Introduction

WHO defines oral health as "a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal (gum) disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity."\textsuperscript{1} It is believed that chronic oral inflammation is an effective risk factor for some systemic diseases such as cerebro- and cardiovascular diseases, diabetes mellitus, respiratory disease and low birth weight.\textsuperscript{2-5} There is increasing
Evidence that inflammatory events may contribute to atherogenesis and cardiovascular disease.\(^6\)

Electrocardiogram is a graphic recording of the electrical potential produced by heart muscles. ST segment is usually iso-electric and its depression or elevation is determined in comparison to the iso-electric line (Figures 1 and 2).\(^7\)

Adler et al suggested that ST segment elevation can be a predictive factor for poor outcome in patients with acute myocardial infarction.\(^8\) Barabess et al believe ST segment depression might be a prognostic feature in AMI patients without ST elevation.\(^9\) In this study the aim was to investigate the relationship between oral health and electrocardiogram ST segment changes to evaluate whether oral health would be related to the given predictive factors (ST segment changes) in prognosis of myocardial infarction.

**Materials and Methods**

Thirty-six patients over 42 hospitalized with diagnosis of myocardial infarction in Isfahan, January-June 2011, were enrolled in the study. Edentulous patients and patients with a history of infection in the past 6 months, systemic diseases and patients receiving periodontal treatment in the past 6 months were excluded from study. According to the electrocardiogram taken on the first day of entry patients were divided to two groups: ST segment elevation (study group A: n=23) and St segment depression (study group B: n=13).

The groups were adjusted for age, gender, smoking habits, regular exercise and family history of cardiac diseases. Electrocardiograms were taken using the same device (Schiller Cardiovitat-1) and interpreted by one specialist. Oral health was assessed in both groups by one educated researcher by means of DMFT index (decayed, missing, filled teeth) and periodontal indices: probing depth (PD), clinical attachment loss (CAL) and bleeding on probing (BOP). Instruments used to analyze oral health status were Michigan O probe with Williams marking. Data gathered were analyzed by the use of t-test and chi-square statistical tests.

**Results**

Mean age of the patients (14 females and 22 males) was 60.56 ±10.90 years. BOP was seen in 34.8% of cases in group A and 53.8% in group B. As shown in Table 1, BOP did not reveal any significant differences between groups A and B \((P=0.22)\) (Table 1).

Mean probing depth in group A was \((2.16±1.1)\) and \((2.21±0.32)\) in group B. No statistically significant differences were observed between probing depths between the two groups \((P=0.84)\) (Table 2, Figure 3).

![Figure 1. ST elevation (↓) in relation to isoelectric line is shown (φ).](image1)

![Figure 2. ST depression (↑) in relation to isoelectric line is shown (♀).](image2)

**Table 1. Comparing BOP between two ECG groups**

| ECG                  | Positive BOP N (%) | Negative BOP N (%) | \(P\) BOP (+) between groups |
|----------------------|--------------------|--------------------|-------------------------------|
| Group A: St elevation| 34.8               | 65.2               | 0.22                          |
| Group B: St depression| 53.8              | 58.3               |                               |

**Table 2. Comparing dental indices, CAL, PD and DMFT between two ECG groups**

|                  | Group A ST elevation \((n=23)\) | Group B ST depression \((n=13)\) | \(P\) (Group A vs Group B) |
|------------------|---------------------------------|---------------------------------|-----------------------------|
| CAL              | \(2.1±1.7\)                     | \(4.2±2.3\)                     | 0.003                       |
| PD               | \(2.16±1.1\)                    | \(2.21±0.32\)                   | 0.84                        |
| DMFT             | \(19.3±5.8\)                    | \(22.3±2.3\)                    | 0.18                        |
Clinical attachment loss was 2.1±1.7 in group A and 4.2±2.3 mm in group B (Table 2). As it has been shown in Figure 4 differences in CAL between the two groups were significant (P=0.003, OR=1.68). DMFT index was 19.3±5.8 for group A and 22.3±2.3 for group B (Table 2). As shown in Figure 5, no significant differences were seen between DMFT index between groups A and B (P=0.18). Interactions between BOP, CAL, DMFT and PD were analyzed and no correlations were observed.

Discussion

Oral and dental diseases are among the most prevalent diseases worldwide. Although these diseases are not important causes of mortality, they might have serious impact on the general health. Periodontal disease and dental caries are among the most common oral diseases. Streptococcus bacteria which are abundant in the oral cavity and are responsible for tooth caries can induce the platelets to bind fibrinogen, aggregate and eventually form a thrombus or platelet clot. In vitro studies have also shown that Porphyromonas gingivalis can induce the aggregation of human platelets. Although Birang et al did not reveal significant differences in coagulation factors between patients with gingivitis and a control group.

Periodontitis is characterized by repeated episodes of inflammation that result from gram-negative bacteria. These bacteria have lipopolysaccharides (LPS) in their cell walls which activate the production of inflammatory mediators such as TNF-α and IL-1β. IL-1β itself is a promoter of smooth muscle cell proliferation and can be responsible for thickening of blood vessels walls.

In 2005 Kosarvo et al proved the presence of two oral pathogens: Porphyromonas gingivalis and Actinobacillus actinomycetemcomitans, within the atherosclerotic plaque.

Cueto et al revealed an association between periodontitis and acute myocardial infarction. However, Hujoel et al reported that such a correlation between coronary heart diseases and periodontitis does not exist. Joshipura et al believe that the controversies may relate to the fact that risk factors are different among different countries and nations. Several epidemiologic studies have been performed in Iran, which show that there is an association between oral health and cardiovascular diseases.

Researchers have performed several studies on factors that might have a role in determining the prognosis of myocardial infarction. As Adler et al suggest ST segment elevation can be a predictive factor for poor outcome in patients with myocardial infarction. Okin et al showed that high levels of C-reactive protein in patients with ST segment depression is also predictive of a worst outcome. Barbress et al believe ST segment depression alone might be a prognostic feature in AMI patients without ST elevation. After studying the relation between microalbuminuria and major ECG changes, Tazeen et al showed that microalbuminuria in Asian popula-
tions can be a predictor for cardiovascular disease. In 2004, Tamaki et al. investigated the association between periodontal conditions and electrocardiogram abnormalities and found no correlations between oral factors and the prevalence of electrocardiogram abnormalities. In the present study, PD, BOP and DMFT indices were not significantly different between the study groups. CAL was significantly different between groups. In a study by Arabi et al., CAL was higher in patients with positive heart scan in contrast to control group with negative heart scan. They believe severe periodontal diseases would be expected to be seen in patients with positive heart perfusion scan. Although ST elevation is related to poorer prognosis in comparison to ST depression, as well as CAL, other indices were also all higher, even though not statistically significant, in the ST segment depression group. According to the results of the present study oral health status might be worse in patients with ST segment depression. Similar studies and studies investigating the relation between oral health and levels of ST segment depression are strongly recommended.

**Conclusion**

No correlation was seen between probing depth, bleeding on probing and DMFT with ST segment changes. Clinical attachment loss was significantly higher in patients with ST segment depression.

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**References**

1. World Health Organization. Oral Health. 2012; Available from: http://www.who.int/topics/oral_health/en.
2. Lamont R, Burme R, Lantz M, Leblanc D. *Oral Microbiology and Immunology*. Washington DC: ASM Press; 2006.
3. Cawson R, Odell E. *Oral Pathology and Oral Medicine*. 8th ed. Philadelphia: Churchill Livingstone; 2008.
4. Seymour GI, Ford PI, Cullinan MP, Leishman S, Yamazaki K. Relationship between periodontal infections and systemic disease. *Clin Microbiol Infect* 2007;13:3-10.
5. Li X, Kolltveit M, Tronstad L, Ingar Olsen I. Systemic diseases caused by oral infection. *Clin Microbiol Rev* 2000; 13:547-58.
6. Libby P, Ridker P, Maseri A. Inflammation and atherosclerosis. *Circulation* 2002;105:1135-43.
7. Goldschlager N, Goldman M. *Principals of Clinical Electrocardiography*, 13th ed. Connecticut: Appleton & Lange; 1989.
8. Adler Y, Wiser I, Vaturi M, Kahana-Duczynimer M, Fink N, Birnbaum Y. Association between electrocardiographic patterns and level of C-reactive protein in patients with first anterior wall acute myocardial infarction. *Cardiology* 2002;97:122-6.
9. Barrabés JA, Figueras J, Moure C, Cortadellas J, Soler-Soler J. Prognostic significance of ST segment depression in lateral leads I, aVL, V5 and V6 on the admission electrocardiogram in patients with a first acute myocardial infarction without ST segment elevation. *J Am Coll Cardiol* 2000;35:1813-9.
10. Doifode VV, Ambadekar NN, Lanewar AG. Assessment of oral health status and its association with some epidemiological factors in population of Nagpur, India. *Indian J Med Sci* 2000;54:261-9.
11. Donaghy J. Oral Health – Summary. 2006 [April]. Available from: http://www.erpho.org.uk/topics/oral_health/
12. Birang R, Abrishtian MR, Khakazad SE, Youssefi-E. Comparative study of CBC, CRP and coagulation factors as the possible risk factors of cardio vascular diseases in patients with gingivitis in comparison with the control group. *J Dent Sch* 2007;25:225-60.
13. Beck JD, Elter JR, Heiss G, Cooper D, Maurielle S, Offenbacher S. Relationship of periodontal disease to carotid artery intima-media wall thickness. The atherosclerosis risk in communities (ARIC) study. *Arterioscler Thromb Vasc Biol* 2001;21:1816-22.
14. Kozaroz EV, Dorn BR, Shelburne CE, Dunn WA Jr, Progulske-Fox A. Human atherosclerotic plaque contains viable invasive Actinobacillus actinomycetemcomitans and Porphyromonas gingivalis. *Arterioscler Thromb Vasc Biol* 2005;25:e17-8.
15. Cueto A, Mesa F, Bravo M, Ocan R. Periodontitis as risk factor for acute myocardial infarction. A case control study of Spanish adults. *J Periodontal Res* 2005;40:36-42.
16. Hujoepl, Drangsholt M, Spiekerman C, DeRouen T. Periodontal disease and coronary heart disease risk. *JAMA* 2000;284:1406-10.
17. Joshipura K, Rimm E, Douglass C, Trichopoulos D, Ascherio A, Willett W. Poor oral health and coronary heart disease. *J Dent Res* 1996;75:1631-6.
18. Arabi S, Torkzaban P, Gholami L, Taghavi M, Hatami M. Comparative evaluation of periodontal indices in patients with ischemic heart disease and positive myocardial perfusion scan. *DJH* 2010;1:17-20.
19. Najafi-Parizi G, Lori A. Periodontal disease as a risk factor for coronary artery disease. *American Journal of Applied Sciences* 2005;2:1526-8.
20. Sadeghian S, Taleghani F, Dorashtian A, Raissi M. Periodontitis as a Risk Factor for Coronary Artery Disease. *J Teh Univ Heart Ctr* 2006;2:105-8.
21. Zamirian M, Raoofi S, Khosropanah H, Javanmardi R. Relationship between periodontal disease and acute myocardial infarction. *Iranian Cardiovascular Research Journal* 2008; 1:216-21.
22. Chitsaz MT, Pourrabbas R, Shir Mohammadi A, Ahmadi G, Vatanakhan A. H. Association of periodontal diseases with elevation of serum C-reactive protein and body mass index. *J Dent Res Dent Clin Dent Prospects* 2008;2:9-14.
23. Nesar V, Khosravi M. Periodontitis as a risk factor in non-diabetic patients with coronary artery disease. *Current Research Journal of Biological Sciences* 2010;2:365-9.
24. Sayar F, Parvin M, Tabarak M. Association between periodontal diseases and changes in blood indice. *Beheshti Univ Dent J* 2005;23:55-64. [In Persian]
25. Okin P, Roman M, Best L, Lee E, Galloway J, Howard B, Devereux R. C-Reactive protein and electrocardiographic...
26. Tazeen HJ, Zeeshan Q, Shiraz H. Prevalence of microalbuminuria and associated electrocardiographic abnormalities in an Indo-Asian population. Nephrol Dial Transplant 2009;24:2111-6.

27. Tamaki Y, Nomura Y, Inoue K, Inosita E, Tsurumoto A, Hanada N. Correlation study on oral health and electrocardiogram abnormalities. Int J Oral Sci 2004;46:241-6.

ST-segment depression additively predict mortality. J Am Coll Cardiol 2005;45:1787-93.