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Research Article

Comparison of Periodontal Destruction between Patients with Coronary Heart Disease and Healthy Subjects Using Panoramic Radiography

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Abstract

Background and aims. Considering the importance and prevalence of cardiovascular disease and periodontal disease, the aim of this study was to compare the amount of periodontal destruction in patients with coronary heart disease (CHD) and healthy controls, using panoramic radiography.

Materials and methods. Fifty-four individuals (27 patients with CHD and 27 patients without CHD) participated in this study; the subjects had undergone angiography procedures for the diagnosis of CHD during the previous year. After patient consent was obtained, panoramic radiographs were taken; then the amount of alveolar bone loss and number of missed teeth were evaluated.

Results. This study showed that the amount of average bone loss in patients with CHD and the average number of extracted teeth were significantly higher than those in healthy subjects ($P<0.001$). The average amount of bone loss according to the number of involved vessels was 4.71 mm in patients with 1 involved vessel, 4.63 mm in patients with 2 involved vessels and 5.14 mm in patients with 3 involved vessels; however, these differences were not statistically significant ($P=0.333$).

Conclusion. This study suggested an association between poor oral condition and CHD, and provided evidence that the improvement of periodontal condition might influence the systemic, inflammatory and haemostatic situation.

Key words: **Coronary heart disease, panoramic radiography, periodontal disease.**

Introduction

Atherosclerosis, an inflammatory disease of the lining of blood vessels associated with local accumulation of lipids in the form of cholesterol, especially LDL,[1] along with coronary thrombosis, is the main reason of morbidity and mortality in the developed and developing countries.[2]

During the last decade, some studies evaluated the relation between inflammation and cardiovascular disease. Based on the results of these studies it was concluded that inflammation plays a key role in the development of atherosclerosis.

The association between high levels of acute phase reactants such as C-reactive protein (CRP), fibrinogen, serum amyloid A and soluble adhesion molecules like ICAM-1, E-selectin, VCAM-1 with the progression of atherosclerosis and with an increased risk for cardiovascular disease has been confirmed by some studies.[3]

Atherosclerosis can result in the narrowing of arteries because of subendothelial deposition of cholesterols, and calcium forming a plaque within the vessel walls. A variety of cell types such as fibroblasts and immune cells accumulate in these cholesterol-rich plaques. The rupture of these plaques yields thrombi that travel distally to occlude the artery, resulting in myocardial infarction.[4]

Genetic and environmental factors such as diabetes,[5] hypertension, smoking, age and abnormal serum lipids[6] are risk factors for coronary artery disease.

Prevalence and incidence of cardiovascular disease are associated with haemostatic and rheological variables which might be mechanisms, risk factors and infections agents (including periodontal disease) which contribute to vascular events. Rheological variables (which influence blood flow) play a role in localizing atherosclerosis and thrombosis; they also promote ischemia.[7]

Recent evidence has shown that high levels of systemic inflammatory and haemostatic factors might possibly accelerate vascular inflammation and promote thrombosis.[8] Therefore, any disorder which elevates these factors in blood stream, such as periodontitis, would be considered as a risk factor for coronary artery disease.[9]

Periodontal disease is the inflammation of tissues surrounding teeth[10] and results from a complex interplay between bacteria and host risk factors such as long-term smoking, poor oral hygiene, poorly controlled diabetes, stress and genetic predisposition. In the presence of inflammation periodontal organisms flourish, enabling their capacity to invade host tissues and gain direct access to the circulation. Repeated bacteremia episodes and endotoxemia are characteristic of periodontal infection.[11]

Periodontal organisms have been found to colocalize within atheromatous plaques.[3] Periodontal disease has been associated with atherosclerosis, cardiovascular disease,[11] diabetes,[5] pre-term low birth weight,[10] stroke,[12] and premature death.[11] Accordingly, via a shared pathogenesis underlying inflammatory response, periodontal disease might account for a portion of the risk for cardiovascular disease.[11]

Considering the importance and prevalence of cardiovascular disease on the one hand and the prevalence of periodontal disease on the other, the aim of this study was to compare the amount of periodontal destruction in patients with coronary heart disease (CHD) and healthy controls, using panoramic radiography.

Materials and Methods

The participants of this cross-sectional, single-blind study consisted of 54 patients (27 patients with CHD and 27 patients without CHD), who referred to Afshar Heart Center in Yazd, Iran, for conventional catheter-based X-ray coronary angiography (CAG) during a 7-month period. All the patients conformed to the American College of Cardiology criteria for suspected coronary artery stenosis. Patients meeting all the following criteria were included in the study: 1) patients with coronary artery disease referring to heart hospital, who had undergone angiography; 2) $\geq$6 natural teeth present; 3) willingness to undergo panoramic radiography and to comply with the study protocol.

According to the Seldinger[13] (1953) approach, catheterization of coronary arteries was performed. After performing coronary angiography, all the images were assessed by a single experienced cardiologist independently to evaluate the stenosis of three main arteries, including the left anterior descending or anterior interventricular (LAD), the circumflex (Cx) and the right coronary artery (RCA) in the heart. All the positive angiographic results for coronary artery stenosis were graded as I, II or III on the basis of the number of stenosis cases of main arteries.

Panoramic radiographies (as a noninvasive method) were taken with a Planmeca 2002 EC Proline multitomographic X-ray unit (Planmeca Co, Helsinki, Finland). They were obtained with a constant 12 mA, 80 kV, and 18 s exposure through 2.5 mm Al filtration, using regular Kodak (Eastman CM cassette) and Kodak T Mat G films (Eastman Kodak Co, Rochester, NY). Films were developed in an automatic film processor (Velopex, Extra-X, Mediavance Instrument

Ltd, London, UK) with standard solution as recommended by the manufacturer. The total time of processing was 4 minutes at 27°C. A single experienced maxillofacial radiologist, unaware of the coronary angiographic results, assessed all the panoramic radiographs. The amount of bone resorption was measured using a caliper with an accuracy of 0.1 mm, while the examiner was not aware of the cardiovascular status of the patients. The distance between CEJ to the most apical point of the alveolar crest was measured in both the mesial and distal aspects of each tooth. In cases in which CEJ of the tooth could not be determined, because of filling or restoration, the CEJ of the neighboring tooth was used as an indicator. In situations in which two adjacent teeth were overlapping, reverse measurement method was used for determination of CEJ. The measurements were performed for all the teeth except third molars. Average values obtained from the mesial and distal surfaces of each tooth were considered as the mean bone loss for a tooth; then the means obtained from all the teeth were averaged to achieve the bone loss for each person.

Results

Evaluation of the angiographic results showed that of 54 patients participating in this study, 27 patients had coronary artery disease while 27 cases were diagnosed as healthy. The average amounts of bone loss in patients with cardiovascular disease and healthy individuals were 4.88 and 3.01 mm, respectively, with statistically significant differences (P<0.001) (Table 1).

The mean number of extracted teeth in patients with CHD were significantly higher than that in healthy subjects (P<0.001) (Table 2).

The amount of average bone loss according to the number of involved vessels was 4.71 mm in patients with 1 involved vessel, 4.63 mm in patients with 2 involved vessels and 5.14 mm in patients with 3 involved vessels; however, these differences were not statistically significant (P=0.333) (Table 3).

Table 1. Comparison of bone resorption between groups

	No.	Average bone resorption (mm)	SD
Healthy subjects	27	3.01	0.61
Cardiovascular patients	27	4.88	0.81

t-test (P <0.001)

Table 2. Comparison of number of extracted teeth between two groups

	No.	Mean number of extracted teeth	SD
Healthy subjects	27	5.63	2.95
Cardiovascular patients	27	8.41	3.04

t-test (P<0.001)

Discussion

The aim of this study was to compare the amount of periodontal destruction in patients with coronary heart disease (CHD) and healthy controls. The present study showed that periodontal destruction in CHD patients was more extensive than healthy controls. In this study the mean bone loss in CHD patients was significantly higher than healthy controls, supporting the results of previous studies.[14-16] However, some studies have confirmed this relationship via clinical periodontal parameters[17,18] or evaluation of serum markers such as C-reactive protein.[17,19] Bone destruction in periodontal disease, leading to tooth loss, results from chronic inflammation of the supporting tissues surrounding tooth structures. Systemic inflammatory response provoked by periodontal disease can lead to the formation of atherosclerotic plaque and cardiovascular disease.

In this study, the number of extracted teeth in CHD patients was significantly higher than healthy subjects, consistent with the results of studies carried out by Johonsson[16] and Humphrey[20] in 2008. The major etiologic factor for tooth loss is caries and endodontic problems in young ages. Tooth loss in middle age and later is mostly due to periodontal disease[12] which results in resorption and destruction of bone until the tooth is lost.

According to this study bone resorption was significantly more extensive in CHD patients than healthy controls; therefore, it might be concluded that the greater number of extracted teeth in CHD patients was due to periodontal disease.

The rate of bone loss associated with coronary artery was another finding of this study. As results showed the amount of average bone loss in patients with 3 involved vessels was higher than patients with 1 or 2 involved vessels but it was not statistically significant (P=0.333). This finding can be attributed to the limited number of samples and distributing them into three groups by the number of involved vessels. It could also be assumed that various risk factors and complexity of their effect on the risk of CHD would

Table 3. Comparation of bone resorption and number of involved vessels

Number of involved vessels	No.	Average bone resorption (mm)	SD
1	8	4.71	0.78
2	7	4.63	0.51
3	12	5.14	0.94
Total	27	4.88	0.81

ANOVA (P=0.333)

yield the aforementioned result.

The present study was limited by the assessment of periodontal disease by radiographic examination, given that measurement provides a correct estimation of ongoing periodontitis but does not account for the burden and type of oral microorganisms.

Results from this study support the association between periodontal disease and CHD and increased risk of cardiovascular disease in patients with periodontitis. Considering that the influence of periodontal infection (with its long-term exposure) could enhance the risk of cardiovascular disease, it is suggested that dental clinics be established as a part of cardiovascular rehabilitation centers, for the purpose of monitoring periodontal situation in CHD patients and delivering necessary treatment if needed. From research point of view, it is suggested that a study be designed in which periodontopathogens can be investigated in the involved coronary arteries during coronary bypass surgery.

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