

# Prevalence of pulp stones in molars based on bitewing and periapical radiographs

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## SUMMARY

**Objective.** To determine prevalence of pulp stones in molars of patients at the Institute of Dentistry Faculty of Medicine Vilnius University and to evaluate the association of pulp stones and gender, patient age, tooth condition.

**Material and Methods.** Intraoral radiographs were reviewed using the Romexis program and pulp stones were assessed in molars. Teeth were distributed into intact and non-intact. Information about patients' gender and age was collected. Data were processed using SPSS IBM (Statistical Package for the Social Sciences 22.0) program. Pearson's Chi-square test ( $\chi^2$ ) was used. Results were considered to be statistically significant when the significance level of  $p < 0.05$ .

**Results.** A total of 531 patients' bitewing and periapical radiographs of molars were evaluated. 2361 molars in total were assessed. Prevalence of pulp stones was 58.8% when pulp stones were found in at least one molar. Pulp stones were detected in 832 molars (35.24%). Patients from 18 to 93 years old were assessed. The highest pulp stones' occurrence was found in the age group from 38 years and older (71.07%). Non-intact maxillary right first molars and maxillary right and left second molars demonstrated a statistically significantly more frequent occurrence of pulp stones than intact molars ( $p < 0.05$ ).

**Conclusion.** More than half of the participants had pulp stones in molars. Higher prevalence of pulp stones was associated with older age and decayed/filled teeth. There was no statistically significant difference between genders with regards to prevalence of pulp stones.

**Keywords:** prevalence, dental pulp calcification, pulp stones, radiography, bitewing, endodontics.

## INTRODUCTION

Pulp stones can become a big problem when root canal treatment is needed and may obliterate or change the shape of endodontic access, block the entry of the canals and change their course by forming curves (1). Consequently, during endodontic treatment, they can increase the risk of complications such as perforations, loss of tooth hard tissues, loss of root canal working length or endodontic treatment failure (1-4).

Pulp stones are one of the pulp calcification forms (5). However, the exact aetiology of pulp stones is unknown (6). It is believed that pulp stones appear with age and are related to pulp irritations such as long-term mastication forces, occlusal trauma, brux-

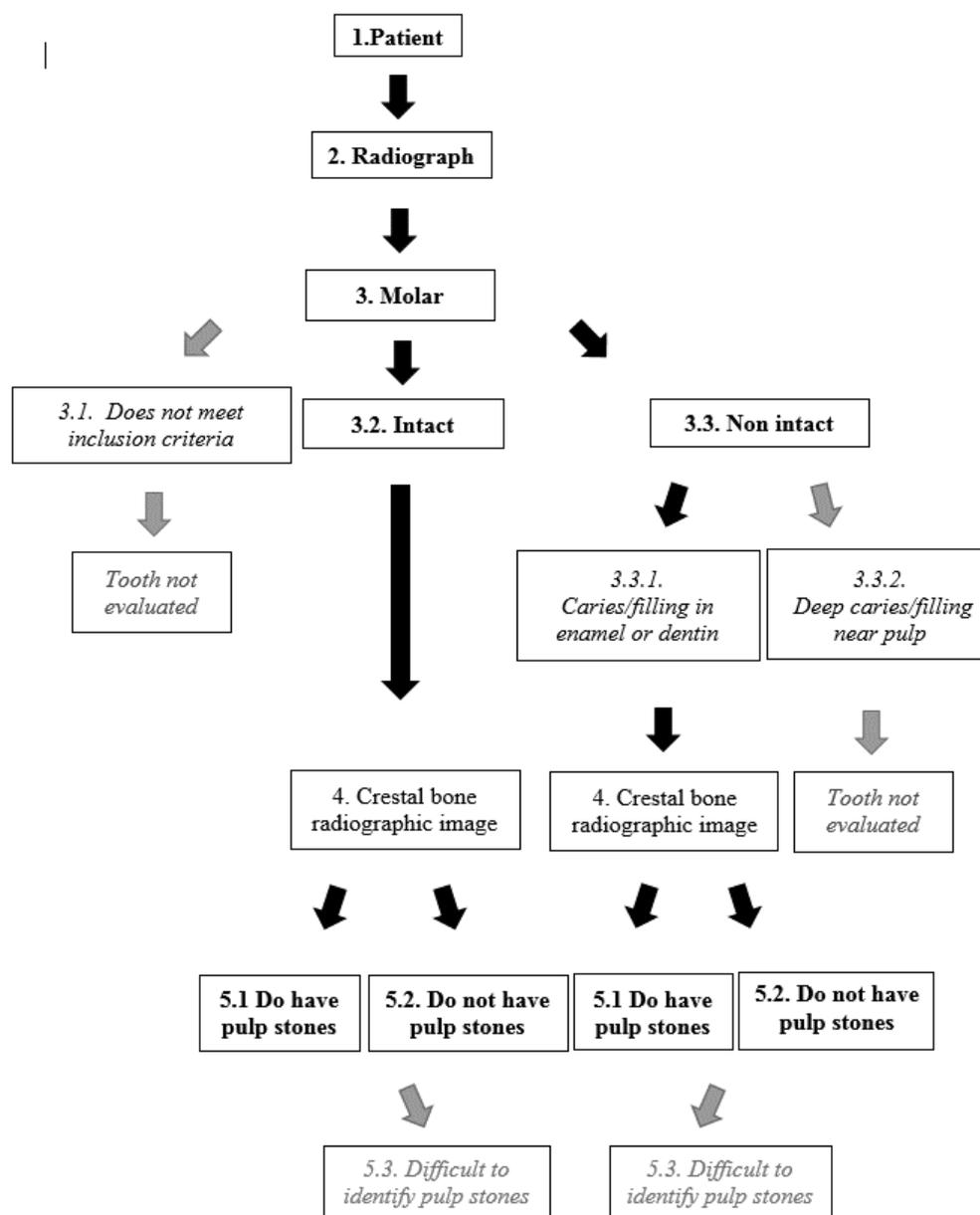
ism, periodontal pathology, orthodontic forces and chronic tooth pulp inflammation caused by caries, it's preparation, resin composites' polymerization shrinkage (5-8).

Pulp stones are found accidentally on bitewing or periapical radiographs (9) but can be seen in panoramic radiographs (10); also, they vary in size, form and number (7, 11). Pulp stones are seen on radiographs as contrasting oval, round or irregularly shaped bodies in the coronary pulp chamber and root canals. According to the location, pulp stones are classified as free, attached to the dentin or embedded into the dentin (7).

There have been several recent studies to determine the association of pulp stones with atherosclerosis and kidney stones (9, 12-16). According to the literature, pulp stones are more frequent with genetic disorders: *dentine dysplasia*, *dentinogenesis imperfecta*, *Van der Woude syndrome*, *taurodontism* (6, 17, 18).

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**Fig. 1.** Scheme of assessment algorithm

Pulp stones are commonly found in healthy human teeth and do not require special treatment unless endodontic treatment is needed. They are seen in all types of teeth, but most often occur in molars (19, 20). According to Jannati's *et al.* systematic review and meta-analysis, the prevalence of pulp stones in a total population is about 36.5% (2). Furthermore, they found out that in more than half of the studies included in the meta-analysis, prevalence of pulp stones is higher among women than among men. Also, the prevalence of pulp stones varies in different countries (2). There is still a lack of reliable studies in a broader range in populations to determine a more accurate distribution of pulp stones globally.

The objective of this study was to assess the prevalence of pulp stones in molars of patients of the Institute of Dentistry Faculty of Medicine Vilnius

University and to evaluate the association of the occurrence of pulp stones and gender, age groups and tooth condition.

## MATERIAL AND METHODS

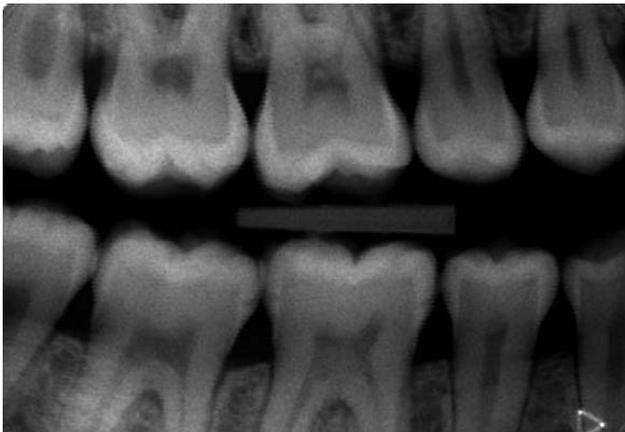
Pulp chambers of molars were analyzed on bitewing and periapical molar radiographs. The assessment was performed in a darkened room using a computer monitor "Deca H430a", with a diagonal 60 cm and resolution of 1920×1080 px. Radiographs were evaluated using Romexis radiographs viewer (version: 3.8.3.R; 2014 yr.; mfr.: Planmeca, Helsinki, Finland). Adequate contrast, optical density and brightness were calibrated, preview tool "magnifying glass" was used. Intraoral radiographs were performed with Planmeca ProX dental radiograph machine (2013 yr.; mfr.: Planmeca, Helsinki, Finland). Image receivers: sensor ProSensor #1 (mfr.: Planmeca, Helsinki, Finland; dimensions:

30.6×20.7 mm); phosphorus plate (mfr.: Planmeca, Helsinki, Finland; dimensions: 30.0×40.0 mm). Planmeca ProScanner (mfr.: Planmeca, Helsinki, Finland; 2015 yr.) was used to scan the phosphorus plate.

### Patient inclusion criteria:

- 18-year-old and older patients who had their bitewing and periapical molar radiographs performed, were selected (they were divided into groups by gender and age);
- only radiographs with high quality or with slight defects, that do not interfere with the evaluation of molar hard tissue or pulp, were selected.

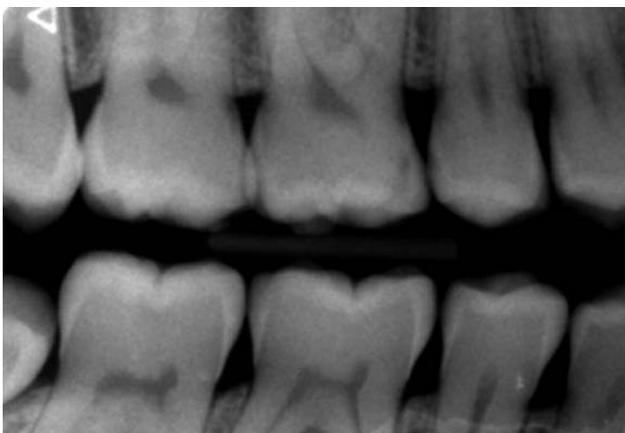
Because of a small number of patients in the oldest age group, in order to get comparable groups, they were arranged: first age group from 18 to 27



**Fig. 2.** Pulp stone in upper right first intact molar tribution of subjects in study subgroups based on MP-SN



**Fig. 3.** Pulp stones in upper right first molar, upper right second molar and lower right first molar. Molars with fillings in dentin (cm<sup>2</sup>)



**Fig. 4.** Intact upper right second molar and lower right first molar without pulp stones



**Fig. 5.** Lower left first molar with caries in dentin and lower left second molar with filling in dentin. Both without pulp stones

years, second from 28 to 37 and third age group from 38 years and older.

#### **Molar inclusion criteria:**

- permanent; intact;
- nonintact with caries in enamel or dentin;
- nonintact with filling in enamel or dentin.

Molars with deep caries or filling near pulp were not evaluated. Presence of superimposition of crestal bone on pulp chamber was checked before pulp stones evaluation. The assessment algorithm is shown in the scheme (Figure 1).

#### **Pulp stones evaluation on radiograph:**

- an intact tooth, pulp stones are seen in the molar pulp chamber (Figure 2);
- a tooth with caries or filling in enamel/dentin, pulp stones are seen in the molar pulp chamber (Figure 3);
- an intact tooth, pulp stones are not seen in the molar pulp chamber (Figure 4);
- a tooth with caries or filling in enamel/dentin, pulp stones are not seen in the molar pulp chamber (Figure 5).

**Statistical data analysis:** data were analyzed with SPSS IBM (Statistical Package for the Social Sciences 22.0) program. Pearson's Chi-square test ( $\chi^2$ ) was used to determine the reliability of the results. Data were considered statistically significant when the significance level was  $p < 0.05$ . The results are represented graphically using the "Microsoft Excel" program and provided with numbers and percentages.

## **RESULTS**

In total, 531 patient's bitewing and periapical radiographs were included.

#### **Prevalence of pulp stones in molars**

More than half of patients had visible pulp stones in at least one molar (Figure 6). It was difficult to identify pulp stones in 10 out of 531 patients (1.88%), therefore they were excluded from statistical analysis. Overall 2,384 molars were evaluated. It was difficult to identify pulp stones in 23 of 2,384 (0.96%) mo-

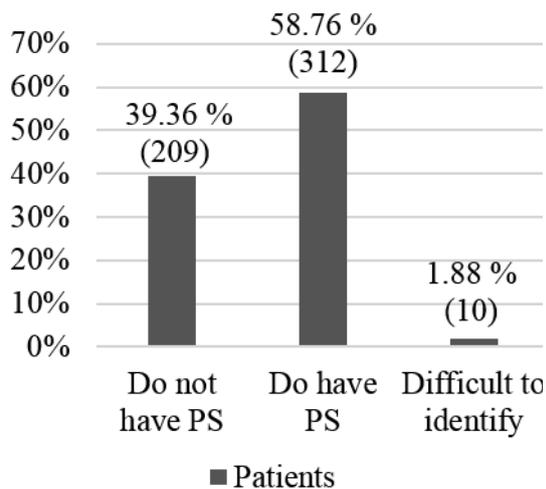


Fig. 6. Prevalence of pulp stones in study participants

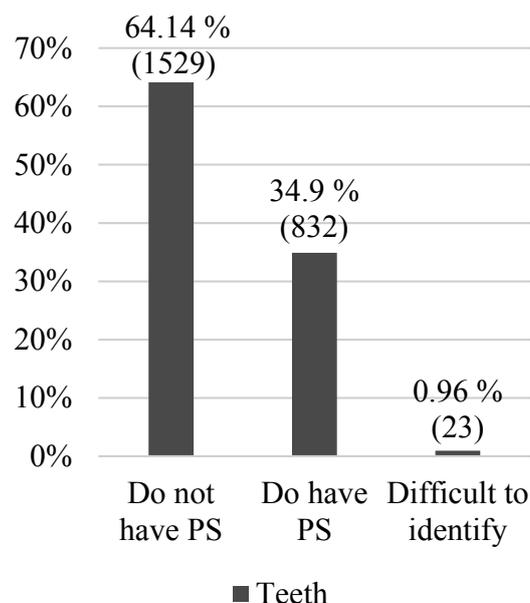


Fig. 7. Prevalence of pulp stones in molars

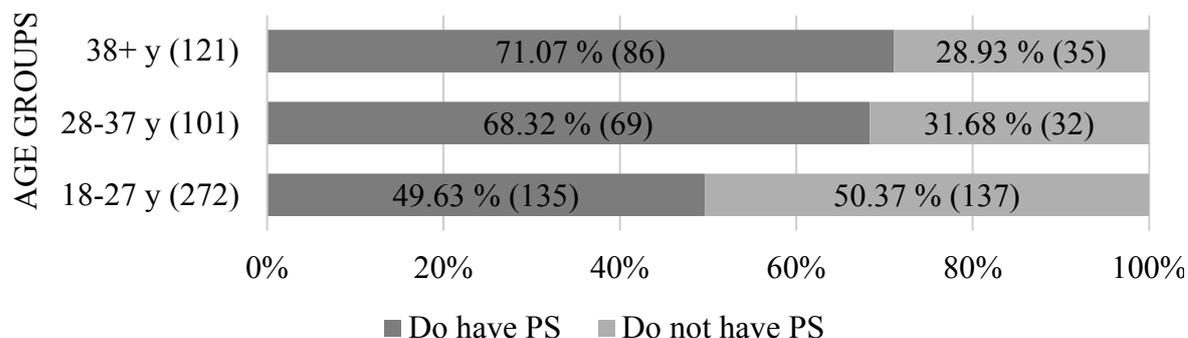


Fig. 8. Prevalence of pulp stones in different age groups

lars, so they were excluded from statistical analysis. Pulp stones were found in about one third of molars (Figure 7).

**Prevalence of pulp stones in gender groups**

From 531 patients, 285 were women and 232 men. 14 cases did not have their gender specified in the “Romexis” program; therefore, they were excluded. 138 (59.5%) men and 165 (57.9%) women had pulp stones in at least one molar. There was no statistically significant difference between genders with regards to pulp stones prevalence (p=0.715).

**Prevalence of pulp stones in age groups**

Patients between 18 and 93 years of age were included in the study. 37

out of 531 cases did not have their age specified in the “Romexis” program; therefore, they were excluded. The majority of patients (272) 55.06% were between age from 18 to 27. Pulp stones were detected in almost half of patients’ molars of first age group, more than two thirds of second age group and the most pulp stones where found in third age group (Figure 8). The results showed that in the youngest group pulp stones

Table. Average distance between anatomical apex and apical foramen

Tooth	In all	Tooth condition					
		Intact			Non intact		
		Sum	Teeth number with PA	(%)	Sum	Teeth number with PA	(%)
	N	n	(%)	N	n	(%)	
16	278	79	34	(43.0)	199	114	(57.3)
17	342	142	31	(21.8)	200	77	(38.5)
26	281	77	43	(55.8)	204	115	(56.4)
27	313	127	27	(21.3)	186	69	(37.1)
36	237	52	22	(42.3)	185	64	(34.6)
37	321	100	16	(16)	221	41	(18.6)
46	257	60	20	(33.3)	197	78	(39.6)
47	332	108	20	(18.5)	224	61	(27.2)

N – marking teeth sum, n – marking part of the sum, PA – pulp stones.

appeared significantly less frequently than in second age group ( $p=0.001$ ). There were no statistically significant differences in prevalence of pulp stones between second and third age group ( $p=0.656$ ). The pulp stones' occurrence increases significantly from the age of 28 ( $p=0.001$ ).

#### Occurrence of pulp stones by tooth anatomy and condition

Most often, pulp stones were seen in the upper left first molar and upper right first molar (Table). Out of 1053 first molars 490 had pulp stones (46.53%), while out of 1308 second molars 342 had pulp stones (26.15%). It was observed that pulp stones appeared more frequently in the first molars compared to the second ones ( $p\leq 0.001$ ). No statistically significant difference was found between the left and the right side molars. Pulp stones were more often seen in the upper molars (510 out of 1214) compared to the lower molars (322 out of 1147), 42.01% and 28.07% respectively ( $p\leq 0.001$ ). Significantly more pulp stones were found in non-intact upper right first, upper right second and upper left second molars compared to intact ones ( $p=0.032$ ,  $p=0.001$  and  $p=0.003$ , respectively).

#### DISCUSSION

In this study, the prevalence of pulp stones in at least one molar among patients was 58.76%, which is much less than in another Lithuanian study showing 94% prevalence of pulp stones (21). Similar results were found in studies from Turkey, where prevalence of pulp stones was between 63.6% and 57.6% (22, 23). However, methodologies among the studies differ: in the present study only molar teeth were assessed; premolars and molars were evaluated in Turkish studies (22, 23); while all teeth were evaluated using orthopantomograms in another Lithuanian study (21). Nevertheless, it was found that pulp stones appear in molars much more frequently than in premolars (31.78% vs 3.74% and 90.92% vs 9.07%, respectively) (22, 23). Rarely pulp stones were found in other teeth groups (24-29).

More than one third out of total 2,384 molars evaluated had pulp stones (34.9%). These results are in agreement with data from Turkey (22) and Lithuania (21), where the prevalence of pulp stones in teeth was 27.8% and 31.5%, respectively. Slight differences might be explained by the characteristics of different populations and/or in assessment methods used. However, pulp stones with diameter less than 200  $\mu\text{m}$  are not seen in the radiographs (11). The percentage (from 78% to 95% in molars) of stones found

in histological evaluation of the pulp is significantly higher than found on radiographs (30). Therefore, the true prevalence of pulp stones might be undetected.

A higher prevalence of pulp stones in first molars than in second ones was found, and more pulp stones were seen in the maxilla than in the mandible. Similar results were found by Ranjitkar *et al.* in Australia, Sisman *et al.*, Colak *et al.* in Turkey and Tamse *et al.* in Israel (22, 23, 27, 31).

Consideration has to be given to the fact, that radiography is not indicated exclusively for pulp stones diagnostics. Therefore, only radiographs that were performed because of suspected caries, periodontal pathology or dental trauma were evaluated. Almost half of the molars were diagnosed with caries or fillings near the pulp chamber or endodontically treated, and had to be dismissed. This loss could have had an impact on the accuracy of the results. In most cases, older patients had not met the inclusion criteria and had to be excluded. Because of this, assessment of actual prevalence was compromised. Moreover, in some cases it was difficult to diagnose caries only on radiographs, without clinical investigation. Radiographical superimposition of the crestal bone on the pulp chamber may also prevent accurate determination of small pulp stones. If the assessment of pulp stone presence was not possible, teeth were excluded from the analysis.

There were studies carried out in Turkey, Iran and India, showing a significantly higher prevalence of pulp stones in women (22, 24, 32). It could be due to women being more sensitive to higher stress levels and, consequently, the higher prevalence of bruxism. However, there is a lack of evidence to support this opinion (33). In this study, almost an equal distribution was observed in men and women, and the Chi-square test confirmed that there was no statistically significant difference in prevalence of pulp stones between genders. This fact could be attributed to different lifestyles and stress levels in populations as similar studies did not find any significant differences in the distribution of pulp stones between men and women as well (19, 21, 25-27).

Pulp stones can be found in patients of different age, although research shows more pulp stones in older people (19, 28, 31). Several studies did not find any age dependence on the prevalence of pulp stones (21, 23, 33). The results obtained in this study confirm that the numbers of pulp stones in molars increase statistically significantly with age. About half of participants in the 18- to 27-year-old age group had pulp stones in at least one molar. In contrast, nearly two-thirds of 28–37-year-olds were diagnosed with pulp stones. The prevalence of pulp stones in the eldest age

group was even bigger at 71.07%. The age seems to be one of the predisposing factors for occurrence of pulp stones. It could be due to chewing forces for a longer period of time, tooth wear or increasing dental treatment needs over time.

More pulp stones appear in decayed teeth than in sound ones and this has been confirmed by previous research (21, 27, 30). In this study, more pulp stones were found in molars with caries or with fillings in the crown compared to intact ones. The exception was the left lower first molar. The group of intact left lower first molars was the smallest one and it might have had influence on the statistical significance. It is likely that in case of the bigger sample of intact left lower first molars the difference would have reached statistical significance. By contrast, pulp stones were statistically significantly more often found in non-intact rather than in intact right upper first, right upper second and left upper second molars. An Australian study also found a higher distribution of pulp stones in non-intact right upper first and left upper second molars than in intact ones (27).

Because of the sample and study limitations, results should be evaluated with caution. As the study sample was comprised only from patients attending Institute of Dentistry Vilnius University,

results regarding prevalence of pulp stones cannot be extrapolated to a general Lithuanian population. Radiographs were evaluated by an undergraduate dental student who did not have much previous experience. In order to assess the impact of aging more precisely the study should comprise a bigger sample with more representative age groups. Furthermore, all teeth should be included in examination for more reliable results. Radiographs should be repeatedly evaluated by 2–3 calibrated specialists. Information about bruxism, past orthodontic treatment, general health, etc. was lacking as only radiographs were assessed. The investigation of the link between pulp stones and kidney stones, atherosclerosis and other systemic or genetic conditions would be of outmost importance.

## CONCLUSION

Within the limitations of the present study it was shown that more than half of the participants had pulp stones in molars. Higher prevalence of pulp stones was associated with older age and decayed/filled teeth. There was no statistically significant difference between genders with regards to prevalence of pulp stones.

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