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Original Article

Prevalence of pulp stones in a selected population in South-east Iran

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Abstract

Background: Pulp stones are calcified masses with unknown etiology in the dental pulp complicating access to the pulp and root canals during root canal therapy. Aim of this study is to determine the prevalence of pulp stones in patients referring to Kerman University School of Dentistry.

Methods: This cross-sectional study was undertaken on 4413 teeth in 852 patients and 1052 bitewing and periapical radiographs. The patients were 3–60 years old and had been referred to the Kerman School of Dentistry for various reasons. Data were collected by radiographic evaluations and the use of a checklist and were then analyzed using SPSS version 19 and the chi-square test with the significance level set at 0.05.

Results: The prevalence of pulp stones was estimated at 13.4% in the patients, significantly increasing with age ($P=0.001$). Most pulp stones were 12.2% in the maxilla and 10.4% in the mandible, indicating a significant difference between the two jaws ($P=0.001$). The highest prevalence of pulp stones was related to the permanent first molars. Most pulp stones were significantly higher in female subjects than in males ($P=0.004$), with no major difference between the left and right sides ($P=0.07$). No significant relationship was found between the prevalence of pulp stones with tooth restoration and dental caries ($P=0.130$).

Conclusion: The prevalence of pulp stones increased significantly with age. In this study, the youngest participant was a 4-year-old male, and the oldest was a 60-year-old female.

Keywords: Dental pulp calcification, Permanent teeth, Deciduous teeth, Root canal therapy

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Introduction

Pulp stones are acquired tooth anomalies.[1] A pulp stone is a calcified mass in the pulp of a healthy, diseased, or erupted tooth, which might be free or attached to the dentin.[2] Calcifications might occur due to ectopic and unorganized precipitation of calcium salts in body tissues, including blood vessels, liver, lungs, brain, and even tooth pulp.[3] A pulp stone is a clear manifestation of physiologic or pathologic calcification in the dental pulp[4] and might be seen in both deciduous and permanent teeth.[5] The etiology of pulp stones is not clearly understood; however, several factors, including dental caries, deep restorations, chronic inflammation, interaction between the epithelium and the dental pulp, circulatory disturbances in the pulp, aging, genetic disorders, orthodontic movements, and calcified nanoparticles, might have a role in the formation of pulp stones.[6] Furthermore, hypercalcemia is a predisposing factor for the formation of pulp stones.[7] Pulp stones might form when the pulp is irritated and attempts to repair itself. The carious teeth of children and adolescents exhibit a 5-fold incidence of pulp calcification compared to non-carious teeth.[8] Although pulp stones are seen in all tooth types, they are more prevalent in molar teeth.[9] The first and second molars are more frequently involved.[4] The pulp stones form more frequently in the coronal areas compared to the radicular areas[5] and are more frequent in the maxillary posterior teeth.[10] Depending on their position, pulp stones might be buried, adherent, or free. Buried pulp stones form in the pulp; however, during the formation of the physiologic dentin, they are buried in the dentinal walls and are more frequently found on the apical third of the root. Adhering pulp stones have a less tenacious adhesion to the dentin compared to the buried type and are never completely covered by dentin. Free pulp stones are found within the tooth pulp and are the most commonly found type on radiographs.[1] Pulp stones are frequently detected on bite-wing and periapical

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radiographs.[6] Stone pulps > 200 µm in size can be detected on radiographs[10] and have different radiographic manifestations. They might be seen as radiopaque structures in the pulp chamber or the root, with a higher frequency in the former; furthermore, they do not have a uniform shape and number. These calcifications might be localized or diffuse in the pulp.[9] Pulp stone sizes differ from tiny particles to large masses[2]; however, they mostly measure 2–3 mm in diameter. One of the most common symptoms of pulp stones is pulpal pain, which might range from mild to severe.[9] The prevalence of pulp stones varies from 8% to 90%, depending on the study type and design and the radiographic technique used.[11] Although the exact etiology of pulpal calcification is unknown, it has clearly been shown that the incidence of pulp stone increases with age.[1,12,13] The majority of researchers believe that the incidence of pulp stones increases up to 8-fold with aging.[14] Some studies have reported no significant differences in the incidence of pulp stones between males and females,[5,11,12,13] but some studies report a higher incidence rate in female subjects.[12,15,16] The present study was undertaken due to the availability of very limited data on the initiation of pulpal calcifications on radiographs in the Iranian population. Furthermore, in the limited number of studies carried out in Iran, the evaluations have only been confined to the posterior teeth.[6] In addition, another important aspect of this issue is the age at which pulp stones are formed, which has not been evaluated in any study. As a result, the present study was designed to determine the prevalence of pulp stones in subjects 3–60 years old so that it would be possible to guess the age at which these pulp stones are formed in this population. The results would help report the prevalence of pulp stones in different types of deciduous and permanent teeth (anterior, premolar, and molar) with different crown conditions (sound, carious, or restored). Moreover, the findings of this study emphasize the proper radiographic diagnosis of pulp stones leading to modifications in common root canal therapy in order to achieve proper access to the root canals in the teeth with pulp stones.

Methods

The present study was based on research proposal #95000334 between December 2017 and January 2019. The sample size was calculated as 852 patients based on previous studies[12,17,18] considering a minimum prevalence rate of 10% and an error coefficient of 2% in the population. The samples were randomly selected from the pool of patients referring to Kerman Faculty of Dentistry for various reasons who underwent bitewing or periapical imaging with Kodak E-speed #2 film (Eastman-Kodak Co., Rochester, NY, USA) using an x-ray unit, Planmeca Intra (Helsinki, Finland). Since the subjects needed their radiographs, they were photographed with a Panasonic DMC-LX5 digital camera (LX5; Panasonic Corporation, Osaka, Japan (with a conventional lens in macro mode. The inclusion criteria consisted of the following:

1. Bitewing or periapical radiographs of patients 3–60 years old were considered,
2. Each examined tooth had to have a wholly formed apex,
3. A pulp stone was reported when a definite radiopaque mass was observed in the pulp chamber or root,
4. Both primary and permanent dentitions were considered.

The excluded samples consisted of:

1. The radiographs of subjects < 3 and > 60 years old,
2. Low-quality radiographs (insufficient exposure, processing errors, and incorrect angulation),
3. Radiographs in which a crown, a bridge, an extensive restoration, or a class V restoration interfered with the clear visualization of the pulp chamber,
4. Third molars.

The present study evaluated bitewing or periapical radiographs of patients 3–60 years old (Figures 1 and 2). Two experienced observers examined all the radiographs using magnifying lenses and an X-ray viewer in a dimmed room on a lightbox with a diffuse light source that filtered the ambient light. After calibration, the first observer completed the checklist of each radiograph and assigned a number to each checklist. The second observer viewed the radiographs again and decided whether they agreed with the check list or not. If there was an inconsistency between the two observers, a consensus was reached after discussion and re-evaluation of the case. A pulp stone was diagnosed when a visible radiopaque mass was seen in the pulp chamber or root. The calcifications were localized

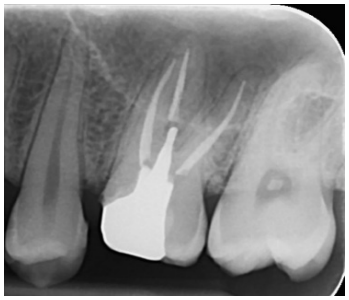

Figure 1. Pulp stone in permanent second molar

Figure 2. Pulp stone in permanent first molar

or diffuse within the pulp, and the sizes of these pulp stones varied from microscopic particles to vast masses. In addition, a checklist that contained demographic data (age and gender) and data on the type of radiograph used, the tooth type (permanent anterior, premolar, and molar teeth, and deciduous anterior and molar teeth), the condition of the teeth (sound, carious, or restored), the dental arch (maxilla or mandible) and the left or right side, was completed for each patient.[18,19] To test the reliability of the radiographic evaluation, the observers re-evaluated 10% of the radiographs two months after the first evaluation. A 95% confidence interval was calculated to estimate the prevalence of pulp stones in different population groups (age groups). The chi-square test evaluated the prevalence of pulp stones regarding nominal and ordinal variables. Data were analyzed with SPSS version 19.00 (SPSS Inc., Chicago, IL, USA), and statistical significance was set at $P<0.05$.

Results

A total of 1055 radiographs (three cases were excluded due to lack of age report) (n = 1052) and 4413 teeth were evaluated in this study (Table 1). The prevalence of pulp stones increased significantly with age (Table 1). In this study, the youngest person was a 4-year-old male who exhibited two pulp stones in his mandibular right first and second primary molar teeth, and the oldest was a 60-year-old female with two pulp stones in her mandibular right first permanent molar and premolars. The number of teeth with pulp stones was higher in the bitewing radiographs, which was statistically significant ($P\leq0.001$) (Table 2). In addition, the most pulp stones on the left side, which was not statistically significant (Table 2). The prevalence of pulp stones was significantly higher in the maxilla than in the mandible ($P=0.007$) (Table 2). Furthermore, analysis of tooth types showed that the first permanent molar teeth exhibited the highest prevalence of pulp stones; of all the deciduous teeth, the second molar teeth demonstrated the highest prevalence of pulp stones (Table 3). Based on the results, the prevalence of pulp stones was higher in restored teeth compared to the sound and carious teeth (Table 4).

Discussion

In this study, after the evaluation of 852 patients, 1052 radiographs, and 4413 teeth, the prevalence of pulp stones was calculated as 13.4% among patients (114 out of 852). In a study by Kazemizadeh et al[20] in Rafsanjan Faculty of Dentistry on 800 patients and 2681 teeth, the prevalence of pulp stones was estimated as 20% in terms of the number of patients and 7–9% in terms of the number of teeth. Ranjitkar et al[17] evaluated 217 dental students and 3296 teeth in Australia and reported a prevalence rate of 46.1% for pulp stones in terms of subjects and 10% in terms of the number of teeth. According to a study by Al-Hadi Hamasha and Darwazeh,[21] from 814 patients referring to a dental school in Jordan, 22% of the evaluated teeth exhibited pulp stones. A prevalence rate of 20.7% for pulp stones in 1380 teeth mentioned by Tamse et al.[16] The differences in the prevalence rate of pulp stones between different studies might, to a greater extent, be attributed to differences between the study populations

Table 1. The prevalence of pulp stones in terms of gender and age (%)

Prevalence		Gender		*P* value	Age groups					*P* value
		Male	Female		3–15	15.1–30	30.1–45	45.1–60	3–60	
Patients with pulp stones (n = 852)	Yes	34 (10.2)	80 (15.4)	*0.031	7 (4.9)	45 (13.6)	46 (16.8)	16 (15.4)	114 (13.4)	0.004
	No	298 (89.8)	440 (84.6)		137 (95.1)	285 (86.4)	227 (83.2)	88 (84.6)	737 (86.6)	
Radiographs with pulp stones (n = 1052) *	Yes	41 (10.0)	105 (16.3)	0.004	10 (5.1)	58 (14.5)	5 (16.9)	23 (17.7)	146 (13.9)	0.001
	No	367 (90)	539 (83.7)		186 (94.9)	343 (85.5)	270 (83.1)	106 (82.2)	905 (13.9)	

* Three cases were excluded due to lack of age report ($n=1052$).

Table 2. The prevalence of pulp stones in terms of the type of radiograph and the jaw and side involved

Prevalence		Radiographic technique		*P* value	Jaw			*P* value	The side involved			*P* value
		Periapical	Bite-wing		Maxilla	Mandible	Maxilla & mandible		Right	Left	Right & left	
Patients with pulp stones, No. (%)	Yes	36)9.2%)	77 (17.0%)	0.001	26 (11.3%)	11 (6.9%)	77 (17.0%)	0.007	54 (12.4%)	60 (15.1%)	0 (0%)	0.21
	No	355 (90.8%)	377 (83.0%)		204 (88.7%)	149 (93.1%)	375 (83.0%)		380 (87.6%)	338 (84.9%)	12 (100%)	
Total*		$n=845$			$n=842$				$n=844$			
Radiographs with pulp stones, No. (%)	Yes	42 (8.8%)	102 (18.1%)	0.0001	29 (10.3%)	14 (7.3%)	103 (18.2%)	0.0001	62 (12.1%)	84 (16.4%)	0 (0%)	0.042
	No	434 (91.2%)	462 (81.9%)		253 (89.7%)	178 (92.7%)	463 (81.8%)		451 (87.9%)	427 (83.6%)	14 (100%)	
Total*		$n=1040$			$n=1040$				$n=1038$			

*The difference in the total number of samples is due to missing data.

Table 3. The prevalence of pulp stones in terms of the tooth

Tooth	The number (%) of pulp stones	The number of each type of tooth (No.) and its percentage of the total (%)
Permanent anterior	3 (0.93)	322 (7.2)
Permanent premolar	13 (0.80)	1614 (36.57)
Permanent first molar	133 (11.58)	1148 (26.01)
Permanent second molar	76 (7.03)	1080 (24.47)
Primary anterior	0 (0)	81 (1.83)
Primary first molar	1 (1.26)	79 (1.79)
Primary second molar	2 (2.24)	89 (2.01)
Total	228 (5.16)	4413

Table 4. The prevalence of pulp stones in terms of the condition of teeth

Tooth condition	The number of teeth with pulp stones	*P* value
Sound	54 (23.68%)	0.130
Carious	76 (33.33%)	
Restored	98 (42.98%)	

and the radiographic techniques used for evaluations. Furthermore, the real prevalence of pulp stones is higher due to the inability of radiographic techniques to show pulp stones with small sizes or a low calcification rate. In the present study, similar to the two studies reported above[13,17] the prevalence of pulp stones in female subjects was higher than that in male participants. These researchers attributed this higher prevalence in female subjects to a higher prevalence of bruxism in females as a chronic, irritating factor of the dental pulp. However, in studies by Al-Hadi Hamasha and Darwazeh[21] and Gulsahi et al,[22] the prevalence of pulp stones was higher in male subjects; such a discrepancy might be related to the different geographic locations of the subjects. This study used periapical and bitewing radiographs to identify pulp stones. Intraoral radiographs provide more standard images compared to extraoral radiographic techniques because x-ray beams are directed at a right angle to the long axis of each tooth; however, no significant difference has been reported in the evaluation of pulp stones between the periapical and bitewing radiographic techniques.[18] Different radiographic techniques have been selected in different studies. In the studies by Baghdady et al,[23] Ranjikar et al,[17] and Malhotra et al,[24] only bitewing radiographs were used to identify pulp stones; however, Ezoddini-Ardakani et al[7] and Horsley et al[25] used panoramic radiographs, and Gulsahi et al[22] and Edds et al[26] used periapical radiographs. In some studies, too, periapical radiographs have been used in association with bitewing radiographs.[16,18,21] In the present study, both periapical and bitewing radiography were used. It must be noted that detecting pulp stones on radiographs is possible when pulp stones are larger than 200 μm in diameter; consequently, tiny pulp stones cannot be seen in radiographs.[17] The present study showed a direct relationship between pulp stones and age. In this study, the youngest participant was a 4-year-old male who exhibited two pulp stones in his mandibular right first and second primary molar teeth, and the oldest was a 60-year-old female with two pulp stones in her mandibular right first permanent molar and premolars. A review of the relevant studies reveals a study that mentions the youngest subject as a 12-year-old female who showed a single pulp stone in her maxillary left first molar tooth.[19] However, previously published studies did not examine when the pulp stone was formed. Furthermore, none evaluated the pulp stone formation at an early age or in primary dentition.[5,6,12,17,18] The normal structure of the tooth pulp changes with aging, with a progressive decrease in the pulp cell count and a gradual increase in the connective tissue of the pulp. Furthermore, aging results in a decrease in fibroblast, odontoblast, and mesenchymal cell counts. In addition, atrophied fibers or fatty deposits might also be found in the pulp.[12] Gulsahi et al,[22] Horsley et al,[25] and Kazemizadeh et al[20] showed an increase in the incidence of pulp stones with aging. However, Al-Hadi Hamasha and Darwazeh did not report such a relationship.[21] These researchers believed that the possible reason for such a finding might be that most of their subjects were < 50 years old. Also, in a study by Sener et al,[13] there was no relationship between age and the pulp stones. They recommended longitudinal studies in this respect because the main etiologic agent for pulpal calcification is chronic irritation due to caries, restorations, and parafunctional habits and their severity and duration, rather than only the subjects' age. Therefore, the only reliable way to evaluate the effect of age on the initiation and formation of calcifications in the dental pulp is to place the patients on annual recall visit schedules in association with periodic radiographs in a long-term program. In the present study, there were more pulp stones on the left than on the right side; however, the difference was insignificant. Also, there was a significant correlation between the pulp stones and the jaw involved, with a higher prevalence of pulp stones in the maxilla. Similarly, in studies by Ranjitkar et al[17] and Nayak et al,[27] the maxilla pulp stones were more prevalent. However, Ezoddini-Ardakani et al[7] reported an equal prevalence rate of pulp stones between the two jaws. In the present study, permanent first molars exhibited the highest prevalence of pulp stones, followed by permanent second molars, which agrees with results from other research studies.[5,17,18,21-23] Their earlier eruption might explain a higher prevalence of pulp stones in the permanent molars compared to the other teeth and the larger size of their coronal pulp, and the larger pulpal tissue as a result of that, which provides more favorable conditions for pulp calcification compared to other teeth.[23] Some researchers reported that the possible reason for a higher prevalence of pulp stones in the permanent first and second molars

might be the high prevalence of caries and restorations in these teeth.[13] Among deciduous teeth, the second molars exhibited the highest prevalence. On the other hand, because of the small quantity of radiographs with primary teeth, this may be one of the drawbacks of the present study. In the present study, there was no significant correlation between pulp stones and the tooth condition, which is consistent with the results of the study by Gulsahi et al[22]; however, in studies by Ranjitkar et al[17] and Sener et al,[13] the prevalence of pulp stones was higher in teeth with caries and restorations. Ranjitkar et al reported that chronic pulp irritation might lead to the formation of pulp stones. The pathologic effect exerted on dental caries by microorganisms might damage the vessel walls, giving rise to the ectopic deposition of calcium salts in the pulp tissue.[5]

Strengths and Limitations

The present study used periapical and bitewing radiographs to identify pulp stones; bitewing radiographs showed significantly more pulp stones than periapical radiographs. However, it cannot be claimed that since the teeth on bitewing radiographs exhibited more pulp stones, this radiographic technique is more accurate for identifying them. In this context, if the periapical and bitewing radiographs had been taken from the same teeth and compared, it might have been possible to determine which one was preferable to the other. However, since the radiographs were independent, comparing them was impossible. Conducting this research was accompanied by some limitations. Since pulp pathology is not the only cause of pulp stone development, it is necessary to consider other factors that are involved in pulp stone formation. It is recommended that other etiological factors, such as tooth wear, bruxism, periodontal conditions, genetic predisposition, fluoride supplementation, and idiopathic factors, also be assessed. Further research must clarify the etiological factors involved in pulp stone development.

Conclusion

The prevalence of pulp stones in the present study was estimated at 13.4% in patients, and the youngest subject with a pulp stone was four years old. Pulp stones were more prevalent in females than males, with a significant increase in their prevalence with age. The permanent first and second molars exhibited the highest prevalence of pulp stones. The maxilla had a higher prevalence of pulp stones compared to the mandible.

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Authors' Contribution

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Visualization: Reza Motaghi, Fatemeh Jahanimoghadam.
Writing–original draft: Fatemeh Jahanimoghadam.
Writing–review & editing: Masoud Parirokh.

Competing Interests

The authors declare that they have no competing interests.

Data Availability Statement

The datasets used and/or analyzed in the current study are available from the corresponding author on reasonable request.

Ethical Approval

All procedures/experiments were performed in accordance with the required guidelines and regulations. This study was approved by Ethics Committee of Kerman University of Medical Sciences (IR.KMU.REC.1395.419).

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References

1. Javadzadeh A, Mohtavipour ST, Dalili Z, Nemati S, Vosooghi Y, Pourhabibi Z. Prevalence of pulp stones in radiographs of patients, referred to Guilan school of dentistry in 2011. J Mashhad Dent Sch. 2014;38(2):99-106.
2. Raj AC, Anekar J, Anand M, Darshan DD, Seema M, Ayilliath A. Correlation of pulp stone prevalence with dietary habits-a pilot study. Health Sci. 2012;1(3):JS003C.
3. Yeluri G, Kumar CA, Raghav N. Correlation of dental pulp stones, carotid artery and renal calcifications using digital panoramic radiography and ultrasonography. Contemp Clin Dent. 2015;6(Suppl 1):S147-51. doi: 10.4103/0976-237x.166837.
4. Zeng J, Yang F, Zhang W, Gong Q, Du Y, Ling J. Association between dental pulp stones and calcifying nanoparticles. Int J Nanomedicine. 2011;6:109-18. doi: 10.2147/ijn.s13267.
5. Sisman Y, Aktan AM, Tarim-Ertas E, Ciftçi ME, Sekerci AE. The prevalence of pulp stones in a Turkish population. A radiographic survey. Med Oral Patol Oral Cir Bucal. 2012;17(2):e212-7. doi: 10.4317/medoral.17400.
6. Gaddalay S, Pathan M, Kale A, Ahhirao Y. Prevalence of pulp stones in urban and rural population of Latur Maharashtra and the challenges encountered: an endodontic perspective. IOSR J Dent Med Sci. 2015;14(9):5-8. doi: 10.9790/0853-14930508.
7. Ezoddini-Ardakani F, Namayandeh SM, Sadr-Bafghi SM, Fatehi F, Mohammadi Z, Shahrabi-Farahani S, et al. Association of pulp stones with coronary artery stenosis. Community Dent Health. 2011;28(4):305-7. doi: 10.1922/CDH_ 2633Ardakani03.
8. Kaswan S, Patil S, Maheshwari S, Rahman F, Khandelwal

S. The relationship between pulp calcifications and salivary gland calcifications. J Clin Exp Dent. 2014;6(5):e474-8. doi: 10.4317/jced.51518.
9. Bains SK, Bhatia A, Singh HP, Biswal SS, Kanth S, Nalla S. Prevalence of coronal pulp stones and its relation with systemic disorders in northern Indian Central Punjabi population. ISRN Dent. 2014;2014:617590. doi: 10.1155/2014/617590.
10. Movahhedian N, Haghnegahdar A, Owji F. How the prevalence of pulp stone in a population predicts the risk for kidney stone. Iran Endod J. 2018;13(2):246-50. doi: 10.22037/iej.v13i2.18181.
11. Stenvik A, Mjör IA. Epithelial remnants and denticle formation in the human dental pulp. Acta Odontol Scand. 1970;28(5):721-8. doi: 10.3109/00016357009058593.
12. Çolak H, Çelebi AA, Hamidi MM, Bayraktar Y, Çolak T, Uzgur R. Assessment of the prevalence of pulp stones in a sample of Turkish Central Anatolian population. ScientificWorldJournal. 2012;2012:804278. doi: 10.1100/2012/804278.
13. Sener S, Cobankara FK, Akgünlü F. Calcifications of the pulp chamber: prevalence and implicated factors. Clin Oral Investig. 2009;13(2):209-15. doi: 10.1007/s00784-008-0212-x.
14. Udoye C, Sede M. Prevalence and analysis of factors related to ooccurrence of pulp stone in adult restorative patients. Ann Med Health Sci Res. 2011;1(1):9-14.
15. Dalili Kajan Z, Nemati S, Dolatabadi N, Javadzadeh AS, Mohtavipour ST. Prevalence of developmental and acquired dental anomalies on digital panoramic radiography in patients attending the dental faculty of Rasht, Iran. J Dentomaxillofac Radiol Pathol Surg. 2013;1(2):24-32. doi: 10.18869/acadpub.3dj.1.2.24.
16. Tamse A, Kaffe I, Littner MM, Shani R. Statistical evaluation of radiologic survey of pulp stones. J Endod. 1982;8(10):455-8. doi: 10.1016/s0099-2399(82)80150-7.
17. Ranjitkar S, Taylor JA, Townsend GC. A radiographic assessment of the prevalence of pulp stones in Australians. Aust Dent J. 2002;47(1):36-40. doi: 10.1111/j.1834-7819.2002.tb00301.x.
18. Ravanshad S, Khayat S, Freidonpour N. The prevalence of pulp stones in adult patients of Shiraz Dental School, a radiographic assessment. J Dent (Shiraz). 2015;16(4):356-61.
19. Kannan S, Kannepady SK, Muthu K, Jeevan MB, Thapasum A. Radiographic assessment of the prevalence of pulp stones in Malaysians. J Endod. 2015;41(3):333-7. doi: 10.1016/j.joen.2014.10.015.
20. Kazemizadeh Z, Zargarpoor R, Ahmadi Kohanali J. A radiographic assessment of the prevalence of pulp stones in patients referred to Rafsanjan faculty of dentistry in 2008. Qom Univ Med Sci J. 2011;5(2):28-32. [Persian].
21. Al-Hadi Hamasha A, Darwazeh A. Prevalence of pulp stones in Jordanian adults. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;86(6):730-2. doi: 10.1016/s1079-2104(98)90212-8.
22. 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;42(8):735-9. doi: 10.1111/j.1365-2591.2009.01580.x.
23. Baghdady VS, Ghose LJ, Nahoom HY. Prevalence of pulp stones in a teenage Iraqi group. J Endod. 1988;14(6):309-11. doi: 10.1016/s0099-2399(88)80032-3.
24. Malhotra S, Bal RK, Bal CS, Kaur K. Prevalence of pulp stones in North Indian population and its correlation with renal stones: a clinical/radiographic study. Indian J Compr Dent Care. 2012;2:127-33.
25. 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;4(2):169-73. doi: 10.1007/s11548-008-0277-7.
26. 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;31(7):504-6. doi: 10.1097/01.don.0000168890.42903.2b.
27. Nayak M, Kumar J, Prasad LK. A radiographic correlation between systemic disorders and pulp stones. Indian J Dent Res. 2010;21(3):369-73. doi: 10.4103/0970-9290.70806.