Original Article

Can Dental Pulp Calcification Predict the Risk of Ischemic Cardiovascular Disease?

Leila Khojastepour[1], Pegah Bronoosh[2✉], Shahdad Khosropanah[3], Elham Rahimi[4]

[1]Associated Professor, Department of Oral Radiology, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Assistant Professor, Department of Oral Radiology, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Associated Professor, Department of Cardiology, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[4]Student Research Committee, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran

✉ Corresponding author:
P. Bronoosh, Department of Oral Radiology, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran

pegah_brix@yahoo.com

Abstract

Objective: To report the association of pulp calcification with that of cardiovascular disease (CVD) using digital panoramic dental radiographs.

Materials and Methods: Digital panoramic radiographs of patients referred from the angiography department were included if the patient was under 55 years old and had non-restored or minimally restored molars and canines. An oral and maxillofacial radiologist evaluated the images for pulpal calcifications in the selected teeth. The sensitivity, specificity, positive predictive value and negative predictive value of panoramic radiography in predicting CVD were calculated.

Results: Out of 122 patients who met the criteria, 68.2% of the patients with CVD had pulp chamber calcifications. Pulp calcification in panoramic radiography had a sensitivity of 68.9% to predict CVD.

Conclusion: This study demonstrates that patients with CVD show an increased incidence of pulp calcification compared with healthy patients. The findings suggest that pulp calcification on panoramic radiography may have possibilities for use in CVD screening.

Key Words: Dental Pulp Calcification; Cardiovascular Disease; Panoramic Radiography

INTRODUCTION

Calcified particles of dental pulps known as pulp calcifications (PC) may be seen in healthy, diseased, and even unerupted pulp [1]. Their prevalence varies widely in different studies whether the report is based on the number of teeth or patients as well as radiographic or microscopic reports [1-6]. Radiographic detection of pulp stones seems to be related to its diameter since only particles larger than 200 μm can be seen on radiographs [7].

So, radiological studies may tend to underreport the true prevalence of pulp calcifications. Radiographic features of pulp calcifications vary from discrete calcifications, named pulp

stones, to more diffuse calcifications within the dental pulp [8]. Although the etiological factors for the formation of pulp calcifications are not well understood, many etiological factors have been claimed to predispose pulp stone formation such as age, gender, various systemic diseases, deep caries and restorations [1,4]. Some studies have noted the possible correlation of systemic disease and occurrence of pulp calcification. Maranhao de Moura and de Paiva confirmed that pulpal calcification has an increased rate in subjects with coronary atherosclerosis [4]. Nayak et al. reported that CVD patients had the maximum number of pulp stones compared with other systemic diseases [5]. Edds et al. proposed that 74% of the patients with a history of CVD had an evident pulp stone, whilst only 39% of patients without a record of CVD had pulp stones [9].

With regard to similar pathogenesis of dental pulp calcification and calcified atheromas, we propose that routine panoramic radiographs may be used as an available and low-cost screening method for early diagnosis of potential CVD. The purpose of this study was to determine the correlation between patients with CVD and the presence of pulp chamber calcifications in different ages and genders on dental panoramic radiographs.

MATHERIALS AND METHODS

Patients who underwent coronary angiography for any reason in Shiraz Namazi Hospital were introduced to this cross sectional study regardless of positive or negative angiography results. An official written consent was taken from all patients.To be included in this study, patients should have met the following criteria of a maximum age of 55 years who had performed angiography with clearly visible untouched or minimally restored maxillary and mandibular molars and/or canines present in their mouth. Since the incidence of pulp stone has been reported to be increased with age, patients older than 55 years, were excluded from this study [6,10,11]. In addition, patients with periodontal disease, deep caries or restorations on molars /canines were excluded. Consequently, 122 subjects (56 females, 66 males) matched the criteria. The demographic information recorded included the patient's age and gender. Digital panoramic radiographs prepared for patients (Planmeca Proline XC,Finland) were processed with CR Regius110 (Konica Minolta, Japan). A maxillofacial radiologist unaware of angiography results evaluated panoramic radiographs for pulp stones, obliterated pulp chambers, significant canal space narrowing, or obliteration and complete calcification of the entire root canal system. First, the unrestored or minimally restored maxillary and mandibular molars were assessed on radiographs for the presence or absence of pulp calcification and the results were recorded as a "yes" or "no". The evaluator then followed the same protocol for maxillary and mandibular canines. Data were analyzed by SPSS 12 software (SPSS Inc., Chicago, Illinois, USA) and logistic regression analysis assessed correlation of angiography results with pulp calcification. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of panoramic radiography to predict cardiovascular disease were calculated. Odds ratio was used to evaluate impact of age and gender.

RESULTS

Out of the original 142 patients, 20 were excluded due to presence of periodontal diseases, deep caries/restorations and ages that were out of the desired range. A total of 122 patients (mean age, 47.72±7.699 years) with revealed angiography results were evaluated for the presence of pulp calcification on the panoramic view. The study consisted of 56 females (45.9%) and 66 males (54.1%).

Of the 44 patients with at least one coronary vessel disease, 68.2% had pulp chamber calcifications, whereas 71.8% of the healthy subjects did not manifest any pulp chamber calcifications (Table 1).

As a screening test, pulp calcification in panoramic radiography had a sensitivity of 68.9%, specificity of 71.8%, positive predictive value of 57.7%, and negative predictive value of 80%. Using odds-ratio of two binomial proportions, the impact of patients' gender and age was controlled by logistic regression model (Table 2). The frequency of pulp calcification was not significantly different between males and females (95% confidence interval, CI = 0.63-4.88; odds ratio = 1.75).

Of the subjects displaying PCs, 43.2% were older than 45 years. Comparing pulp calcification frequencies between ages, there was no statistically significant difference (95% CI = 0.35-3.38; odds ratio = 0.765).Considering age as a quantitative variant, the chance of pulp chamber calcifications did not increase by age. The distribution of the numbers and the percentages of pulp chamber calcifications for both genders are shown in table 2.

The average number of pulp calcification in molars was significantly higher in CVD patients (0.342) compared with the normal group (0.174) (P value=0.03), while the average number of canines with pulp calcification did not differ considerably in CVD (0.068) and normal patients (0.109) (P value =0.381).

Table 1. Utility of Panoramic Radiography in Detecting Atherosclerosis

PC panoramic \ CVD	+	-	Total
+	30(68.2%)	22(28.2%)	52(42.6%)
-	14(31.8%)	56(71.8%)	70(57.4%)
Total	44(100%)	78(100%)	122(100%)

Table 2. Risk of Calcification According to Age and Gender

Calcification		+	-	Total	OR (95%CI)	Adjusted OR (95%CI)
Age	<45	14(41.2%)	20(58.8)	34(100%)	1	1
	>45	38(43.2%)	50(56.8)	88(100%)	1.09(0.35-3.38)	0.765(0.23-2.51)
Sex	m	24(36.4%)	42(63.6)	66(100%)	1	1
	f	28(50%)	28(50%)	56(100%)	1.75(0.63-4.88)	1.78(0.64-4.99)

DISCUSSION

Atherosclerosis is a life-threatening disease and it rarely manifests any signs or symptoms; therefore, its early detection is crucial in preventing stroke or heart attack. Panoramic radiographs are relatively inexpensive and are already made routinely in a large part of the adult population. Therefore, these radiographs might represent an enormous potential as a screening tool for many systemic diseases [8,12-15]. Regarding the large number of individuals who suffer from stroke and myocardial infarction each year, dentists may have a substantial role in the early diagnosis of these fatal diseases, and their incidental findings in panoramic radiographs can have a significant profit for public health.

Nowadays, the quality of treatment is getting of much concern in developing countries, such as Iran. So, dentists should be capable of screening panoramic radiographs to detect any sign of systemic diseases and taking a more detailed medical history of suspicious patients [13]. The purpose of this study was to investigate whether dental pulp calcifications visible on digital panoramic radiographs can predict the potential of future cardiovascular diseases.

The study performed by Edds et al. demonstrates that patients with CVD have an increased incidence of pulp stones compared to patients with no history of CVD.9 A positive correlation was also found between cardiovascular disorder and pulp stones in a study conducted by Nayak et al.5 Horsley reported an accuracy of 66.4% of pulp calcification in the screening of carotid calcification when pulp calcification was present.8 In the present study, as a screening test, detecting pulp calcification in the panoramic radiography was fairly useful to predict atherosclerosis in CVD patients (sensitivity=68.9%), which is in agreement with previously mentioned studies, but is in contrast to one [1].

Panoramic images were screened in this study to detect pulp calcifications, since all teeth could be evaluated in a single image.

Our results are in agreement with the study carried out by Edds et al., although they evaluated periapical radiographs for pulp calcifications [9].

In the present study, most pulp chamber calcifications were found in molars. This is in agreement with the previous studies [4,6]. Reports stated that the greater supply of blood to molar pulp tissues may cause precipitation of calcium in the pulp chamber. Besides, earlier show-up of first molars in the mouth and consequent increased stress on these teeth may explicate the increased rate of pulp calcification [1]. It is also worth to note that in our study, molar pulp calcification in CVD patients was significantly higher than the normal group. As reported in the literature, the prevalence of pulp stones increases with age [6,10,11]. To make the effect of aging less important, subjects older than 55 years were excluded in the present study. Since pulp stone formation without the presence of inflammation in the pulp is not probable in this age group. However, the rate of pulp calcification was higher for subjects older than 45 years compared to younger individuals. Statistically, age increase did not alter the chance of calcification significantly. All manifestations of pulp calcifications were recorded in this study. Recently, more sophisticated imaging modalities such as CBCT are widely used specifically for patients in need of dental implants with a broad age spectrum. Further evaluation to explore a correlation between specific types of pulp calcification using CBCT and vascular disease may be helpful. In the present study, the population consisted of symptomatic patients referred for angiography tests. Although our study has some bias in this point, obtaining angiographs from the general population to create a random sampling is not ethically confirmed.

Another limitation of this study was the small sample of subjects that results in wide confidence intervals or risk of errors in statistical analysis.

So, further evaluation with a large sample is recommended to assess whether pulp chamber calcification is a systemic condition rather than a local response to longstanding irritants.

CONCLUSION

Acknowledging the limitations of this study, it is suggested that the routine dental radiography could possibly be used as an available screening method for early detection of patients at risk of cardiovascular diseases. It is necessary to emphasize that it is the patient's physician and not the dentist who makes the final diagnosis. In addition, using the panoramic radiography as a principal diagnostic tool to detect atherosclerosis is not recommended.

ACKNOWLEDGMENTS

REFERENCES

1- Şener S, Cobankara FK, Akgünlü F. Calcifications of the pulp chamber: prevalence and implicated factors. Clin Oral Investig. 2009 Jun;13(2):209-15.

2- Arys A, Philippart C, Dourov N. Microradiography and light microscopy of mineralization in the pulp of undermineralized human primary molars. J Oral Pathol Med. 1993 Feb;22(2):49-53.

3- Moss-Salentijn L, Hendricks-Klyvert M. Calcified structures in human dental pulps. J Endod. 1988 Apr;14(4):184-9.

4- Maranhão de Moura AA, de Paiva JG. Pulpal calcifications in patients with coronary atherosclerosis. Endod Dent Traumatol. 1987 Dec;3(6):307-9.

5- Nayak M, Kumar J, Prasad LK. A radiographic correlation between systemic disorders and pulp stones. Indian J Dent Res. 2010 Jul-Sep;21(3):369-73.

6- Gulsahi A, Cebeci AI, Ozden S. A radiographic assessment of the prevalence of pulp stones in a group of Turkish dental patients. Int Endod J. 2009 Aug;42(8):735-9.

7- Moss-Salentijn L, Klyvert MH. Epithelially induced denticles in the pulps of recently erupted, noncarious human premolars. J Endod. 1983 Dec;9(12):554-60.

8- Horsley SH, Beckstrom B, Clark SJ, Scheetz JP, Khan Z, Farman AG. Prevalence of carotid and pulp calcifications: a correlation using digital panoramic radiographs. Int J Comput Assist Radiol Surg. 2009 Mar;4(2):169-73.

9- Edds AC, Walden JE, Scheetz JP, Goldsmith LJ, Drisko CL, Eleazer PD. Pilot study of correlation of pulp stones with cardiovascular disease. J Endod. 2005 Jul;31(7):504-6.

10- Rajesndran. Shafer' S. Textbook Of Oral Pathology. 6th ed. India: Elsevier; 2009.

11- Kumar S, Chandra S, Jaiswal JN. Pulp calcifications in primary teeth. J Endod. 1990 May;16(5):218-20.

12- Khosropanah SH, Shahidi SH, Bronoosh P, Rasekhi A. Evaluation of carotid calcification detected using panoramic radiography and carotid Doppler sonography in patients with and without coronary artery disease. Br Dent J. 2009 Aug;207(4):162-3.

13- Friedlander AH, Norman KM. Panoramic radiographic detection of systemic disease. In: Farman AG, editor. Panoramic radiology. Berlin Heidelberg: Springer-Verlag; 2007. p. 167-71.

14- Khojastehpour L, Shahidi SH, Barghan S, Aflaki EL .Efficacy of Panoramic Mandibular Index in Diagnosing Osteoporosis in Women. J Dent Tehran Univ Med Sci. 2009;6(1):11-5.

15- Khojastehpour L, Afsa M, Dabbaghmanesh MH. Evaluation of Correlation between Width and Morphology of Mandibular Inferior Cortex in Digital Panoramic Radiography and Postmenopausal Osteoporosis. Iran Red Crescent Med J. 2011 Mar;13(3):181-6.