



## Evaluation of the Frequency of Pulp Stone Formation During Orthodontic Treatment in Three Periods: Late Adolescence, Middle-aged, and Young People

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### ABSTRACT

**Background and aim:** This study examines pulp stones, which are calcified masses found in the pulp chamber of both healthy and diseased teeth. Factors such as age, caries, periodontal disease, and orthodontic treatments can contribute to their formation. The study aimed to determine the prevalence of pulp stone formation after orthodontic treatment across three age groups: adolescents, young adults, and middle-aged adults.

**Material and methods:** This retrospective study examined pulp stone formation in incisors and molar teeth of 57 orthodontically treated patients across different age groups consisting of adolescents (20 to 28 years), young adults (29 to 37 years), and middle-aged adults (38 to 47 years). A total of 19 patients per age group met specific inclusion criteria. All patients were treated with fixed orthodontics, having completed at least 12 months of treatment under the supervision of a single practitioner to minimize treatment variability. The data were analyzed by SPSS version 26 with a chi-square test to examine the growth of pulp stones in the coronal pulp area.

**Results:** Pulp stones were detected with a higher occurrence in the maxilla and among young adults compared to other groups. Additionally, the prevalence of pulp stones is higher in the maxillary central and lateral incisors as well as the mandibular first and second molars.

**Conclusions:** Although young adults demonstrated a higher prevalence of pulp stones in specific teeth, statistical analysis revealed no significant association between age and the formation of pulp stones. Consequently, age cannot be considered a determining factor in their prevalence.

### 1. Introduction

Pulp stones are calcified masses that can form within the pulp chamber of healthy or diseased teeth either in the form of free, attached, or embedded, even in primary or permanent teeth with incomplete eruption.<sup>[1]</sup> Pulp stones are classified as dental anomalies and mostly occur in the coronal pulp, ranging in size from small nodules to large masses that can occupy the entire pulp cavity.<sup>[2, 3]</sup> The exact cause of pulp stone formation is not fully understood. However, factors such as age, caries, surgical procedures, periodontal disease, and irritation by various cariogenic microorganisms lead to pulp stone formation as a result of damage to vessels and deposit calcium,<sup>[4]</sup> genetic predisposition,<sup>[5]</sup> pulp circulation problems,<sup>[6]</sup> long term dental irritants such as deep caries and restoration,<sup>[7]</sup> and orthodontic treatments<sup>[8]</sup> have been associated with their development. Pulp stones can be visualized radiographically as round or oval opacities that may present as either single or multiple entities.<sup>[9]</sup> However, their occurrence on radiographs is less common than their histological presence.<sup>[10]</sup> Pulp stones can potentially interfere with access to the apical root during endodontic treatment, leading

to treatment failure or tooth loss.<sup>[11]</sup> While pulp stones typically do not require specific treatment unless they cause symptoms,<sup>[5]</sup> they can pose challenges during endodontic procedures, especially in cases where orthodontic treatment has been performed.<sup>[6]</sup> Orthodontic forces applied to teeth can induce changes in the pulp, including the development of secondary dentin, internal root resorption, cyst formation, pulp necrosis, and pulp calcification.<sup>[7, 8, 12]</sup> The present study aimed to determine the prevalence of pulp stone formation after orthodontic treatment in various age groups, which may aid in assessing the complexity of root canal treatment for teeth that have undergone orthodontic treatment.

### 2. Material and Methods

In the current study, the formation of dental pulp stones in the pulp chamber was evaluated across different age groups and tooth types, specifically focusing on adolescents (aged 20-28 years), young adults (aged 29-37 years), and middle-aged adults (aged 38-47 years). Maxillary and mandibular incisors and molars were selected for this study due to the ease of

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pulp stone observation and minimal image distortion of the teeth crowns. The study included 19 patients in each age group who met specific inclusion criteria, which included being above 20 years of age, having class I occlusion with mild to moderate crowding, undergone a minimum of 12 months of non-extraction fixed orthodontic treatment, possessing high-quality panoramic radiographs without significant errors before and after treatment, having been treated with fixed orthodontics by a single practitioner to minimize treatment variations. For tooth alignment, light, continuous forces ranging from 50 to 150 grams (0.5–1.5 N) are applied. Exclusion criteria for the study encompassed systemic diseases such as diabetes, osteoarthritis, hyperthyroidism, lip and palate clefts, teeth with deep restorations, history of trauma, periodontal diseases, immature incisor teeth with open apexes, teeth with root canal treatment, history of orthognathic surgery, history of bruxism, teeth without brackets during treatment, pre-existing pulp stone and roots with severe curvature or calcifications. An endodontist examined all the



Fig. 1. Before orthodontic treatment.

radiographs to check for the formation of pulp stones after treatment. The first panoramic radiographs were obtained before the orthodontic treatments (Fig. 1), while the second panoramic radiographs were taken at least one year after the beginning of active orthodontic treatments (Fig. 2). The formation or increase in size of pulp stones in the coronal pulp area of the teeth was recorded, and variables such as age, gender, and location of pulp stones were recorded. Data were analyzed in SSPS software version 26 with a chi-square test with a p-value of 5%.

#### Ethical approval

The research protocol has been reviewed and approved by the Ethics Committee for Biological Studies at the Islamic Azad University, Khorasgan Branch (IR.IAU YAZD REC, 1401.045). Participants were assured of the confidentiality of their information and informed that the research adhered to the highest ethical standards.

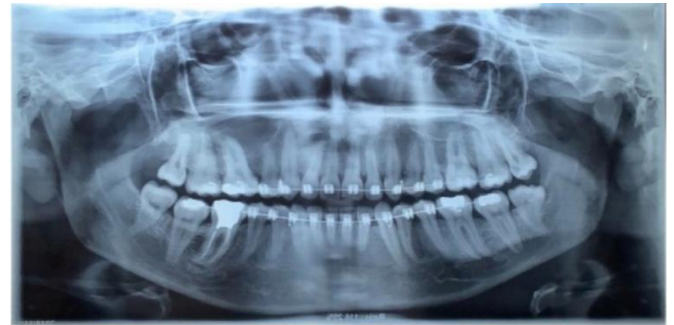


Fig. 2. One year after the beginning of orthodontic treatments.

### 3. Results

Analyzing data collected with reliable tools is a fundamental foundation of any study and research. In this study, the researcher aims to examine the data using various methods to test and evaluate the hypotheses. To achieve this purpose, the collected data are first analyzed using descriptive statistics and then applied in inferential statistics to verify the validity of the research

hypotheses. Table 1 shows the frequency distribution of pulp stone formation in different age groups. Fig. 3 shows the frequency of pulp stone formation in different kinds of teeth. Table 1 Frequency distribution of dental pulp stone formation in different age levels.

Table 1. Frequency distribution of dental pulp stone formation in different age levels.

Tooth Type	Pulp Stone Formation/Years Old			P-value
	Adolescents	Young Adults	Middle-aged Adults	
Maxillary Central Incisor	32.7%	51%	16.3%	0.066
Maxillary Lateral Incisor	25%	62.5%	12.5%	0.141
Mandibular Central Incisor	50%	50%	0%	0.865
Mandibular Lateral Incisor	100%	0%	0%	0.517
Maxillary First Molar	31%	52.4%	16.7%	0.534
Mandibular First Molar	32.1%	42.9%	25%	0.518
Maxillary Second Molar	16.7%	72.2%	11.1%	0.248
Mandibular Second Molar	8.31%	5.45%	7.22%	0.183
Maxillary Third Molar	0%	0%	0%	0.499
Mandibular Third Molar	0%	100%	0%	1.00

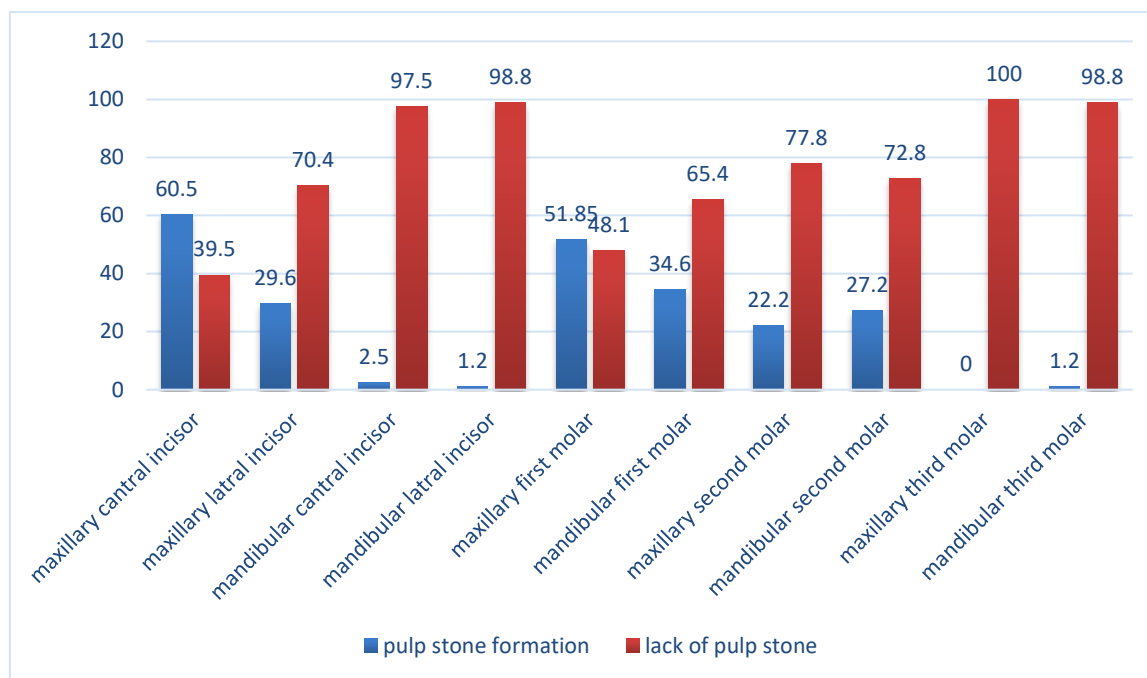


Fig. 3. Frequency distribution of pulp stone formation.

#### 4. Discussion

This study aimed to investigate the prevalence of dental pulp stones in patients who had received fixed orthodontic treatment at three different age groups and to understand their relationship with specific age groups and teeth. The study conducted by Acharya et al.,<sup>[13]</sup> reported a threefold higher occurrence of dental pulp stones in the maxilla compared to the mandible, stating that the total number of teeth with pulp stones in the maxilla and mandible arches was 238 and 61, respectively, which is consistent with the results of the current study. Alajam et al.,<sup>[14]</sup> also stated in their study that the prevalence of pulp stones in the maxilla compared to the mandible was higher and that the prevalence of this condition was greater on the left sides of the jaws than on the right sides. Jena et al.,<sup>[15]</sup> also reported a higher prevalence of dental pulp stones in maxillary molars. Additionally, a study by Ertas et al.,<sup>[16]</sup> noted that the prevalence of dental pulp stones is significantly higher in the maxilla than in the mandible. In the study by Hekmatian et al.,<sup>[17]</sup> the frequency distribution of pulp stones in the maxilla was significantly higher than in the mandible. However, in the study by Patil et al.,<sup>[18]</sup> no significant difference between the two jaws in this regard was found.

According to a CBCT-based observational study by Zhang et al. and colleagues, the anatomical distribution of dental pulp stones varies among populations. While some findings report a higher prevalence in maxillary teeth, other studies indicate a greater occurrence in mandibular teeth.<sup>[19]</sup> The diversity in study results can be attributed to factors such as race and ethnicity; therefore, it may be necessary to conduct further investigation with a larger sample size to inform decisions in this matter. Based on the results of the current study, the highest occurrence of dental pulp stones was observed in upper central incisors. However, in most studies, the highest prevalence of dental pulp stones was reported in the upper first and second molars, which is inconsistent with the current study's results.<sup>[14-17, 20, 21]</sup> This discrepancy could be attributed to anatomical variations, genetic differences among individuals, patient age, variations in orthodontic treatment, and variations in study methodologies. In the study by Tassoker et al.,<sup>[22]</sup> no significant difference was reported between the prevalence of dental pulp stones and tooth type. One theory suggests that molars, due to their larger size and more extensive

blood vessels, may have a higher probability of calcification and subsequent formation of dental pulp stones. Another theory suggests that molars erupt earlier, resulting in longer exposure to local factors such as occlusal forces, tooth abrasion, and bruxism. The prevalence of dental pulp stones in upper central and lateral incisors and lower first and second molars was higher in young adults compared to other age groups. Despite differences in the occurrence of dental pulp stones among individuals, no statistically significant association was observed between age and dental pulp stone prevalence. In other words, the possibility of pulp stone formation in different ages is similar. Al Ajam et al.,<sup>[14]</sup> reported in their study that patients in the middle-aged group (31–40 years) exhibited a higher prevalence of pulp stones compared to other age groups in all first and second molars in both jaws, a finding consistent with the results of the current study. Javadzadeh et al.<sup>[21]</sup> also mentioned in their study that the prevalence of dental pulp stones increases with age in patients. This disparity may stem from the broader age range of 12 to 80 years in their study compared to the narrower range of 20 to 47 years in the current study. In addition, in Javadzadeh's study, a weak correlation between age and the number of pulp stones was mentioned, suggesting that as age advances, the number of pulp stones per person increases. According to their findings, the mean age and standard deviation for patients with pulp stones were  $36.3 \pm 14.01$ , whereas for those without pulp stones, the figures were  $28.7 \pm 11.56$ . This finding aligns closely with the current study's results regarding the prevalence of pulp stones in young adults.

In the study by Mahmoudi et al.,<sup>[23]</sup> no significant relationship was observed between age and the prevalence of dental pulp stones, which aligns with the findings of the current study. However, the results of the studies by Javadzadeh et al.,<sup>[21]</sup> and Tassoker et al.,<sup>[22]</sup> showed that the possibility of dental pulp stones increases with age. Additionally, the study by Hsieh et al.,<sup>[24]</sup> did not report a significant difference in the prevalence of dental pulp stones between age groups. In the study by Rodriguez et al.,<sup>[25]</sup> the highest prevalence was reported in the 31- to 40-year age group, which is nearly consistent with the results of the current study. The discrepancies in findings of other studies could be due to differences in study methodology, imaging

tools, inclusion criteria, and environmental variations. To determine the effect of age on the formation of dental pulp stones, it may be reliable to use data from past cohort studies and analyze previously obtained radiographs from patients. This study investigated the formation of pulp stones across three age groups: adolescents, young adults, and middle-aged adults. Among these age groups, young adults exhibit a higher prevalence of pulp stones in their maxillary central and lateral incisors as well as the mandibular first and second molars. Despite individual variation in the occurrence of pulp stones, no significant, meaningful relationship was found between age groups. Therefore, pulp stones are likely to occur regardless of age, and age is not an effective factor in determining the prevalence of pulp stones.

#### 4. Conclusion

This study investigated the formation of pulp stones across three age groups: adolescents, young adults, and middle-aged adults. Among these age groups, young adults exhibit a higher prevalence of pulp stones in their maxillary central and lateral incisors as well as the mandibular first and second molars. Despite individual variation in the occurrence of pulp stones, no significant, meaningful relationship was found between age groups. Therefore, pulp stones are likely to occur regardless of age, and age is not an effective factor in determining the prevalence of pulp stones.

#### Conflict of Interest

The authors declared that there is no conflict of interest.

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#### References

- [1] Ravanshad S, Khayat S, Freidonpour N. The prevalence of pulp stones in adult patients of Shiraz Dental School, a radiographic assessment. *Journal of dentistry*. 2015;16(4):356-61.
- [2] Palatyńska-Ulatowska A, Fernandes MC, Pietrzycka K, Koprowicz A, Klimek L, Souza RA, et al. The pulp stones: morphological analysis in scanning electron microscopy and spectroscopic chemical quantification. *Medicina*. 2021;58(1):5. <https://doi.org/10.3390/medicina58010005>.
- [3] Chalikkandy SN, Bhandi S, Al Shawkani HA, Al Wadei MH, Kader MM, Jaafari AH, et al. A systematic review assessing the dental pulp stone prevalence in the Saudi Arabian population. *The Saudi Dental Journal*. 2023;35(7):803-11. <https://doi.org/10.1016/j.sdentj.2023.07.012>.
- [4] Gürhan C, Saruhan E. Pulp stones: any relevance with the levels of serum calcium, parathyroid hormone, vitamin D and uric acid. *Restorative Dentistry & Endodontics*. 2024;49(2):e17. <https://doi.org/10.5395/rde.2024.49.e17>.
- [5] Meyfarth SR, Ramirez I, Silva-Sousa AC, Proff P, Gabardo MC, Sousa-Neto MD, et al. Investigation of genetic polymorphisms in genes encoding growth factors and dental pulp calcification in orthodontic patients. *Journal of Oral Biology and Craniofacial Research*. 2024;14(6):712-9. <https://doi.org/10.1016/j.jobcr.2024.09.013>.
- [6] Patil S, Sinha N. Pulp stone, haemodialysis, end-stage renal disease, carotid atherosclerosis. *Journal of clinical and diagnostic research: JCDR*. 2013;7(6):1228-31. <https://doi.org/10.7860/JCDR/2013/5087.3042>.
- [7] Zhang W, Wang Y, Ye L, Zhou Y. Distribution and influencing factors of pulp stones based on CBCT: a retrospective observational study from southwest China. *BMC Oral Health*. 2024;24(1):947. <https://doi.org/10.1186/s12903-024-04727-3>.
- [8] Babanouri N, Sahmeddini S, Khoshmakani MR. Effects of orthodontic treatment on pulp stone formation: a retrospective study. *BioMed Research International*. 2023;2023(1):7381610. <https://doi.org/10.1155/2023/7381610>.
- [9] Zahran SS, Alamoudi RA. Radiographic evaluation of teeth with pulp stones and pulp canal obliteration: characteristics, and associations with dental parameters. *Libyan Journal of Medicine*. 2024;19(1):2306768. <https://doi.org/10.1080/19932820.2024.2306768>.
- [10] Donta C, Kavvadia K, Panopoulos P, Douzougou S. Generalized pulp stones: report of a case with 6-year follow-up. *International Endodontic Journal*. 2011;44(10):976-82. <https://doi.org/10.1111/j.1365-2591.2011.01903.x>.
- [11] Pietrzycka K, Pawlicka H. Clinical aspects of pulp stones: A case report series. *Dental and Medical Problems*. 2020;57(2).
- [12] Kansu O, Ozbek M, Avcu N, Aslan U, Kansu H, Gençtoý G. Can dental pulp calcification serve as a diagnostic marker for carotid artery calcification in patients with renal diseases?. *Dentomaxillofacial Radiology*. 2009;38(8):542-5. <https://doi.org/10.1259/dmfr/13231798>.
- [13] Acharya N, Chakradhar A, Kafle D. Radiographic Assessment of Occurrence of Pulp Stones in Molars of Selected Adult Nepalese Populations at Tertiary Care Center. *Kathmandu University Medical Journal*. 2021;19(2):216-20. <https://doi.org/10.3126/kumj.v19i2.49649>.
- [14] Alaaajam WH, Saleh AA, Alghamdi NS, Ain TS, Algarni YA, Abubaker M. Incidence and distribution of pulp stones among Southern Saudi Arabian sub-population. *SAGE Open Medicine*. 2021;9:1-7. <https://doi.org/10.1177/20503121211062796>.
- [15] Jena D, Balakrishna K, Singh S, Naqvi ZA, Lanje A, Arora N. A Retrospective Analysis of Pulp Stones in Patients following Orthodontic Treatment. *The Journal of Contemporary Dental Practice*. 2018;19(9):1095-9. <https://doi.org/10.5005/jp-journals-10024-2387>.
- [16] Ertas ET, Veli I, Akin M, Ertas H, Atici MY. Dental pulp stone formation during orthodontic treatment: A retrospective clinical follow-up study. *Nigerian Journal of Clinical Practice*. 2017;20(1):37-42.
- [17] Hekmatian E, Shokrgozar A, Maleki V. Assessment of prevalence of pulp stones on digital panoramic radiographs of patients referring to Isfahan Dental School in 2013. *J Isfahan Dent Sch*. 2015;11(3):169–75.
- [18] Patil SR, Araki K, Abd Ghani H, Al-Zoub IA, Sghaireen MG, Gudipani RK, et al. A cone beam computed tomography study of the prevalence of pulp stones in a Saudi Arabian adolescent population. *Pesquisa Brasileira em Odontopediatria e Clinica Integrada*. 2018;18(1):3973. <http://dx.doi.org/10.4034/PBOCI.2018.181.45>.
- [19] Zhang W, Wang Y, Ye L, Zhou Y. Distribution and influencing factors of pulp stones based on CBCT: a retrospective observational study from southwest China. *BMC Oral Health*. 2024;24(1):947. <https://doi.org/10.1186/s12903-024-04727-3>.
- [20] Korkmaz YN, Aydin ZU, Sarioglu B. Orthodontic treatment and pulp stone formation: is there a relationship?. *Clinical and Experimental Health Sciences*. 2019;9(4):340-4. <https://doi.org/10.33808/clinexphealthsci.600144>.
- [21] Javadzadeh A, Mohtavipour ST, Vosooghi Y, PourHabibi Z, Nemati S, Dalili Z. Prevalence of Pulp stones in radiographs of patients, referred to Guilan school of dentistry in 2011. *Journal of Mashhad Dental School*. 2014;38(2):99-106. <https://doi.org/10.22038/jmds.2014.2252>.
- [22] Tassoker M, Magat G, Sener S. A comparative study of cone-beam computed tomography and digital panoramic radiography for detecting pulp stones. *Imaging science in Dentistry*. 2018;48(3):201-12. <https://doi.org/10.5624/isd.2018.48.3.201>.

- [23] Mahmoudi E, Moudi E, Seyedmajidi S. Assessing the prevalence of pulp stones by cone beam computed tomography in a population in north of Iran. *Journal of Mazandaran University of Medical Sciences*. 2022;32(212):120-8.
- [24] Hsieh CY, Wu YC, Su CC, Chung MP, Huang RY, Ting PY, et al. The prevalence and distribution of radiopaque, calcified pulp stones: A cone-beam computed tomography study in a northern Taiwanese population. *Journal of Dental Sciences*. 2018;13(2):138-44. <https://doi.org/10.1016/j.jds.2017.06.005>.
- [25] Rodrigues VS, Schacht J, Bortolotto M, Manhaes J, Tomazinho LF, Boschini S. Prevalence of pulp stones in cone beam computed tomography. *Dent Press Endod*. 2014;4(1):57-62. <http://dx.doi.org/10.14436/2178-3713.V4.N1.057-062.oar>.

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