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### Association of systemic and periodontal diseases: A hospital based study

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#### Abstract

**Background:** In recent years there has been considerable interest in possible links between periodontal disease and systemic diseases. Research has shown that periodontal disease is associated with several other diseases like diabetes mellitus, cardiovascular disorders, respiratory disorders, gastrointestinal disorders, hepatic disorders, renal disorders, bone/joint disorders and hypertension. The main aim of this study is to determine the frequency of periodontitis in patients with systemic diseases (Diabetes, CVS and respiratory disorders mainly) admitted in the hospital.

**Materials and methods:** The study population consisted of 60 patients each of CVD, respiratory disease, and diabetes mellitus, making a total of 180 patients in the systemic disease group. A control group of 200 subjects were also included in the study for comparison purpose. The periodontal status of the patients with these confirmed medical conditions was assessed with the help of sterilized dental mirror, periodontal probe, wooden tongue depressor and torch.

**Result:** Systemic diseases negatively impacting periodontal status. In terms of periodontitis, 29% of population experienced mild periodontitis, 32% had aggressive periodontitis, 26% had moderate periodontitis while 13% had gingivitis.

**Conclusion:** Diabetes mellitus, CVD, and respiratory disease are associated with a higher severity of periodontal disease. The bidirectional relationship between periodontal diseases and systemic illnesses imply that improving oral health can lead to betterment of systemic health.

**Keywords:** Periodontitis, systemic health, oral health, cardiovascular disease (CVS), diabetes

#### Introduction

Researches has shown that periodontal disease is associated with several other diseases. For a long time it was thought that bacteria was the factor that linked periodontal disease to other disease in the body; however, more recent research demonstrates that inflammation may be responsible for the association [1]. Therefore, treating inflammation may not only help manage periodontal diseases but may also help with the management of other chronic inflammatory conditions. In recent times, evidence from well-designed studies began to emerge in the late 1980's of possible linkages between chronic periodontal disease and other systemic diseases. Since then there has been an exponential rise in the number of studies that have investigated links between periodontal disease and various diseases with the main areas of interest being: atherosclerotic cardiovascular disease, diabetes, and respiratory diseases. Associations between periodontitis and many other diseases and conditions have also been reported including adverse pregnancy outcome; chronic kidney disease; rheumatoid arthritis; cognitive impairment; obesity; metabolic syndrome; and cancer. Periodontal disease refers to the inflammatory processes that occur in the tissues surrounding the teeth in response to bacterial accumulations, or dental plaque, on the teeth [2]. The bacterial accumulations cause an inflammatory response from the body. The chronic and progressive bacterial infection of the gums leads to alveolar bone destruction and loss of tissue attachment to the teeth [3]. Periodontal disease has many states or stages, ranging from easily treatable gingivitis to irreversible severe periodontitis. The mechanisms by which periodontal infections may influence systemic health have been described as follows:

1. Oral-hematogenous spread of periodontal pathogens and direct effects to target organs.
2. Transtracheal spread of periodontal pathogens and direct effects to target organs.
3. Oral-hematogenous spread of cytokines and antibodies with effects at distant organs.

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In this study we are concerning association of periodontal conditions with mainly 3 systemic condition which includes Diabetes, Cardiovascular diseases and respiratory conditions.

**Diabetes:** Diabetic patients are more likely to develop periodontal disease, which in turn can increase blood sugar and diabetic complications [4] People with diabetes are more likely to have periodontal disease than people without diabetes, probably because people with diabetes are more susceptible to contracting infections. In fact, periodontal disease is often considered a complication of diabetes. Those people who don't have their diabetes under control are especially at risk. Research has suggested that the relationship between diabetes and periodontal disease goes both ways - periodontal disease may make it more difficult for people who have diabetes to control their blood sugar [5]. Severe periodontal disease can increase blood sugar, contributing to increased periods of time when the body functions with a high blood sugar. This puts people with diabetes at increased risk for diabetic complications [6].

A recent hypothesis links chronic subclinical inflammation with insulin resistance, initiating the development of type 2 diabetes. The triggers of inflammation are many and potentially include oral infection, which may lead to a cascade of events, including increased cytokine production, activation of acute-phase protein synthesis, and consequent insulin resistance that produces pathogenic changes resulting in type 2 diabetes [7] Periodontal pathogens, especially *P. gingivalis*, have the ability to invade deep vascular endothelium associated with the periodontium, and can be found within pathological vascular plaques. In patients with periodontal disease, chronic low-level systemic exposure to periodontal microorganisms may exist, leading to significant changes in plasma levels of cytokines and hormones [8]. Due to the dynamic nature of the inflamed periodontium, the tissue may serve as an endocrine-like source of inflammatory mediators. Among the inflammatory biomarkers examined, CRP and IL-6 appear to be promising, due to their plausible biological mechanisms, as exposed in studies of links between periodontal disease and systemic diseases [9]

**CVS:** Several studies have shown that periodontal disease is associated with heart disease. While a cause-and-effect relationship has not yet been proven, research has indicated that periodontal disease increases the risk of heart disease [10]. Scientists believe that inflammation caused by periodontal disease may be responsible for the association. Periodontal disease can also exacerbate existing heart conditions. Patients at risk for infective endocarditis may require antibiotics prior to dental procedures [11].

Atherosclerosis is a condition in which the artery wall thickens as a result of the accumulation of calcium and fatty materials that form plaques and cause the arteries to harden and stiffen. Depending on location, complications of atherosclerosis include angina, myocardial infarction, stroke, or aneurysm [12]. Bacteria, central to the initiation and progression of periodontitis, may provide a direct or indirect mechanistic link to the development of atherosclerotic disease. The association between periodontal disease and atherosclerotic cardiovascular disease is independent of other known confounding risk factors [13]. Periodontal disease may be associated with CVD due to mutual risk factors for atherogenesis and periodontal disease. In order to consider periodontal disease as a risk factor for atherosclerosis and other CVDs, the presence of pathogens associated with

periodontal infection should be localized in serum or atheromatous plaques [14].

Etiologically, the chronic presence of periodontal microbes can lead to atherogenesis via two pathways: direct invasion of the arterial wall and the release, in response to infection, of systemic inflammatory mediators with atherogenic effects. These pathogens, especially *P. gingivalis*, have demonstrated the ability to interact with the endothelial surface and to induce smooth-cell proliferation, causing damage and impairing the vasomotor functionality of the endothelial cells [15]

**Respiratory Disease:** Research has found that bacteria that grow in the oral cavity can be aspirated into the lungs to cause respiratory diseases such as pneumonia, especially in people with periodontal disease [16]. Studies investigating a link between COPD and periodontitis remain preliminary and as such there is no clear evidence [16]. Pneumonia, involving infection within the airways, may associate with periodontitis especially as many potential opportunistic pathogenic bacteria are found within the oral cavity. Improved oral hygiene has been shown in randomised controlled trials to have an important role in the prevention of pneumonia in a variety of at risk-populations. However, there are few studies investigating the effects of established chronic periodontitis in relation to acquired lung infections [17].

Researchers have suggested that a link between osteoporosis and bone loss in the jaw. Studies suggest that osteoporosis may lead to tooth loss because the density of the bone that supports the teeth may be decreased, which means the teeth no longer have a solid foundation. Researchers found that men with gum disease were 49% more likely to develop kidney cancer, 54% more likely to develop pancreatic cancer, and 30% more likely to develop blood cancers [18]

### Materials and methods

The study was conducted to assess the periodontal status among patients with CVD, respiratory disease, and diabetes mellitus, and compare with the healthy individuals. The data were obtained. Before conducting the study, the required permission for conducting the study was obtained from the concerned hospital authorities. Ethical clearance was obtained and written informed consent to carry out the study was obtained from the participants/attendees before carrying out the examination. The study population consisted of 60 patients each of CVD, respiratory disease, and diabetes mellitus, making a total of 180 patients in the systemic disease group. A control group of 200 subjects were also included in the study for comparison purpose.

Conscious patients having permanent dentition and suffering from one disease were selected for the study after taking informed consent. Patients with acute infections, pain, pregnancy, loss of teeth due to trauma or any accident and total absence of teeth were excluded which resulted in total sample size of 180 patients. The patients were asked about their disease and the reason for visiting hospital. Their medical reports were assessed to rule out co-morbidities. Dental examination was performed using sterilized dental mirror, periodontal probe, wooden tongue depressor and a torch light. Data for systemic disease and periodontal status was recorded for every patient. The normal number of teeth was taken to be 28 excluding 3rd molars for this study. The clinical examination of the subjects was carried out by a single, trained examiner. The control group included the healthy subjects without any systemic disease/conditions.

Equal number of both males and females participants were included to avoid gender bias. Matching of the subjects in the systemic disease/conditions and control group was done on the baseline characteristics such as age, gender, and oral hygiene habits.

General information regarding the patient’s demographic profile, oral hygiene practices, and personal habits (such as tobacco, alcohol, or any other abusive habits). All relevant information regarding the age, oral hygiene aids used (finger, stick, toothbrush, tooth paste, tooth powder, tongue cleaner, mouth washes, and interdental brushes), and frequency of tooth brushing (once and twice daily) was recorded.

According to Periodontal disease classification, gingivitis was taken as inflammation of gums. Periodontitis (generalized

with > 30% sites covered) is categorized as mild, moderate and aggressive, with mild having 1-2 mm of and clinical attachment loss moderate being 3-4mm and aggressive being >5 mm.

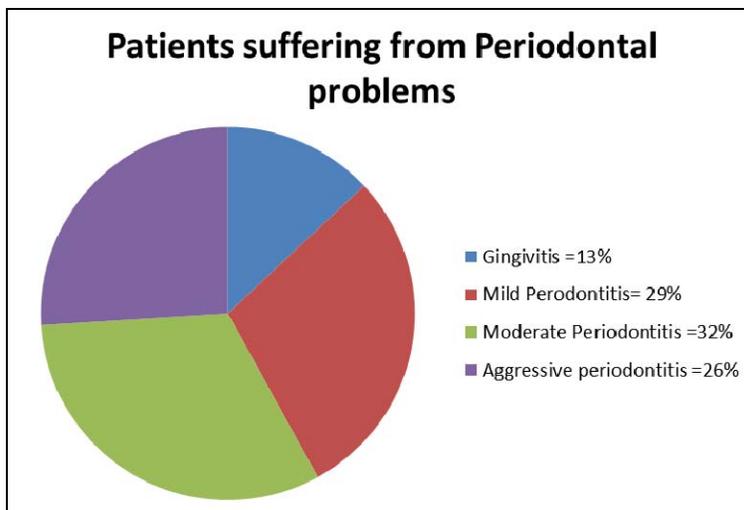
**Result**

There were equal number of males and females in the selected sample of 180 patients with the mean age of 43.28 years (± 14.45) and the age range as 25-65 years. 87% of the sample has periodontitis while 13% had gingivitis. Demographic details of patient is given in table no 1.

In terms of periodontitis, 29% of population experienced mild periodontitis, 32% had aggressive periodontitis, 26% had moderate periodontitis while 13% had gingivitis. Periodontal status of patients with systemic diseases is given in table 2.

**Table 1:** Demographic details of patients

Variables	Diabetes Mellitus(n=60)	CVS (n=60)	Respiratory Disorders (n=60)	Controls (n=200)
Age(years)				
25-35	12	8	19	53
36-45	17	16	11	72
46-55	15	24	16	44
56-65	16	12	14	31
Smoking/Alcohol				
Yes	24	31	27	121
No	36	29	33	79
Frequency of brushing				
Once	44	38	31	142
Twice	16	12	29	58
Tongue cleaning				
Yes	14	21	19	151
No	46	39	41	49
Use of mouthwash				
Yes	22	26	18	61
No	38	34	42	139
Method of cleaning				
Toothpaste and toothbrush	24	26	31	92
Neemstick	17	21	14	57
Manjan and finger	19	13	15	51



**Table 2:** Periodontal status of patients with systemic diseases

Periodontal status	Diabetes	CVS	Respiratory diseases	Controls(n=200)
Gingivitis (23)	6 (26.08%)	9 (39.13%)	8 (34.7%)	134
Mild Periodontitis (52)	20 (38.46%)	15 (28.84%)	17 (32.6%)	48
Moderate Periodontitis(57)	19 (33.3%)	23 (40.3%)	15 (26.31%)	12
Aggressive Periodontitis (48)	15 (31.25%)	13 (27.08%)	20 (41.6%)	6

It was seen that 23 patients in systemic group were having gingivitis, 52 had mild periodontitis, 57 had moderate and 48 were having aggressive periodontitis while in controls, very less number of subjects were suffering from periodontitis. In diabetic patients 26.08% population were having gingivitis, 38.46%, 33.33%, 31.24% were having mild, moderate and aggressive periodontitis respectively. In patients having CVS problem majority were having Moderate periodontitis (40.3%) and in respiratory disorders 41.6% were having aggressive periodontitis.

### Discussion

There is highly significant association between periodontal and systemic diseases. It can be seen that systemic diseases always affect oral hygiene negatively as none of the patient had sound oral health. Periodontally majority 32% of the patients had moderate form of periodontitis while 29% and 26% had moderate and severe periodontitis respectively. Both types of D.M. are known risk factor for periodontitis and it is cited as the 6th most common complication of D.M.<sup>19,20</sup> The poor blood sugar control puts diabetic patients at 2.8 times higher risk of periodontitis and almost 4.2 times at risk of alveolar bone loss relating hyperglycemia with increased chances of periodontitis<sup>[21]</sup>.

A longitudinal study of diabetes and periodontal disease has been carried out in an Indian population in the United States having a prevalence of non-insulin-dependent diabetes of about 50%. This is the highest reported prevalence of non-insulin-dependent diabetes in the world<sup>[22]</sup>. Poor glycaemia control was defined as the occurrence of glycated hemoglobin of 9% or more at follow-up. The results indicated that severe periodontitis at baseline is associated with increased risk of poor glycaemic control at follow-up 2 or more years later. These findings suggest that severe periodontitis may be an important risk factor in the progression of diabetes, and control of periodontal infection is essential to achieve long-term control of diabetes mellitus<sup>[23]</sup> Grossi and Genco reexamined the studies that addressed the effect of periodontal treatment on metabolic control of diabetes mellitus<sup>[23]</sup>. Six of these studies included type 1 patients, and two studies included type 2 patients. Periodontal treatment was divided into two groups, mechanical treatment only and with systemic antibiotics as an adjunct to mechanical treatment. The results show that the effect of periodontal treatment on diabetic metabolic control is dependent on the mode of therapy. Results from the study by Grossi *et al.*<sup>[24]</sup> indicated that the effective control of periodontal infection in diabetic patients could reduce the level of advanced glycation end-products (AGEs) in the serum. AGEs are known to cause hyperglycemia, which is a complication of diabetes; thus, the level of glycaemic control seems to be the key factor<sup>[25]</sup>. Many researchers have noted similar positive correlations of poor glycaemic control in patients with high tooth attachment loss<sup>[26, 27]</sup>. Prevention and control of periodontal disease must be considered as an integral part of diabetes control.

Depending on location, complications of atherosclerosis include angina, myocardial infarction, stroke, or aneurysm. Together, cardiovascular diseases are the number one cause of death globally<sup>[28]</sup>. An estimated 17.5 million people died from CVDs in 2013, representing 31% of all global deaths.<sup>29</sup> Bacteria, central to the initiation and progression of periodontitis, may provide a direct or indirect mechanistic link to the development of atherosclerotic disease. The association between periodontal disease and atherosclerotic cardiovascular disease is independent of other known

confounding risk factors. A systematic review published in 2003 studied the evidence supporting the association between PD and CVD<sup>[30]</sup>. Thirty-one human studies were selected. The authors concluded that “periodontal disease may be modestly associated with atherosclerosis, myocardial infarction and cardiovascular events”. Other three systematic reviews reported a modest but significant association between CVD and periodontal disease. The case control study, conducted in Southern Brazil, found a significant association between periodontitis and acute coronary syndrome.<sup>31</sup> One cross sectional study observed significant association between periodontal disease and severe obstruction of coronary artery. However, the authors did not present multivariate analysis with adjustment for confounders related to periodontitis and CVD<sup>[32]</sup>. The other cross-sectional study did not present a multivariate analysis to investigate the association between the two conditions, and reported that periodontal disease was elevated in patients with Ischemic Coronary Atherosclerosis<sup>[33]</sup>. Some potential methodological biases should be considered in order to avoid erroneous conclusions about a causal relationship between periodontal disease and adverse cardiovascular events in these populations<sup>[34]</sup>. The criteria adopted to define periodontal disease exposure in these studies must also be carefully analyzed. More interventional studies, with larger sample sizes, need to be conducted in the population.

Patients with respiratory disorders had great effect on periodontal health as most of patients suffered aggressive periodontitis. The literature states that oral bacteria can be aspirated to cause pulmonary infections and dental plaque can initiate as well as aggravate pneumonia. Chlamydomphila pneumonia; a pathogen involved in pneumonia is shown to increase chances for periodontitis as well as atherosclerosis<sup>[35, 36]</sup>. There has been discussion about poor periodontal health in asthmatic individuals and the decrease in bone density especially in mandible in patients using inhaled corticosteroids. Periodontal attachment loss can also cause a decrease in lung function<sup>[37]</sup>. Maintaining good oral hygiene in C.O.P.D. patients decreases the frequency of exacerbation in chronic periodontitis patients which relates periodontitis as a risk factor for C.O.P.D<sup>[38-40]</sup>. In C.O.P.D. patients; aggressive periodontitis is a common finding<sup>[41]</sup> Therefore, all these findings in the present study suggest the relationship between systemic health and periodontal disease, which is in line with most of the studies that have revealed periodontal diseases to be more pronounced among the patients with systemic disease/conditions. Periodontal disease is a very prevalent oral condition and is responsible for a considerable portion of tooth loss, especially among the elderly population.

### Conclusion

Oral health has a direct and or indirect impact on the overall general health. Periodontal disease is a risk factor for the development of various systemic conditions. Although most evidence in regard to the relationship between periodontal disease and systemic conditions is consistently supportive of our study, 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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