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Original Article

Prevalence of and relationship between pulp and renal stones: A radiographic study

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ABSTRACT

Aim: The aim of the present study was to determine the prevalence of and the relationship between pulp and renal in affected patients and in healthy adults.

Materials and methods: A total of 240 patients participated in the study. Group A consisted of 120 patients who had renal calculi and Group B had 120 randomly selected controls for the study. The periapical radiographs for all patients were evaluated for the presence or absence of the narrowing of dental pulp chambers and pulp canals. The radiographs were also evaluated to determine the presence or absence of pulp stones. The results were compared and analyzed using the Chi-square test ($p < 0.001$).

Results: A total of 164 patients had pulp narrowing and 112 patients had pulp stones, which included 55 controls and 57 renal calculi patients. There was no statistical correlation between pulp narrowing and renal stones ($p > 0.001$) and also between pulp stones and renal stones ($p > 0.001$).

Conclusion: However, there was no significant correlation between the presence of pulp stones and renal stones, and the incidental findings of pulp stones on periapical radiographs can provide useful information in the early diagnosis of the systemic calcifications.

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1. Introduction

Calcified structures located in the dental pulps of normal, diseased, and nonerupted teeth in both primary and permanent dentition are identified as pulp stones.¹ They may be positioned in the coronal or radicular segment of the pulp. Based on the locus, pulp stones can be categorized as embedded, adherent, and free type. The embedded stones are contrived in the pulp but get enclosed in-reach of the canal walls owing to the staking of physiological dentin and are customarily placed at the apical portion of the root.²

Odontoblasts and a calcified tissue simulating the dentin may be contemporaneous over the peripheral aspect of the pulp stones.³ The adherent pulp stones are minimally annexed to the dentin and they are not in the least completely immured by the dentin when correlated to embedded pulp stones. Both category of pulp stones may element eloquently occlude the canals and may be present at a curve which may baffle with the root canal treatment.⁴ Kronfeld and Boyle⁵ classified pulp stones histologically into “true” or “false” types. True pulp stones are much more aberrant in pattern and are lined by odontoblasts. They consist of dentin, whereas false pulp stones are composed of the mineralizing

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degenerating cells of the pulp tissue.^{3,6} A third type of pulp stones, 'diffuse' or 'amorphous' type, is also beamed in proximate confederation with the blood vessels.⁶

Pulp stones have been chronicled as the symptoms of the metamorphosis in the pulp tissue rather than their origin. The explicit pathophysiology of pulp calcification is not known; however, multiple elements such as degeneration of pulp tissue, aging factor, residual epithelium rests in the pulp tissue, operative maneuvers, flawed blood supply of the pulpal tissue, periodontal disorders, orthodontic treatment, long-standing carious lesion, deep fillings, or abrasion, genetic causes, and certain syndromes like the van der Woude syndrome have been put forward as etiological factors in the formation of pulp stones.^{6,7} It has also been observed that an irritated pulp, when endeavoring to overhaul itself, may lead to pulpal stone formation. The carious teeth of children and young adults were reported to have a 5 times higher incidence of calcifications of the pulp than in the teeth which are non-carious.⁶

The pulp calcifications noticeably ensue all through the dentition in patients with systemic or genetic conditions like dentin dysplasia and dentinogenesis imperfecta.⁴ The conditions like hypercalcaemia, gout, and renal calcifications that are noted secondary to the calcium metabolism have been observed as the pre-disposing factors for pulp stone formation. Pulpal calcification has been frequently ascertained in patients with end-stage renal disease (ESRD) and transplanted patients, and a positive correlation between the chronicity of the renal disease and the pulpal obliteration has been noticed in the premolar and molar teeth of such patients.⁸ Various studies have exhorted pulp stones to be a manifestation of systemic illnesses leading to pathological biomineralization in multifarious organs of the body,^{9,10} while a few authors have implied that complex biomechanical and physiologic alterations seen in systemic diseases do not alter the dentin and pulp and hence, no correlation exists between the pulpal calcifications and calcifications in other parts of the body.¹¹

The aim of the study was to determine the prevalence of pulp stones in patients with renal stones and healthy adults and to determine the relationship between the pulp stones and renal stones.

2. Materials and methods

The study included a total of 240 patients to determine the prevalence of pulp stones in patients with renal stones and to determine if any relationship exists between the pulp stones and renal stones. All the patients were divided into 2 groups. Group A consisted of 120 randomly selected renal calculi patients from the Nephrology Department and Group B had 120 randomly selected controls from the patients visiting the outpatient department of College of dentistry for the study. Ethical clearance was obtained from the Institutional Ethical Committee. A detailed medical and dental history of all the patients was recorded. Patients with any history of cardiovascular diseases, gout, gall stones, or any other systemic diseases were excluded from the study. Patients with any attrition or abrasion, presence of radiographically observable periodontal diseases, and presence of Class V restorations were also

excluded from the study. A total of 3452 conventional periapical radiographs (6939 of posterior and anterior teeth) from 240 patients were evaluated for the presence of pulp stones. The radiographs with poor angulations, improper exposures, or faulty processing, which could lead to scoring difficulties and the radiographs with carious and restored teeth were excluded from the study. The periapical radiographs for all patients were evaluated for the presence or absence of the narrowing of dental pulp chambers and pulp canals. Narrowing was defined as a notable reduction in the size of the pulp chamber and the pulp canals. All the radiographs were interpreted by two examiners (oral radiologists) in a dark room by using a standard viewing box under the 2× magnification and with the peripheral light being blocked out, to ensure the accuracy of the diagnosis. Narrowing was defined as a notable reduction in the size of the pulp chamber and the pulp canals. The definite radiopaque masses inside the pulp chambers were identified as pulp stones and scored as present or absent. The data were entered using statistical software SPSS version 20.00 (SPSS Inc., Chicago, USA) and analyzed using the Chi-square test. Statistical significance was set at 5% level of significance ($p < 0.05$).

3. Results

Out of 3452 periapical radiographs, a total of 6939 teeth from 240 patients were evaluated in the study. The mean age of the patients was 33.9 ± 10.6 years for Group A and 34.8 ± 11.2 years for Group B. There were 68 (56.67%) males and 52 (43.33%) females in Group A and 63 (52.5%) males and 57 (47.5%) females in Group B. 75 (62.50%) of renal calculi patients and 88 (73.33%) of controls had pulp narrowing (Table 1). There was no statistical association between pulp narrowing and renal stones (Chi-square = 3.2322, $p = 0.0728$). 112 patients in total had pulp stones, which included 55 (45.48%) of controls and 57 (47.50%) of renal calculi patients (Table 2). There was no statistically significant association between the presence of pulp stones and renal stones (Chi-square = 0.0673, $p = 0.7962$).

4. Discussion

Pulp stones are calcifications established in the pulp chamber or pulp canals of deciduous and permanent dentition. They are usually found on dental radiographs accidentally and the

Table 1 – Distribution of patients with and without pulp narrowing.

	Absence of pulp narrowing (%)	Pulp narrowing (%)	Total (%)
Controls	32 (26.67)	88 (73.33)	120 (100)
Renal calculi patients	45 (37.5)	75 (62.5)	120 (100)
Total	77 (32.08)	163 (67.92)	240 (100)
Chi-square = 3.2322, $p = 0.0728$ ($p > 0.05$). $p > 0.001$ (non-significant).			

Table 2 – Distribution of patients with and without pulp stones.

	# of patients without pulp stone (%)	# of patients with pulp stones (%)	Total (%)
Controls	65 (54.16)	55 (45.84)	120 (100)
Renal calculi patients	63 (52.5)	57 (47.5)	120 (100)
Total	128 (53.33)	112 (46.67)	240 (100)
Chi-square = 0.0673, $p = 0.7962$ ($p > 0.05$).			

incidence of pulp stones has been explored in many radiological researches as mentioned in the literature. A multitude of disparity in the prevalence of pulp stones has been found in different populations.^{12–16} The prevalence varies from 8% to 90%, in relation to the type and design of study and radiographic technique adapted. This discrepancy may also have emanated from the difference in sample and sample size in studies from the past. Moreover, the representation of prevalence was also contrasting in the literature. Few researches presented the prevalence stationed on individual and teeth numbers, and the others expressed only the prevalence depending on the number of teeth.¹⁷ Histological approach of assessment is proclaimed to yield magnified values than radiographic method. The prevalence stationed on radiographic observations has been noted to be around 20–25%,^{15,18} while histological explorations have delineated a surpassing prevalence.¹⁹ Recently, Hamasha and Darwazeh¹⁵ determined the prevalence of pulp stones in Jordanian adults to be 51.4% in a radiographic study and Ranjitkar et al.¹³ reported a prevalence of 46.1% in an Australian population.

The frequency of pulp stones has been proclaimed to escalate with increasing age. The extent of the pulp chamber may be curtailed due to the secondary dentin deposition with advancing age.¹⁰ A downturn in the volume of the pulp chamber due to the deposition of the secondary dentin and deposition of calcified masses in the root has been observed by Bernick and Nedelman.²⁰ Some studies have reported that there is no significant difference between genders, while others have reported an increased prevalence of pulp stones among female population.^{13,14} They have been reported to be located more commonly in coronal pulp in comparison to radicular pulp. Pulp stones may vary in numbers, ranging from 1 to 12 or even more in an individual tooth, with size varying from minute microscopic particles to a large mass that may block the pulpal space.¹⁴

Renal lithiasis is not uncommon and is observed to be advancing across the world and it has been established that essentially 5% of females and 12% males of American population will develop a renal stone at some point during their life time. Urolithiasis has established to affect around 5% of the US population.²¹ In certain regions of the globe, as in the Middle East, the lifetime risk noted to be much higher. It poses a compelling health care concern in a working-age group subjects.²² Renal stone evolution is customarily due to genetic and environmental components. Genetic factors are rarely noted to influence the formation of renal stones, since the alterations in the gene pool crop up at a declining pace. The consequence of the diverse and multitude environmental

factors is more credible, as the transition occurs over a less interval of time. Alteration in dietary habits and climatic conditions are the significant environmental factors that have the most positive impact on the advancing prevalence.²³

The 16th century disclosed the first cited increase in stone disease when European Stein-Schneiders (stone cutters) observed an excessive need in their services. Modifications in food production and corn welcoming a popular staple food transpired parallelly.²⁴ This bolstered obesity, which is at present an established risk factor for the formation of stone, due to increased intake of corn-based starchy foods. Other dietary risk factors, such as increased fructose intake, increased oxalate, reduced fluid, and calcium consumption, are also considered to be the risk factors for renal stone development.^{23,25} Epidemiologic studies have observed an elevated sodium and animal protein consumption to have an ambiguous brunt on stone risk. However, minimizing of sodium and animal protein intake and maintenance of recommended normal dietary calcium intake exhibited crippled stone activity in recurrent hypercalciuric stone formers. The intake of animal protein has expanded in a number of countries, along with the exaggeration of stone disease,^{23,26} while certain researches have exhibited a reduction in stone prevalence among geriatric population with excessive consumption of sodium and sodium-rich diet.²⁷ These altercations could be credited to the differences in sampling methodology, design of the research or renal calculi patients losing lives at a younger age. Renal stone formation has been correlated with various medical co-morbidities such as hypertension, cardiovascular disorders, obesity, diabetes mellitus, and chronic renal disorders.²⁸

Pulp calcifications are not clinically identified and are incidentally noted on intraoral radiographs such as bitewing and periapical radiographs, as radiopaque bodies enclosed in the pulp chamber and root canal. As the calcifications are not of the defined size and volume to be noted on radiographs, the incidence studies depending on radiographic observations would not be authentic. The periapical and bitewing radiographs, when compared for their adequacy in the determination of pulpal calcification, demonstrated no significant discrepancy. Thus, periapical radiographs were used to determine pulp stones in the present study.

88 patients in Group A and 75 patients from Group B showed narrowing of the pulp space. No statistically significant relation ($p < 0.001$) was found between the pulp narrowing in both the groups. A total of 46.67% patients showed the presence of pulp stones. 45.84% patients from Group A and 47.5% patients from Group B showed pulp stones. The results were higher when compared to the findings of Malhotra et al.¹² who showed 18.1% prevalence of pulp stones in healthy adults and 25.4% prevalence in patients with renal stones and Ciftcioglu et al.⁹ who showed a prevalence of 28% pulp stones in renal patients. There was no statistically significant relation between the presence of pulp stones and renal stones ($p > 0.001$) in the study, as opposed to the findings of Malhotra et al.¹² who demonstrated a statistically significant relation between the presence of renal stones and pulp stones.

It has been noted that the formation of pulp stones simulates the formation of renal stones. Immunohistochemical studies revealed that type I collagen was evenly located

throughout the pulp stones and osteopontin was found in the peripheral area of the pulp stones.²⁹ Osteopontin was observed to play an elemental role in the calcification front, as it was located in the tangential field of the pulp stones and a similar occurrence of osteopontin was observed in renal calcifications.^{30,31} These observations propose that a positive alliance occurs between the incidence of pulp stones and kidney stones in contrast to the findings of the study.

5. Conclusion

The study, however, did not report any significant association between pulp stones and renal stones but it seems to be of compelling clinical attention. Further large-scale, multi-institutional studies are encouraged to authorize any positive correlation between pulp and renal calcifications along with other systemic disorders. It is, thus, advised that routine dental radiographs could deliver as a significant prognostic tool for early detection of potential renal stones. This screening modality could easily be advocated as a tool in public health programs for early identification of possible renal calculi symptoms since it requires less radiation.

Conflicts of interest

The author has none to declare.

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