



## EVALUATION OF PULP STONES IN A SUBPOPULATION OF NORTHEAST TURKEY

### TÜRKİYE'NİN KUZAY DOĞU POPULASYONUNDA PULPA TAŞLARININ DEĞERLENDİRİLMESİ

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#### ABSTRACT

**Aim:** To evaluate the prevalence and distribution of pulp stones in posterior teeth by using digital panoramic radiographs in a Turkish subpopulation.

**Materials and method:** Panoramic radiographs of 3,113 patients ranging in age from 15 to 35 (1,836 females and 1,277 males) were retrospectively examined to determine the prevalence and distribution of the pulp stones. All data were obtained from dental records. All posterior teeth were investigated except third molars, and the data obtained were recorded as present or absent according to genders in both arches, in the left and right side according to tooth type in both arches. Pearson's chi-squared and Fisher's exact tests were used for difference comparisons ( $P<0.05$ ).

**Result:** Of the 3,113 patients, 395 (12.6%) had one or more teeth that contained pulp stones. Pulp stones were noted in 14.7% of females and in 9.7% of males, with significant difference between genders ( $P<0.05$ ). Pulp stones were detected in 1,122 of the 38,225 teeth (2.9%). Pulp stones were more common in the maxilla (4.3%) than in the mandible (1.4%), with significant difference between arches ( $P<0.05$ ). The prevalence of pulp stones was more frequent in the first and second molars in each dental arch. Pulp stones were more frequent as the bilateral than unilateral in the maxilla and mandible.

**Conclusion:** The prevalence of pulp stones was found in 12.6% of dental patients, with gender difference. Maxillary first molars were most commonly found to have pulp stones. Pulp stones were more frequent as the bilateral in the maxilla and mandible.

**Key words:** Prevalence; Dental Pulp Calcification; Radiography

#### ÖZET

**Amaç:** Bu çalışmanın amacı bir Türk populasyonunda dijital panoramik radyografiler kullanarak arka grup dişlerde pulpa taşlarının sıklık ve dağılımını değerlendirmektir.

**Gereç ve Yöntemler:** Yaşları 15 ile 35 arasında değişen 3113 hastanın panoramik radyografileri pulpa taşlarının sıklık ve dağılımını belirlemek için retrospektif olarak incelendi. Tüm veriler hastalara ait kayıtlardan elde edildi. Üçüncü büyük azı dişleri dışındaki tüm azı dişleri incelendi. Elde edilen veriler her iki arkta cinsiyetlere göre kaydedildi ve ayrıca her iki çenede diş tipine göre sağ ve sol tarafta var ya da yok olarak kaydedildi. Pearson ki-kare ve Fisher exact testi istatistiksel farklılığı karşılaştırmak için kullanıldı ( $P<0.05$ ).

**Bulgular:** 3113 hastanın 395'i (%12.6) bir ya da daha fazla pulpa taşı bulunan dişe sahipti. Pulpa taşları kadınların %14.7'sinde ve erkeklerin %9.7'sinde gözlemlendi. Erkekler ve kadınlar arasındaki farklılık önemliydi ( $P<0.05$ ). 38225 dişin 1122'sinde (%2.9) pulpa taşı belirlendi. Pulpa taşı üst çenede (%4.3) alt çeneden (%1.4) daha fazlaydı ve çeneler arasındaki farklılık önemliydi ( $P<0.05$ ). Pulpa taşları her iki çenede birinci ve ikinci azı dişlerinde çok yaygındı. Pulpa taşları üst ve alt çenede simetrik olarak daha sık bulundu.

**Sonuç:** Hastaların %12.6'sında pulpa taşı bulundu ve cinsiyetler arasındaki farklılık istatistiksel olarak önemliydi. Pulpa taşı üst birinci azı dişlerinde çok sık bulundu. Pulpa taşları alt ve üst çenede çoğunlukla simetrik olarak gözlemlendi.

**Anahtar Kelimeler:** Prevalans; Diş pulpası kalsifikasyonu; Radyografi

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## INTRODUCTION

Pulp stones are foci of calcification in the dental pulp. Pulp stones occur most commonly in the posterior teeth of both permanent and deciduous dentitions.<sup>1, 2</sup> Stones may exist freely within the pulp tissue or be attached to or embedded in dentine.<sup>1</sup> They may range in size from a macroscopic to microscopic mass. Although most are microscopic, they vary in size, with some as large as 2 or 3 mm in diameter, almost obliterating the pulp chamber.<sup>3</sup> They are reported to occur more often in the coronal pulp but are also found in the radicular pulp, and they may appear in a single tooth or several teeth. A single tooth may have from 1 to 12 or even more stones with different sizes.<sup>2-4</sup>

The etiology of pulp stones is controversial. Whereas some etiological factors include pulp degeneration, inductive interactions between epithelium and pulp tissue,<sup>5</sup> age,<sup>6</sup> circulatory disturbances in pulp,<sup>7</sup> orthodontic tooth movement,<sup>8</sup> idiopathic factors,<sup>9</sup> and genetic predisposition,<sup>10</sup> other etiological factors link pathological calcification with nanobacteria and/or bacterial toxin penetration.<sup>11</sup> Despite a number of microscopic and histochemical works, the exact cause of pulp calcifications remains largely unknown.<sup>2</sup> Pulp stones may be classified as true or false.<sup>12</sup> True pulp stones contain dentin and are lined by odontoblast, whereas false pulp stones are composed of degenerative cells of the pulp that have been mineralized.<sup>2,5</sup> This morphological distinction is based alone on histological analyses.<sup>12</sup>

Pulp stones are diagnosed by radiographic imaging and histological slides. The radiographic appearance of pulp stones is fairly variable. They may be seen as radiopaque masses of variable size and shape within pulp chambers or root canals or they may extend from the pulp chamber into the root canals. Pulp stones occur in all tooth types but most frequently in molars.<sup>2,3,12</sup> The prevalence of pulp stones varies from 8% to 90%, depending on the study design, type, and radiographic technique employed.<sup>1, 5</sup>

Pulp stones can cause endodontic problems by hindering access to root canals and their subsequent shaping.<sup>13, 14</sup> Small pulp stones do not cause any pain, but as they increase in size, they may apply pressure to the sensory nerve and cause pain.<sup>12</sup> The purposes

of this study were to evaluate the frequency of pulp stones in a group of Turkish dental patients using digital panoramic radiographs and to investigate possible associations between pulp stones and gender, tooth type, dental arch, and side.

## MATERIALS AND METHODS

This study included evaluation of 3,113 panoramic radiographs selected from dental records of patients who were referred to the Faculty of Dentistry at Recep Tayyip Erdoğan and Karadeniz Technical University, Turkey, with different dental complaints. The age of the patients was limited to 15-35 range, probably to eliminate the effect of age. After examining the dental records, patients with cardiovascular disease, autoimmune disorders, ongoing orthodontic treatment, and poor radiographs were excluded from the study. Restored or carious teeth, fractured teeth, impacted teeth, and teeth with crowns were not evaluated in this study. Considering that teeth with deep fillings and caries lesions are more prone to have pulp stones, only teeth that were non-carious and unrestored were included.

All panoramic radiographs were taken by an experienced radiologist in both centers (OP200 D, Instrumentarium Dental F1-04300 Tuusula, Finland). To evaluate pulp stones, radiographs were digitalized at an effective resolution of 22 Ip/mm (1100 dpi) and then pulp chambers were examined under 2x magnification using Image CliniView™ DICOM software by one examiner. Molars and premolars in the maxilla and mandible were examined for absence or presence of pulp stones, except third molars. Definite radiopaque bodies observed inside the pulp chambers were described as pulp stones and were recorded as present or absent according to genders in both arches, on the left and right side according to tooth type in both arches (Figure 1). A sample of 100 radiographs was re-examined by the same examiner two weeks later and an agreement of 100% was obtained. Statistical differences of the data were evaluated using the SPSS program (SPSS 18.0, Chicago, IL, USA). The data obtained were analysed by Pearson's chi-squared and Fisher's exact tests ( $p < 0.05$ ).



Figure 1. Images of pulp stones as bilateral in both arches under 2x magnification on digital panoramic radiography.

Table 1. Distribution and frequency of pulp stone according to genders

Pattern	Female (%)	Male (%)	Total (%)	P
<b>Patients with pulp stone</b>	271 (14.7)	124 (9.7)	395 (12.6)	<b>0.00</b>
<b>Patients without pulp stone</b>	1565 (85.2)	1153 (90.2)	2718 (87.3)	
<b>Total patients</b>	1836 (100)	1277 (100)	3113 (100)	
<b>Teeth with pulp stone</b>	739 (3.2)	383 (2.4)	1122 (2.9)	<b>0.00</b>
<b>Teeth without pulp stone</b>	22012 (96.7)	15091 (97.5)	37103 (97.0)	
<b>Total teeth</b>	22751 (100)	15474 (100)	38225 (100)	

## RESULTS

This study consists of 1,836 (58.9%) females and 1,277 (40%) males, with a mean age of  $23.68 \pm 6.43$  years. The distribution of patients and teeth having pulp stones according to gender is shown in (Table 1). Of the 3,113 patients, 395 (12.6%) had one or more teeth that contained pulp stones, which comprised 271 (68.6%) females and 124 (31.3%) males, with significant difference between genders. Pulp stones were detected in 1,122 of the 38,225 teeth, to give a tooth prevalence of 2.9%. Pulp stones were detected in 3.2% (739/22,751) of teeth in females and in 2.4% (383/15474) of teeth in males, with significant difference between the genders ( $P < 0.05$ ).

The distribution of pulp stones in the maxilla and mandible according to gender is represented in (Table 2). Pulp stones were observed in 4.3% (847/19,254) of teeth examined in the maxilla and in 1.4% (275/18,971) of teeth examined in the mandible, with significant difference between arches ( $P < 0.05$ ). Pulp stones were most frequently detected in maxillary first molars (10.7%; 503/4,683) and least detected in maxillary second premolars (0.14%, 7/4,943). The prevalence of pulp stones in the maxilla was higher in males (5.4%; 422/7,794) than in females (5%; 574/11,460), whereas its prevalence in the mandible was almost equal for females (1.4%; 165/11,291) and males (1.4%; 110/7,680). The prevalence of pulp stones was higher in the first molars than in the second molars in each dental arch

Table 2. Distribution and frequency of pulp stone according to genders, arches and tooth types

Tooth type	Female No of teeth		Male No of teeth		Total No of teeth		P
	Total N	With PS n (%)	Total N	With PS n (%)	Total N	With PS n (%)	
<b>Maxilla</b>	11460	574 (5.0)	7794	422 (5.4)	19254	847 (4.3)	0.21
<b>First premolar</b>	2880	6 (0.2)	1975	3 (0.1)	4855	9 (0.1)	0.93*
<b>Second premolar</b>	2920	6 (0.2)	2023	1 (0.04)	4943	7 (0.1)	0.29*
<b>First molar</b>	2800	350 (12.5)	1885	153 (8.1)	4685	503 (10.7)	<b>0.00</b>
<b>Second molar</b>	2860	212 (7.4)	1911	116 (6.0)	4771	328 (6.8)	0.07
<b>Mandible</b>	11291	165 (1.4)	7680	110 (1.4)	18971	275 (1.4)	0.86
<b>First premolar</b>	2911	12 (0.4)	1993	8 (0.4)	4904	20 (0.4)	0.95
<b>Second premolar</b>	2855	13 (0.4)	1920	3 (0.1)	4775	16 (0.3)	0.07
<b>First molar</b>	2693	72 (2.6)	1765	52 (2.9)	4458	124 (2.7)	0.58
<b>Second molar</b>	2832	68 (2.4)	2002	47 (2.3)	4834	115 (2.3)	0.90
<b>Total</b>	22751	739 (3.2)	15474	383 (2.4)	38225	1122 (2.9)	<b>0.00</b>

\*: Results of Fisher Exact test, PS: Pulp stone

Table 3. Distribution of pulp stone according to location and arches.

Teeth	Maxilla (%) N=19254				Mandible (%) N=18971			
	L	R	L+R	Total	L	R	L+R	Total
<b>First premolar</b>	5 (0.6)	2 (0.2)	1 (0.1)	8 (1.0)	2 (0.2)	6 (0.8)	6 (0.8)	14 (1.8)
<b>Second premolar</b>	2 (0.2)	1 (0.1)	2 (0.2)	5 (0.6)	2 (0.2)	2 (0.2)	6 (0.8)	10 (1.3)
<b>First molar</b>	36 (4.8)	89 (12.0)	189 (25.6)	314 (42.6)	14 (1.8)	28 (3.7)	41 (5.5)	83 (11.2)
<b>Second molar</b>	60 (8.1)	50 (6.7)	109 (14.7)	219 (29.7)	28 (7.8)	25 (3.3)	31 (4.2)	84 (11.3)
<b>Subtotal</b>	103 (13.9)	142 (19.2)	301 (40.8)	<b>546 (74.0)</b>	46 (6.2)	61 (8.2)	84 (11.3)	<b>191 (25.9)</b>

and when data for both arches were combined. The prevalence of pulp stones in the maxilla was of a similar frequency in the first and second premolars, whereas the prevalence in the mandible was higher in first premolars (0.4%) than in second premolars (0.3%). Pulp stones were more frequent as the bilateral than unilateral in the maxilla and mandible. Among the unilateral pulp stones, right side ones were more common than the left-side ones (Table 3).

## DISCUSSION

Previous studies have described pulp stones using radiography. However, the true prevalence is likely to be higher because pulp stones with a diameter less than 200 µm cannot appear on radiographs.<sup>2, 5</sup> To determine the prevalence of pulp stones, Baghdady et al.<sup>15</sup> and Colak et al.<sup>1</sup> used bitewing radiographs, al-Hadi Hamasha and Darwazeh<sup>16</sup> used periapical and bitewing radiographs, and Satheeshkumar et al.,<sup>17</sup> Syrynska et al.,<sup>18</sup> and Turkal et al.<sup>19</sup> used panoramic radiographs in their study. Panoramic radiographs show the entire mouth area, and panoramic images are excellent for screening for pulpal calcifications, as all teeth can be examined using the same image.<sup>20</sup> This study was evaluated the pulp stone with digital panoramic radiograph so that posterior teeth involved with calcification in both the maxilla and mandible can be ruled out.

Review of the literature revealed a wide discrepancy in the frequency of pulp stones in different populations. Furthermore, the presentations of prevalence were also different in the literature. Some studies presented the prevalence based on person and teeth numbers, and the others reported only the prevalence based on teeth number.<sup>4, 11, 21</sup> The results of this study showed that the prevalence of total patients with pulp stones was 12.6% (395/3,113), and the prevalence of total teeth with pulp stones was 2.9% (1122/38,225). This finding is lower than the results of a study performed in the Turkish population by Sisman et al.<sup>21</sup> (57.6%) and Colak et al.<sup>1</sup> (63.6%); this result is almost consistent with the findings of Gulsahi et al.<sup>4</sup> (12%) and Turkal et al.<sup>19</sup> (12.7%). These contradictory results in the same population may be explained with marked differences in the sample size and in the method used. The findings of Ranjitkar et al.<sup>11</sup> (10.3%) among a young Australian population are lower than ours, whereas the results of Baghdady et al.<sup>15</sup> (14.8%) among an Iraqi group and al-Hadi Hamasha and Darwazeh<sup>16</sup> among Jordanians (22.4%) are higher than our findings. These differences in prevalence among populations may be due to ethnic and geographic variations.

In this study, females presented a higher prevalence of pulp stones than males, with statistical difference. This results is in line with other studies previously observed.<sup>1,15,21</sup> However, some studies have reported that pulp stones were more common in males than in females, and other studies have

showed no significant differences between genders.<sup>11,15,21</sup>

Regarding the prevalence of reported pulp stones in this study, most of the pulp stones were found in have maxillary teeth, especially the first molars, which is consistent with the results of Sisman et al.,<sup>21</sup> Turkal et al.,<sup>19</sup> and Ranjitkar et al.<sup>11</sup> However, al-Hadi Hamasha and Darwazeh<sup>16</sup> observed that the prevalence of pulp stones was more common in mandibular first molar teeth, whereas Gulsahi et al.<sup>4</sup> reported that the frequency of pulp stones was similar in both the maxillary and mandibular arch. In this study, the prevalence of teeth with pulp stones in the maxillary and mandibular arch was higher in molars than in premolars. The reason for this is unclear, but Ranjitkar et al.<sup>11</sup> alluded that molars, being the largest in the arch, may have a better blood supply to the pulp tissues, which may not be conducive for precipitation of more calcification-forming factors.<sup>4, 15</sup>

The correlation of pulp stones with cardiovascular disease, collagen, and autoimmune disease has been investigated. The limitations in this study included the sample, comprised of young adults who have not had systemic and autoimmune disturbance, so age-related changes and the relationship between systemic disorders and pulp stones could not be reported. The currently held clinical view is that pulp stones have no significance other than possibly causing difficulties during endodontic therapy, such as hindering canal location and negotiation.<sup>11</sup>

## CONCLUSION

The prevalence of pulp stones was 12.6% of patients and 2.9% of teeth examined, with significant difference between genders. Pulp stones were most frequently detected in maxillary first molars and least detected in maxillary second premolars. Pulp stones were most frequently detected in maxillary first and second molars.

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