PREVALENCE OF PULP STONES AND ITS RELATION WITH CARDIOVASCULAR DISEASES AND DIABETES MELLITUS USING DIGITAL RADIOGRAPHS: A RETROSPECTIVE STUDY

*Shibu Thomas Mathew [1] *, Maha Ahmad Al-Mutlaq [2], Razan Fahad Al-Eid an[2], Danah Mohammed Al-Khural si[2] Hiba Adam [4]*

Assistant Professor, Riyadh Elm University, An Namudhajiyah, Riyadh 12734, Saudi Arabia
General Dentist, Ministry of Health, Riyadh, Saudi Arabia
General Dentist, Riyadh, Saudi Arabia
Dental intern, Riyadh Elm University, Riyadh, Saudi Arabia

ABSTRACT

Objectives: This study aimed to investigate the usefulness of digital radiographs in detecting the association between pulp stones and the symptoms of cardiovascular diseases (CVDs) and diabetes mellitus (DM). Additionally, this study aimed to determine the pervasiveness of pulp stones with independent variables, such as age. gender, and tooth type using digital radiographs.

Methodology: A total of 1030 patients from a university clinic participated in the study. The selection and recruitment of the case extended from 2016 to 2018. Patients were categorized into two groups: medically fit patients and medically compromised patients, who were subjected to intraoral X-ray examination. Radiographs were collected and examined for the presence and absence of pulp stones.

Results: The results showed that 86.25% of pulp stones were significantly associated with CVD and DM. By implication. 87.79% of participants aged 46-60 years were prone to developing pulp stone. There was a significant difference in pulp stone development between male and female patients.

Conclusion: The outcome showed a significant relationship between pulp stones and older age. The prevalence of pulp stones is significantly higher among patients with systemic diseases, especially in a cardiac and diabetic population.

Key words: cardiovascular diseases, dental pulp calcification, diabetes mellitus. prevalence, radiography.

Introduction

Cardiovascular diseases (CVDs) are major public health problems, and they are defined as diseases of the heart and veins. CVDs could be hypertension, heart illnesses, heart attack, stroke, heart failure, arrhythmia, heart valve issues, coronary illness, deep vein thrombosis, and pulmonary embolism.[1] Moreover, pulp stones are defined as calcified structures found in either or both the coronal region and radicular'pulp.[2]

The etiological factors involved in the formation of pulp stories have been studied by many researchers, but the etiology is still indistinct in dentistry. Sound, emerging, and developed teeth can have pulp stones. Moreover, possible reasons for the formation of pulp stones could be age, orthodontic forces, periodontal diseases, fluoride intake, and systemic diseases.[3' 4] Additionally, the formation of pulp stones might be related to longstanding aggravations. for example, caries, profound fillings, and interminable irritation. A few[T] researchers stated that pulp stones are a component of an aggravated pulp trying to repair its tissues. Pulpal discomfort is one of the continuous side effects related to pulp stones. The pain may vary from slight to severe pain. They can obstruct the root trenches, which prompts endodontic failure.[5-7]

Previous studies have related CVDs with the development of pulp stones. Nevertheless, these studies do not address the pathological connection with CVDs and DM. Thus, this study aimed to investigate the usefulness of digital radiographs in detecting the association between pulp stones and the symptoms of CVDs and diabetes mellitus (DM). Additionally, this study aimed to determine the pervasiveness of pulp stones with independent variables, such as age, gender, and tooth type using digital radiographs. Thus, detecting a CVD or DM through an intraoral radiograph might be a helpfill method.[8]

Methods

Before commencing the study, approval by the Institutional Review Board (IRB) of the university was obtained [RC/IRB/2016/556]. Participants were informed about the study and informed written consent was obtained. Data were retrospectively collected from the university clinics between 2016 and 20IS. The case selection and recruitment w[T]ere done by four investigators based on the presence or absence of pulp stones seen in panoramic, bitewing, and periapical radiographs. For this study, the inclusion criteria were as follows: (1) patients who have a history of CVDs and DM or both, (2) aged between 15 and 60 years, (3) presence of pulp stones in premolar and molars only, and (3) teeth free from periodontal disease. The exclusion criteria were as follows: (1) anterior teeth. (2) patients with grossly destructed teeth. (3) teeth with metal crowns, (4) extensive metallic restoration. (5) edentulous arches, (6) any disease other than CVD or DM. e.g., renal diseases, central nervous system disorders, or epilepsy, and (7) obscured panoramic.

The sample populations were divided into tw[T]o major groups: **Group I** for medically fit patients and **Group II** for the medically compromised patients. Furthermore, medically compromised patients were divided into three subgroups: **Group A** as patients with CVDs including myocardial infarction, angina pectoris, heart disease, hypertension, and patients who had undergone heart surgery; **Group B** as patients with DM; and **Group C** as patients with both CVDs and DM. Data were analyzed based on the differences of having pulp stones between medically fit and medically compromised patients, differences between male and female subjects, differences across age groups, and the distribution of pulp stones among individual tooth types based on patient's health status.

To increase the reliability of measures, each investigator conducted inter-observer and intra-observer reliability tests, it was assessed by the Krippendorff s alpha and Fleiss kappa coefficient of agreement index. The collected data were tabulated into spreadsheets in Microsoft Excel 2017 and imported into SPSS software for statistical analysis (SPSS Inc., Chicago. IL. USA). Descriptive statistical analyses were performed along with the chi-square test w[T]ith a significant value of <0.05.

Results

A total of 1030 patients from a university clinic were recruited for this study. Interestingly. Table 1 shows that medically compromised patients were more likely to develop pulp stones (63.68%) than medically fit patients (36.32%), and this association was statistically significant (p-value <0.05).

From Table 2, by far, the greatest pulp stone formation was found among diabetic patients (49.42%) followed by CVD patients (39.95%). Also, 10.62% of CVD patients with DM show pulp stone formation. Moreover, the comparison was done in a statistically significant manner (p-value <0.05).

Across both genders, just over half the sample, 575 were males and 455 were females, of whom 66% of both male and female patients (680/1030) had pulp stone seen in the radiographs. However, the incidence of pulp stone development showed that male patients had a higher likelihood of pulp development than female patients. These findings were statistically significant (p-value <0.05) (Table 3).

The prevalence of pulp stones revealed that 27.35% of participants aged 15-30 years had the lowest pulp stone development, whereas 31.47% of participants aged 46-60 years developed stones at this age range, and participants aged 31-45 years had the highest likelihood at 41.18% to develop pulp stones. The differences between age groups are highlighted in Table 4.

Furthermore, the prevalence of pulp stones distributed among individual tooth types based on the patient's health status showed a statistically significant for all teeth, except teeth #27, #37. and #48 (Table 5). The average pairwise percent agreement showed that the coders had a 94.4% agreement. The examination had a Fleiss kappa value of 0.88, which is excellent. The observed agreement was 0.94, while the expected agreement was 0.53. Krippendorff s alpha for the analysis was 0.883. which is above Krippendorff s benchmark of 0.800. The inter-observable test provided assurance and confidence in the study results.

Discussion

This study assessed the association between pulp stones and symptoms of CVDs and DM and determined the pervasiveness of pulp stones with independent variables, such as age, gender, and tooth type using digital radiographs.

CVD is the most common cause of mortality and morbidity in the diabetic population. The latest assessment by the International Diabetic Federation is that 592 million (1 in 10 individuals) will become diabetic by 2035 worldwide.[9] Pulp stones present little clinical difficulty during root canal treatment, because it may obstruct the root canal orifice. Thus, adequate knowledge regarding pulp stone management and root canal morphology is needed.[4,10]

Previous studies considered routine digital radiography as the best option to check for the presence of pulp stones.[11] [12]

This study shows that patients aged 31-45 years had higher pulp occurrence at 41.18%, which was in agreement with that reported by Hillmann et al. that pulp stones increase in frequency with age.[10]

The present study demonstrated a higher prevalence of pulp stones in patients with DM at 49.42% and CVDs at 39.95% when compared with the development of pulp stones in medically fit patients at 36.32%. Notably, many studies have linked the significant occurrence of pulp stones with patients with CVDs and DM. Edds et al. found a unique association between pulp stones and arteriosclerosis and other cardiovascular diseases. Hie study recorded the occurrence of calcification in the pulp of atherosclerosis patients. It further discovered the development of calcification in the extirpated dental pulp vessels of patients with CVD.[13]

In contrast Nayak et al. investigated an Indian populace and discovered that the pervasiveness of pulp stones in hypertensive patients was 15.85% higher than that in medically fit patients.[14]

In another study on dental pulps of DM patients, no vascular changes were found in the tissue. Indistinct calcified bodies in the pulp of diabetic patients w[T]ere reported in the survey.[15]

Factors thought to be influencing dental stone formation in diabetic patients have been explored in a study conducted by Catanzaro et al.[16] They concluded that the dental pulp in DM patients ages rapidly because of endarteritis, poor blood circulation in the matured teeth, and increased inflammatory response during chrome phases in diabetic patients.[16] Tirese factors could influence pulp stone formation. However, further investigations that take these factors into account are warranted.

More pulp stones were found among male participants than in female participants. However, the findings of this study oppose those of previous studies, of which they found that female patients developed more pulp stones than male patients. The investigation of Horsley et al., Talla et al., and Bains et al. has shown a slight increase in the incidence of stone development in the female population than in the male population.[12,1^18]

Finally, some important drawbacks need to be considered. First, anterior teeth were excluded from our sample, so any pulp calcification in the anterior teeth was not recorded. Second, the sample tended to miss people who have other systemic diseases that showed calcification in other body organs such as kidney stones, cranial calcifications, gall bladder stones, and breast calcifications. Third, the current study is not specifically designed to record the pulp stone histologically, only radiographically.

This study suggests that patients with pulp stones have high susceptibility to develop DM and CVDs. Therefore, patients should be screened to assess such complications at an early stage. Further research is recommended to determine the causes of pulp stone formation.

Conclusion

The results of this study support the idea of a significant association between the development of pulp stones hi DM and CVD patients. Moreover, this study provides additional evidence of the increased formation of pulp stones with age. Further studies on pulp stones can be carried out if longitudinal examinations could affirm a connection between heart diseases and pulp stone development.

Conflicts of Interest Statement

None

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None.

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Corresponding Author

Dr. Shibu Thomas Mathew

Assistant Professor,
Riyadh Elm University. An Namudhajiyah. Riyadh 12734, Saudi Arabia
Phone no. +966534014050
Email: smathew @ riyadh.edu.sa

Table 1: Comparison of pulp stone prevalence between medically fit and medically compromised patients.

Medical Condition	n=	Pulp stones present		Pulp stones not present		p-value
		(%)	n=	(%)	D=	0.000
Medically fit	528	36.32%	247	80.29%	281	
Medically compromised	502	63.68%	433	19.71%	69	
Total	1030	100%	680	100%	350	

Comparison of pulp stone prevalence between medically fit and medically compromised patients

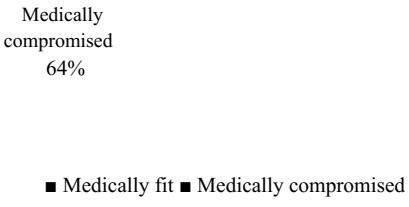

Table 2: Prevalence of pulp stones based on medical condition

Medically compromised	n=	Pulp stones present		Pulp stones not present		p-value
		n=	(%)	n=	(%)	0.000
CVD	197	173	39.95%	24	34.78%	
DM	253	214	49.42%	39	56.52%	
Both	52	46	10.62%	6	8.70%	
Total	502	433	100%	69	100%	

Prevalence of pulp stones based on medical condition

Table 3: Prevalence of pulp stones among male and female patients

Gender	Total	Pulp stones present		Pulp stones not present		p-value
	D=	n=	(%)	n=	(%)	0.000
Males	575	397	58.38%	178	50.86%	
Females	455	283	41.62%	172	49.14%	
Total	1030	680	100%	350	100%	

Table 4: Prevalence of pulp stones in different age subgroups

Age Group	n=	Pulp stones present		Pulp stones not present		p-value
		n=	(%)	n=	(%)	**0.000**
15-30 years	390	186	27.35%	204	58.29%	
31-45 years	369	280	41.18%	89	25.43%	
46-60 years	271	214	31.47%	57	16.29%	
Total	1030	680	100%	350	100%	

Table 5: Comparison of prevalence of pulp stones among individual teeth based on medical condition

Tooth number	Medically fit	Medically compromised	p-value
14	2%	11%	0.000
15	1%	11%	0.000
16	34%	52%	0.000
17	18%	31%	0.001
18	2%	20%	0.000
24	9%	8%	0.000
25	13%	16%	0.000
26	31%	46%	0.000
27	14%	28%	0.387
28	3%	28%	0.000
34	8%	10%	0.000
35	13%	14%	0.000
36	28%	42%	0.000
37	13%	27%	0.927
38	2%	26%	0.000
44	8%	1%	0.000
45	13%	4%	0.000
46	22%	26%	0.000
47	16%	36%	0.000