



# International Journal of Medical Research & Health Sciences

www.ijmrhs.com Volume 2 Issue 3 July - Sep Coden: IJMRHS Copyright ©2013 ISSN: 2319-5886

Received: 4<sup>th</sup> Apr 2013 Revised: 23<sup>rd</sup> Apr 2013 Accepted: 29<sup>th</sup> Apr 2013

Review article

## PERIODONTAL DISEASE AND SYSTEMIC HEALTH: A REVIEW

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### ABSTRACT

Periodontal disease is an infectious disease. However, certain factors like environmental, physical, social and host stresses may affect and modify disease expression. Certain systemic disorders affecting the neutrophil, monocyte/macrophage and lymphocyte function result in altered production or activity of host inflammatory mediators which may affect the initiation and progression of gingivitis and periodontitis. Evidence has also shed light on the converse side of the relationship between systemic health and oral health i.e. the potential effects of periodontal disease on a wide range of organ systems like the cardiovascular, endocrine, reproductive and the respiratory system. This article sheds light on the effects of periodontal disease on different systemic conditions, the possible mechanisms involved and the role of periodontal therapy on systemic outcomes.

**Keywords:** Periodontal medicine, Systemic diseases, Pregnancy, Osteoporosis, Alzheimer's.

### INTRODUCTION

The periodontal diseases are a family of chronic inflammatory diseases, including gingivitis and Periodontitis, which involve the periodontium (the bone and soft tissues that support the teeth in the jaws). Gingivitis, an inflammation of the gums, is a very common condition. Periodontitis is also common and is a more severe condition that causes loss of bone that supports the teeth. Research over the last 30 years has described the role of bacterial plaque in causing periodontal disease, and controlled clinical trials suggest that periodontal treatment (such as scaling and cleaning of teeth) usually stabilizes the condition

and improves periodontal health.<sup>1,2</sup> Thus, periodontal management, with an emphasis on bacterial plaque control, is an evidence-based intervention with established health outcomes.

A wide range of systemic conditions, ranging from the hormonal changes of puberty and pregnancy to disease entities involving immune dysfunction, connective tissue disease and malignancy, have manifestations in the mouth. The dynamics of the periodontium are a product of its circulation, hormonal changes and immune response mechanisms. Changes in systemic health that affect any of these factors can be

reflected in changes in periodontal health. While this is well known, the main concerns of periodontics remain focused on oral causes, oral risks and oral remedies. Indeed, dental education, management and research have been limited by the dualistic notion that the oral cavity is separate from the rest of the body.

However, recent research suggests that periodontal diseases can influence systemic health through two mechanisms. The first is direct, by the pathogenic action of dental plaque bacteria that enter the bloodstream (bacteraemia). The second is indirect, by the distant effect of inflammatory mediators, such as cytokines, prostaglandins and serum antibodies that are induced by periodontal disease.

**Focal infection theory :** In 1900's, William Hunter, a British physician, first developed the idea that oral microorganisms were responsible for a wide range of systemic conditions that were not easily recognized as being infectious in nature.<sup>3</sup> He claimed that gingivitis, periodontitis and carious teeth with periapical infections as 'foci of infection'. Hence, he advocated the removal of teeth with sepsis to improve the overall systemic health.

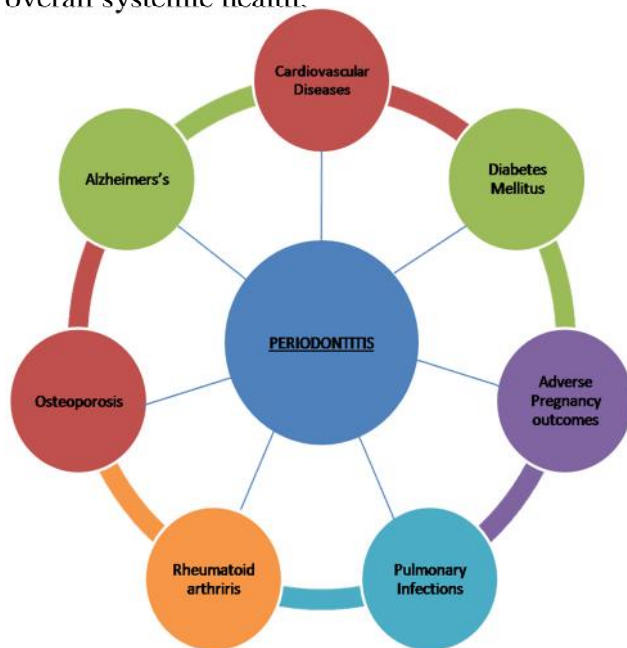


Fig1: The most significant areas identified to date to have a suspected oral-systemic connections

**Current era:** The Focal infection theory fell into dispute in the 1950's when widespread extraction failed to reduce or eliminate the systemic conditions. The theory, had been based on very little, if any, scientific evidence. In 1989, a landmark publication ushered, Mattila and colleagues<sup>4</sup> reported that when patients presented to the emergency room with a cardiac arrest, they were more likely to have a high index of oral disease, which included gingivitis, periodontitis, and endodontic problems.

[Fig.1]

**A. Periodontal diseases and cardiovascular diseases:**

The risk factors for cardiovascular diseases (CVD's) such as hypertension, hypercholesterolaemia, and smoking do not account for all the variations in the incidence and severity of CVD. Certain unrecognised risk factors may also play a role in the pathogenesis of the same. Bacteraemia as caused due to eating, flossing, brushing is a particular risk for people with damaged heart valves, prosthetic valves and various cardiac anomalies that may develop bacterial endocarditis if bacterial vegetations form in parts of the heart with turbulent blood flow. Another possible mechanism is that periodontal infection can cause hypercoagulability state by an increase in fibrinogen, C- reactive protein, white blood cell count and von Willebrand factor causing ischemic heart disease. Clinical studies have found that people with periodontal diseases are almost twice as likely to suffer from coronary artery disease as those without periodontal diseases.<sup>5</sup> CVD and periodontal diseases may share a similar causative pathway through a hyper-inflammatory phenotype. Moreover, periodontal diseases may also exacerbate existing heart conditions. Patients at risk for infective endocarditis may require antibiotic cover prior to dental procedures likely to cause bacteraemia's. People diagnosed with acute cerebrovascular ischaemia, particularly non-haemorrhagic stroke,

were found to be more likely to have a periodontal infection.<sup>6</sup> Here, the periodontal disease may contribute directly to the pathogenesis by providing a persistent bacterial challenge to the arterial endothelium resulting in the narrowing of the vessel lumen.

#### **B. Periodontal disease and diabetes mellitus:**

Although the relationship between periodontal disease, inflammation and overall health has been suspected, numerous studies are providing more comprehensive evidence for this link. In this context, diabetes predisposes oral tissues to greater periodontal destruction but several studies have now identified that periodontal disease leads to poor glycemic control. It was hence predicted that there exists a *two-way* relationship between periodontal disease and diabetes mellitus.<sup>7</sup> Although diabetes is a metabolic disorder and periodontitis is an infectious disease, the relationship occurs through the ability of both conditions to induce an inflammatory response leading to the production of inflammatory mediators. These proinflammatory cytokines such as Interleukin-6 impair the glucose-stimulated release of insulin from the pancreas. Infact, periodontal disease has been considered as the sixth complication of diabetes.<sup>8</sup> Periodontal therapy, on the other hand, can stabilize glycemic control and reduce complications from unstable blood sugar levels.

#### **C. Periodontal disease and adverse pregnancy outcomes:**

The adverse pregnancy outcomes associated with periodontal disease are pre term low birth (PTLBW) weight and pre-eclampsia. Preterm low birth weight is a significant cause of infant morbidity and mortality. There are a number of risk factors associated with adverse pregnancy outcomes including low socioeconomic status, the mother's age, race, multiple births, smoking, alcohol abuse, systemic maternal infection, genitourinary tract infections and bacterial vaginosis.<sup>9</sup> It was hypothesized that periodontal

infection which serves as a reservoir for anaerobic bacteria and inflammatory mediators may be a potential threat to the foetal -placental unit by provoking an inflammatory response producing prostaglandin production resulting in pre term labor.<sup>10</sup> Offenbacher and colleagues found that the risk of PLBW was 7.5-fold greater if the mother had evidence of periodontal disease compared to those with no periodontal disease.<sup>11</sup> These findings support the theory that blood-borne bacteria can reach the foetus and thus induce an immunologic response.

Pre-eclampsia is a common disorder of pregnancy that is characterized by hypertension and the presence of protein in the urine. A case-control study carried out in Colombia showed a consistent link between exposure to periodontal disease and subgingival pathogens and pre-eclampsia in pregnant women.<sup>12</sup>

#### **D. Periodontal disease and pulmonary infections.**

To date there have been two systematic reviews, both of which concluded that there was evidence of an association between periodontal disease and two respiratory conditions, bacterial pneumonia and chronic obstructive pulmonary disease (COPD). Bacterial pneumonia is either community-acquired or hospital acquired (nosocomial). The main cause of the first type is aspiration of bacteria that reside on the oropharynx. Oropharynx being the primary site of potential respiratory pathogens can lead to pneumonia with subsequent aspiration. The most important established risk factor for COPD is a history of prolonged cigarette smoking. There were some reports of an association between COPD and poor oral hygiene.<sup>13</sup> Though conflicting results have been obtained regarding the link between periodontitis and acute respiratory infections, it can be concluded that improvement of oral hygiene and professional oral health care are vital for reducing the occurrence of pneumonia among high-risk elderly adults especially those living in nursing homes.

### **E. Periodontal disease and rheumatoid arthritis:**

The two diseases share some basic characteristics: both, diseased gingival tissues and joints affected by rheumatoid arthritis (RA) produce similar cytokines and growth factors that promote the dissolution of bone, a problem shared by both diseases. This suggests the presence of a common underlying inflammatory mechanism. Levels of antiCCP antibodies (anti-cyclic citrullinated peptide antibody) are considerably higher in RA patients with periodontal disease,

Suggesting that periodontitis may be a contributing factor in the pathogenesis of RA. Coincidentally, *P.gingivalis* produces an enzyme that induces citrullination of various autoantigens.<sup>14,15</sup>

### **F. Periodontal disease and osteoporosis:**

The common factor between osteoporosis and periodontal disease is the excessive osteoclastic activity and bone loss initiated through chronic inflammatory conditions. This shared chronic inflammatory response may predispose individuals with periodontitis to osteoporosis. Estrogen modulates cytokines that regulate bone metabolism and the host inflammatory response. Lack of estrogen increases the number of osteoclasts causing an imbalance in bone metabolism and a reduction in bone density. Periodontitis also activates the inflammatory response and the osteoclasts. Many investigations have found a significant correlation between periodontal disease and estrogen deficiency. These two risk factors, working together, can induce osteoporosis.<sup>16</sup> Further, risk factors such as age, smoking and estrogen deficiency are the same for both, periodontal disease and osteoporosis.

### **G. Periodontal disease and Alzheimer's disease:**

There is evidence that periodontal disease may be a risk factor for dementia through the bacterial and viral infections commonly found in periodontal disease. Periodontal infections may

result in elevating the systemic inflammatory response which in turn may contribute to existing brain and vascular pathologies that would impact brain function.<sup>17</sup> Hence, timely treatment of periodontal infections that reduces oral pathogens would also reduce the risk of systemic infection.

### **CONCLUSION**

The emerging field of periodontal medicine offers new insights into the concept of the oral cavity as one system interconnected with the whole human body. The potential link between periodontitis and systemic conditions is now the focus for a wide range of research around the world. The potential for periodontal pathogens to gain access to the systemic circulation through ulcerated pocket walls is certainly present.

Biologically plausible mechanisms support the role of periodontal infection in these conditions, but periodontal infection should not be presented as the cause but a readily modifiable risk factor for such systemic diseases and conditions.

However, in order to show cause between periodontal disease and systemic condition, the need for more studies is greatly advocated by physicians and dentists. In general, larger and more randomized populations and better controlled clinical trials will be required to substantiate the correlation of periodontal disease to these systemic conditions.

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