

## A radiographic assessment of the prevalence of pulp stones in a group of Turkish dental patients

A. Gulsahi<sup>1</sup>, A. I. Cebeci<sup>2</sup> & S. Özden<sup>2</sup>

department of Oral Diagnosis and Radiology, Faculty of Dentistry, Başkent University; and department of Oral Diagnosis and Radiology, Faculty of Dentistry, Ankara University, Ankara, Turkey

### Abstract

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**Aim** To determine the prevalence of pulp stones in a group of patients using radiographs, and to assess any associations with age, gender, systemic diseases, tooth type, jaw, caries, restorations, impacted third molars and dental anomalies including dens invaginatus, taurodontism, dens evaginatus and microdontia.

**Methodology** A total of 519 patients were selected randomly amongst patients referred to Oral Diagnosis and Radiology Department, Faculty of Dentistry, Ankara University. After clinical inspection, full-mouth peri-apical radiographs were obtained. An oral radiologist examined the radiographs to identify pulp stones. Frequency distribution of teeth with pulp stones was calculated and statistical analysis was performed with chi-square test.

**Results** Of the patients, 313 (60%) were female and 206 (40%) were male. Sixty (12%) had one or more

teeth that contained pulp stones. Amongst the 13 474 teeth examined radiographically, 627 (5%) had pulp stones. There was no significant association between pulp stone occurrence and gender or systemic diseases. As age increased, the prevalence of pulp stones increased ( $P < 0.01$ ). Molars had statistically more pulp stones than premolars and incisors ( $P < 0.001$ ). Frequencies in both maxillary and mandibular jaw were similar. There was no association between pulp stones and impacted third molars, caries, restorations or dental anomalies.

**Conclusions** The prevalence of pulp stones increased with age and was significantly higher in molar teeth than premolars and incisors. There was no significant association between pulp stones and gender, systemic diseases, impacted third molars, condition of the crown and dental anomalies.

**Keywords:** aetiology, calcification, prevalence, pulp, radiography.

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### Introduction

Pulp stones are calcified masses in the dental pulp of healthy, diseased, or unerupted teeth (Baghdady *et al.* 1988, al-Hadi Hamasha & Darwazeh 1998). Stones may exist freely within the pulp or be attached to or embedded in dentine (Bevelander & Johnson 1956,

Goga *et al.* 2008). Pulp stones range in size from small microscopic particles to large masses that almost obliterate the pulp chamber (Baghdady *et al.* 1988). They are reported to occur more often in the coronal region but are also found in the radicular pulp (Baghdady *et al.* 1988, Arys *et al.* 1993, al-Hadi Hamasha & Darwazeh 1998).

Despite several microscopic and histochemical studies, the exact cause of such pulp calcifications remains largely unknown (Goga *et al.* 2008). However, a number of conditions have been claimed to predispose to pulp stone formation such as ageing, caries, operative procedures, periodontal disease, epithelial rests in

Correspondence: Ayse Gulsahi, Department of Oral Diagnosis and Radiology, Faculty of Dentistry, Başkent University, 11. sok. no:26 06490 Bahçelievler, Ankara, Turkey (Tel.: +90 312 215 13 36; fax: +90 312 215 29 62; e-mail: [agulsahi@baskent.edu.tr](mailto:agulsahi@baskent.edu.tr)).

the pulp tissue, orthodontic tooth movement, idiopathic factors and genetic pre-disposition (Baghdady *et al.* 1988, Siskos & Georgopoulou 1990).

The prevalence of pulp stones varies from 8% to 90% (Moss-Salentijn & Hendricks-Klyvert 1988). Many prevalence studies have identified pulp stones using radiography. The true prevalence is likely to be higher, because pulp stones with a diameter smaller than 200 µm can not be seen on radiographs (Moss-Salentijn & Hendricks-Klyvert 1988, Goga *et al.* 2008). Some researchers have investigated the prevalence of pulp stones or the association of this condition with other dental conditions (Tamse *et al.* 1982, Baghdady *et al.* 1988, al-Hadi Hamasha & Darwazeh 1998, Ranjitkar *et al.* 2002). However, no study has assessed the prevalence of pulp stones in the Turkish population. The aims of this study were to determine the prevalence of pulp stones in a group of Turkish dental patients using radiographs, and to evaluate the association of this condition with age, gender, systemic diseases, tooth type, jaw, caries, restorations, impacted third molars and other dental anomalies.

## Materials and methods

A total of 519 patients (age range 18-54 years) were randomly selected from patients referred to Oral Diagnosis and Radiology Department, Faculty of Dentistry, Ankara University. Of the patients, 313 (60%) were female and 206 (40%) were male and a total of 13 474 teeth were examined. The study was approved by the Ethics Committee of the Ankara University, Faculty of Dentistry. After detailed clinical inspection of restorations, caries and/or anomalies, full-mouth periapical ( $n = 10$ ) radiographs were obtained using the paralleling technique. Ultraspeed D (Eastman Kodak Company, Rochester, NY, USA) films were used along with parallel film holders (Rinn Corporation, Elgin, IL, USA). Exposure time was 0.5 s using the Sirona Dental X-ray System (Siemens, Bernsheim, Germany). Films were processed in a Med LD 24 (Dürr Dental, Bietigheim-Bissingen, Germany) automatic processor using developing solutions (Hacettepe University, Ankara, Turkey). An oral radiologist examined the radiographs on a view box in a dimmed room focusing attention upon pulp stones. Statistical analysis of the data was using the Statistical Package for the Social Sciences (SPSS 12.0). Frequency distribution of teeth with pulp stones was calculated. The data were evaluated by chi-square analysis. Differences were considered as significant when  $P < 0.05$ .

## Results

The distribution of patients having pulp stones according age groups is shown in Table 1. Of the 519 subjects, 60 (12%) had one or more teeth that contained pulp stones. These were detected in 38 (63%) males and 22 (37%) females, with no significant association by gender. However, prevalence of pulp stones increased with age ( $P < 0.01$ ). The relation between pulp stone prevalence and systemic diseases was not significant.

The distribution of teeth with pulp stones according to location and gender is summarized in Table 2. Amongst the 13 474 teeth, 627 (5%) were found to contain pulp stones. Pulp stones were found in 5% of 8028 teeth in the female group and 4% of the 5446 teeth in the male group. In the maxillary arch, the highest prevalence of pulp stones was observed in the incisor teeth of females (10%) and molars (8%). In the mandible, molars contained the highest prevalence of pulp stones (female 7% and male 5%) for both genders. Finally, the average values for both male and female patients revealed that pulp stones occurred in molar teeth significantly more often than in premolars and incisors ( $P < 0.001$ ). Similar frequencies in both maxillary (5%) and mandibular (4%) arches were found.

The teeth with pulp stones were also been examined for caries and restorations. There was no significant association between pulp stones and caries or restorations. Impacted third molars were also assessed. Twelve patients (20%) with pulp stones had impacted third molars, 96 patients (21%) not having pulp stones had impacted third molars. The difference was not statistically significant.

The distribution of dental anomalies in teeth with pulp stones is shown in Table 3. Of the 627 teeth with pulp stones, 46 teeth (7%) had dens invaginatus, four teeth (1%) had taurodontism, four teeth (1%) had dens evaginatus, and two teeth (0.3%) had microdontia. No significant association was found between pulp stones and any of these conditions.

**Table 1** Distribution pulp stone (PS) by age

Patient age (years)	No. of patients	No. of patients with PS	% of patients with PS
<19	136	2	1.47
19-29	105	13	12.38
30-39	127	17	13.38
>40	151	28	18.54
Total	519	60	12

**Table 2** Number and distribution of teeth with pulp stones by gender and location

Tooth type	Maxilla				Mandible				Total			
	Teeth with PS		Total		Teeth with PS		Total		Teeth with PS		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
Incisor	40 (3)	117 (10)	1176	1810	37 (3)	69 (4)	1243	1834	77 (3)	186 (5)	2419	3644
Premolar	23 (3)	28 (3)	773	1075	21 (3)	48 (4)	809	1182	44 (3)	76 (3)	1582	2257
Molar	42 (6)	92 (8)	733	1093	38 (5)	72 (7)	712	1034	80 (6)	164 (8)	1445	2127
Subtotal	105 (4)	237 (6)	2682	3978	96 (3)	189 (5)	2764	4050	201 (4)	426 (5)	5446	8028
Total	342 (5)		6660		285 (4)		6814		627 (5)		13 474	

PS, pulp stone; M, male; F, female.

**Table 3** Number and distribution of dental anomalies in teeth with pulp stones (n)

Tooth condition	Molar		Premolar		Incisor	
	Maxillary	Mandibular	Maxillary	Mandibular	Maxillary	Mandibular
Dens invaginatus	-	1	-	1	44	-
Taurodontism	-	4	-	-	-	-
Dens evaginatus	-	-	-	-	4	-
Microdontia	-	-	-	-	2	-
Total	0	5	0	1	50	0

## Discussion

Detection of pulp stones using dental radiographs is only possible when the diameter is larger than 200 µm (Osborne & Ten Cate 1976, Baghdady *et al.* 1988, Moss-Salentijn & Hendricks-Klyvert 1988). The paralleling technique was used rather than the bisecting angle technique, as distortion could occur in the latter whilst in the paralleling technique a more standard image can be obtained by having the central beam perpendicular to the long axis of the tooth (Baghdady *et al.* 1988). Bitewing radiographs could also be used, but would limit the examination to the crown only. Whilst Baghdady *et al.* (1988) used bite wing radiographs to investigate the prevalence of pulp stones, al-Hadi Hamasha & Darwazeh (1998) assessed both periapical and bite wing radiographs. Tamse *et al.* (1982) examined both periapical and bitewing radiographs to identify pulp stones and to compare the two radiographic techniques and concluded that no significant difference was found between the projections.

al-Hadi Hamasha & Darwazeh (1998) examined patient records of 814 Jordanian adults and pulp stones were present on radiographs in 51% of the patients and 22% of the teeth studied. Baghdady *et al.* (1988) assessed 515 Iraqi teenage subjects and recorded that 19% of the teeth contained pulp stones. Furthermore,

Ranjitkar *et al.* (2002) examined the prevalence of pulp stones in an Australian population and pulp stones were found in 46% of the subjects and 10% of the teeth. Tamse *et al.* (1982) evaluated full-mouth radiograph of 300 patients and reported that 21% had pulp stones. In the present study, pulp stones were found in 12% of the subjects and 5% of the teeth. This finding is lower than the results of similar studies (Tamse *et al.* 1982, Baghdady *et al.* 1988, al-Hadi Hamasha & Darwazeh 1998, Ranjitkar *et al.* 2002). However, such findings from related studies should be compared with caution because of the variations in sampling procedures and the types of radiograph examined.

Some investigators have reported that pulp stones were more common in females than in males (Stafne & Szabo 1933, Tamse *et al.* 1982). The present study found no significant difference between genders.

Pulp stones are reported to increase in frequency with age (Tamse *et al.* 1982, Shafer *et al.* 1983, Seltzer & Bender 1985). The present study confirmed this finding. However, another study was reported that age was not associated with pulp stones (al-Hadi Hamasha & Darwazeh 1998).

The correlation of pulp stones with cardiovascular diseases, collagen or autoimmune disease has been investigated. Although Stafne & Szabo (1933) and Edds *et al.* (2005) found a significant relation between pulp

stones and presence of arteriosclerosis, osteitis deformans and cardiovascular diseases, the present study did not show such a correlation between reported systemic diseases and prevalence of pulp stones.

Similar frequencies in both maxillary and mandibular arches were found in the present study. This finding was in agreement with al-Hadi Hamasha & Darwazeh (1998). In most previous studies the trend for a higher occurrence of pulp stones in molar teeth compared with premolars and incisors were noted (Tamse *et al.* 1982, Baghdady *et al.* 1988, al-Hadi Hamasha & Darwazeh 1998, Ranjitkar *et al.* 2002). This study confirmed this finding.

Any irritation to the pulp caused by operative procedures, chronic irritants such as caries, abrasion, erosion, periodontal diseases and traumatic response to orthodontic treatment may have a deleterious influence on the pulp (James *et al.* 1959, Baghdady *et al.* 1988). The effect of irritation by the microorganisms of dental caries on the pulpal tissue could produce a vascular wall injury, resulting in deposition of calcium salts within the tissue. Ranjitkar *et al.* (2002) suggested that chronic pulp irritation might lead to pulp stone formation, but these results need to be interpreted with caution given that they were derived from radiographic evidence only and that data for carious and restored teeth were pooled for analysis. A higher occurrence of pulp calcification has been noted in carious, unrestored teeth than in restored teeth, presumably because the pulps have some degree of chronic inflammation because of the previous insults. This study, however, did not reveal a significant association between the existence of pulp stones and the condition of the crown of the tooth (intact, caries or restored). Furthermore, no relationship between impacted third molars and prevalence of pulp stones was found. Other studies also failed to find any significant association between pulp stone occurrence and the presence of caries or restorations (Tamse *et al.* 1982, Baghdady *et al.* 1988).

In the study performed by al-Hadi Hamasha & Darwazeh (1998), high incidence of pulp stones was associated with conditions such as dilacerations, impactions, taurodontism and enamel pearls. The same authors, investigating the prevalence of taurodontism in Jordanian adults, reported that 27% of taurodont teeth had pulp stones or calcifications (Darwazeh *et al.* 1998). However, in this study, no significant association was found between pulp stones and dens invaginatus, taurodontism, dens evaginatus and microdontia.

## Conclusions

The prevalence of pulp stones increased with age. However, there was no significant association between pulp stone occurrence and gender and systemic diseases. In addition, pulp stones in molar teeth were significantly more common than premolars and incisors. There was no relationship between pulp stones and impacted third molars, caries, restorations and dental conditions including dens invaginatus, taurodontism, dens evaginatus and microdontia.

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