiovascular risk is a major public health finding. Atherosclerosis is thought to be the underlying cause of approximately 50 percent of deaths in developed countries and is essentially responsible for a large fraction of the clinical problems seen by physicians caring for adult patients. Although the strength of the association between periodontal and cardiovascular diseases remains to be fully established, it is in the interest of public health to address this issue for informed patient care and developing therapeutic applications.

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