

## Utilization of Specific Index for Measuring the Association between Periodontal Conditions and Coronary Artery Disease

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**Abstract: Problem statement:** There is increasing evidence that periodontal disease could play a role in the Progression of coronary heart disease although there are conflicting results about this association in the literature and the difference of used periodontal scoring systems among the studies might be a reason. The purpose of this study was to evaluate a specific scoring system Periodontal Index for Risk of Infectiousness (PIRI) in comparison with one of the classic periodontal indices Extent and Severity Index (ESI). **Approach:** A Total of 200 patients (100 candidate for bypass Surgery and 100 presumably healthy controls) were enrolled in this cross-sectional study age and sex matching were done for the two groups. PIRI and ESI were used to assess the periodontal status in both groups. **Results:** The average of attachment loss extent in CHD group was  $94.77 \pm 13$  and for severity:  $4.47 \pm 1.36$ . The mean ESI scores was significantly higher in patients than in controls ( $p < 0/0001$ ) PIRI score showed that 87 patients in CHD group were in moderate group and 13 patients in severe group also PIRI scores between two groups, showed a significant difference ( $p = 0/01$ ). A logistic regression model showed a association between both indices and coronary situation of patients. **Conclusion:** Our findings suggest that PIRI might be the best indicator for quantifying of subgingival surface exposure to microbial products and the risk of systemic consequences of periodontitis. Although it should be evaluated in other studies.

**Key words:** Periodontal index, coronary artery disease, PIRI, periodontal conditions, coronary artery disease, specific index, CHD

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### INTRODUCTION

Atherosclerosis is a vascular disease that reduces arterial lumen size through plaque formation and arterial wall thickening. The pathological complications of atherosclerosis, namely Coronary Heart Disease (CHD) and stroke, remain the leading cause of mortality in the western world (Dehlaghi *et al.*, 2007).

CHD has many known risk factors such as Age, Male gender, Hypertension, Hyperlipidemia, Diabetes mellitus, Positive Family history, Smoking (Baum *et al.*, 2006). But many conditions increase risk of CHD, yet, through atherosclerosis. It seems this phenomenon becomes inflammatory (Najafi-Parizi and Lori, 2005).

Therefore, the theory of "Focal infection" was introduced in 1990 supposing that inflammation was a cause in Pathogenesis of CHD. During the last decade, results of studies carried out regarding this theory have shown that chronic infectious diseases can increase the rate of atherosclerosis and subsequently CHD (Joshipura, 2002; Spahr *et al.*, 2006; Pussinen *et al.*, 2003). Periodontitis has always been the most common infectious disease in this field and it has been proved in

various epidemiological studies to be a risk factor for CHD (Beck *et al.*, 2001; Pussinen *et al.*, 2005). Periodontitis is a chronic bacterial infection which is caused by gram negative bacteria; creating chronic inflammation in tooth surrounding tissues, it results in formation of periodontal pockets, destruction of tooth connecting tissue and alveolar bone and finally loss of teeth (Joshipura *et al.*, 1996; Deliarhyris *et al.*, 2004; Matilla *et al.*, 2000; Takata *et al.*, 2001; Kane and Havel, 1999; Sakurai *et al.*, 2007). Prevalence of severe Periodontitis in various societies has been reported to be 10-15% in different studies (Joshipura *et al.*, 1996; Deliarhyris *et al.*, 2004; Matilla *et al.*, 2000).

De Stefano showed that in adults with Periodontitis the risk of CHD has had an increase (25%) (Takata *et al.*, 2001). Results of Beck *et al.* (2005) comprehensive study revealed that Periodontitis is a main predicting index for CHD. Among these studies, however, some researchers Howard *et al.* (2001); Rech *et al.* (2007) and Hujoel *et al.* (2000) didn't find a relationship between CHD and Periodontitis. In spite of inconsistent results in this field, two meta-analysis studies carried out by (Janket *et al.*,

2003; Bahekar *et al.*, 2007) showed an ongoing increase in prevalence of CHD in patients with Periodontitis in comparison with people with normal periodontium (Janket *et al.*, 2003; Hujoel *et al.*, 2000).

Differences in periodontal index used in these studies are significant. Number of remained teeth, CPITN index, Plaque Index, probing depth, gingival margin location to CEJ, Total dental index, Papillary bleeding score and asymptomatic dental score are some indices used in these researches to evaluate the status of patients periodontium (Bahekar *et al.*, 2007; Pai *et al.*, 2004; Tuominen *et al.*, 2003; Genco *et al.*, 2002; Tenrolouris *et al.*, 2004; Loesche *et al.*, 1998; Desvarieux *et al.*, 2003; Wu *et al.*, 2000). Some of the mentioned researchers believe that application of some of these indices in such studies may underestimate intensity and severity of periodontal disease in especially older patients, in spite of achieving a meaningful relationship between these indices and increased risk of CHD (Desvarieux *et al.*, 2003; Janket *et al.*, 2004). Also, some proposed indices are too complex to use in this field and diversity of indices used by researchers to examine this special relationship show that there still is no agreement regarding the selection of suitable index. Therefore, a group of researchers in Belgium (2001) introduced a separate index called Periodontal Index for Risk of Infectiousness (PIRI) to evaluate systemic risk resulted from periodontal chronic infection (Hung *et al.*, 2003). Geerts *et al.* (2004) used PIRI index, in two studies, in patients with CHD and healthy persons and results of these two studies showed that this index showed more likelihood of entrance of pre-inflammatory components from patients periodontium into the blood circulation (Geerts *et al.*, 2004). The present study was carried out to compare PIRI index with an index which represents severity and intensity of periodontal disease in patients who are waiting for heart coronary arteries implantation.

## MATERIALS AND METHODS

The present study is of cross-sectional with control group. Patients waiting for heart coronary arteries implantation in Heart Surgery Section of Shafa Hospital (Kerman University of Medical Science) were simply selected and control group was selected among the patients' spouses who had referred to hospital for a check-up. Patients with the history of every systemic disease rather than heart disease and also edentulous patients were excluded from the study. Both groups underwent periodontal examination to determine the scores of two indices: PIRI and Extent and Severity

index. Periodontal examination was performed by a general dentist using a single-use mirror and Williams's periodontal probe in enough light. Examination included probing depth determination and furcation involvement for all teeth. Probing was done in all teeth for 4 quadrants. For Bucal: Mesial, middle and distal side and for lingual (palatal): Middle sides were probed and for furcation involvement, probing of furcation was done in first and second molar teeth. PIRI index was calculated as follows (Hein, 2005).

**Score 1:** Which was specified as follows: In this part, a digit between 1 and 6 was calculated concerning number of pockets and relevant probing depth.

**Score 2:** In this part, a digit between 1 and 4 was calculated based on number and degree of furcation involvement (Table 1 shows the values assigned to the different parameters for the PIRI).

Finally, number related to PIRI score calculated from total of both numbers calculated in parts A and B. Index interpretation was in a way that modes "High: 6<<10, Moderate: 1<<5, Low: 0".

To determine ESI index, Attachment Loss was evaluated with application of probing using Ramfjord method. Index was reported in the form of two numbers in a parenthesis; the left one represents extent and the right one shows the severity of disease. On the other hand, ESI = (20, 3) means 20% of the area has this disease and average Attachment Loss is 3 mm (Newman *et al.*, 2006). Evaluation was done in one upper jaw quadrant and one lower jaw quadrant. Disease extent was in fact the percentage of examined areas whose attachment loss was more than 1 mm and its severity was average attachment loss in affected areas. To calculate attachment loss, distance between free gingival margin and Cemento-Enamel Junction (CEJ) and distance between this margin and gingival sulcus or pocket was measured and to calculate distance between CEJ and depth of the pocket, first number was subtracted from the second number.

Table 1: Definition of the PIRI

Pocket lesion	Score 1
<5 pockets of 5-6 mm	1
>= 5 pockets of 5-6 mm	2
<5 pockets of 7-8 mm	3
=>5 pockets of 7-8 mm	4
<3 pockets of >= 9 mm	5
>= 3 pockets of >= 9 mm	6
Furcation involvement	Score 2
<3 furcations of class I	1
>= 3 or <3 furcations of class I or II	2
>3 or <3 furcations of class II or III	3
>= 3 furcations of class III	4

In a case gingival margin is more apical than CEJ; its distance to CEJ is recorded as a negative number. Attachment loss in mesial, facial, distal and lingual areas of every examined tooth was recorded. Interproximal area was recorded in buccal surface while the probe was parallel to tooth longitudinal axis. Finally, after data were collected, agreement percent was compared between two indices in both groups using chi square test. All patients volunteered to participate in this research and objectives of this research were explained to them and all of them signed the written agreement letter. In the case of periodontal disease, patients were referred to the periodontics department of dental school by the researcher. After the collected data was recorded in a computer, it was analyzed by SPSS Software. To analyze data, logistic model were used.

## RESULTS

About 200 people participated in the present study (100 waiting for heart coronary artery implantation and 100 healthy people with no heart problems). Average age of all participants was 52.17±5.93 years (53.56±6.51 for patients and 50.7±4.89 for control group). Women and men constituted 53 and 47 percentage of case group respectively and 54 and 46 percentage of control group respectively.

Average extent of attachment loss of more than 1 mm was 94.77±13 in case group and 71.99±28.27 in control group. Extent of attachment loss in both groups showed a significant difference and it was higher in case group than in the control group (p<0.0001). Average severity of attachment loss was 4.47±1.36 in case group and 3.05±1.63 in control group, showing a significant difference between two groups. This average was also higher in case group (p<0.0001). Thus, this study showed that extent and severity index in patients waiting for heart coronary artery implantation was significantly higher than that in healthy people.

In evaluating PIRI index in case group, nobody was placed in mild group, 87 in moderate group and 13 in severe group. In control group, 7, 86 and 7 people were placed in mild, moderate and severe groups respectively. As shown, the highest dispersion in both groups was related to moderate index; in case group, mild cases were lower than that in control group while it was opposite in terms of severe group. Like extent and severity Index, PIRI index showed a significant difference (p = 0.01) in both groups (Table 2). On the other hand, PIRI index represented a difference in periodontal status in both groups. Studying the effect of various variables on patients cardiovascular status showed that as patients get older they had a higher request to implant their heart coronary artery.

Table 2: PIRI index and extent and severity of periodontal disease in case and control groups

Variables	Case group (n = 100)	Case group (n = 100)	p-value
Age	53±6.51	50.7±4.89	0.08
<b>Gender</b>			
Females (%)	47	46	
Males	53	54	
Extent of disease	94.77±13	71.99±28.27	<0.0001
Severity of disease	4.47±0.26	3.05±1.63	<0.0001
<b>PIRI index (%)</b>			
Mild	0	7	0/01
Moderate	87	86	
Severe	13	7	

Concerning gender, women appeared to have more request than men but this difference was not significant (OR = 1.04, CI95%:59-1.81).

## DISCUSSION

The present research aimed to study the possibility of using one special periodontal index (PIRI) for patients with severe CHD. The mentioned index, in comparison with one of general and standard periodontal indexes (ESI), showed significant differences in periodontal status between two groups. In the present study, extent and severity of attachment loss in patients waiting for heart coronary artery implantation was reported to be more than that in healthy people. In the past decade, several studies have been carried out concerning the accompaniment of Periodontitis and CHD; most results have shown a relationship between these two diseases. In spite of this relationship, some researchers still believe that accuracy of this relationship and its mechanism is not reliable and thus to confirm is reliability; several epidemiological studies must be carried out in bigger populations. It can be implied that selecting periodontal evaluation index in these studies is of great importance. Application of various periodontal indices by researchers makes the results difficult to compare.

In a study carried out by Geerts *et al.* (2005) average PIRI index in both case and control groups had a significant difference (p<0.0001). Another difference exists between our study and Geerts *et al.* (2004) study which relates to the number of patients in moderate group of PIRI in both case and control groups.

Choosing an accurate and unique index for performing such studies seems essential. According to Offenbacher and Beck, common classification of periodontitis to “mild, moderate and severe” groups or other methods of measuring severity of disease like attachment loss are not suitable indices for determining risk of systemic inflammation resulted from periodontal

disease and probing depth extent is the best indicator for determining level of bleeding surface beneath gums through which microbial products can enter blood. This surface will be calculated through calculating two parameters of number and depth of periodontal pockets and number and severity of involvement of furcation area in any patient; it is the basis of PIRI index. On the other hand, determining this index is a rapid way to estimate bio-film areas beneath gingival and epithelial walls of periodontal pockets; this index estimates the risk of entering pre-inflammatory mediators from periodontium to the blood circulation. PIRI index is able to evaluate pumping effect (entrance path of bio-film components under gingiva from thin and mostly bleeding epithelium of periodontal pockets to blood) while this phenomenon can't be recognized by classical periodontal indices because these indices can only evaluate tissue destruction level in order for epidemiological studies to be carried out. Therefore, researchers are advised to consider PIRI index used in this research in studying the relationship between these two diseases.

### CONCLUSION

The growing body of evidence that supports periodontal-CHD association requires us also thinks about special kind of periodontal health measuring, the most notable of which is the periodontal risk of infectiousness (PIRI).

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