

# Prevalence of pulp stones in cone beam computed tomography

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## ABSTRACT

**Introduction:** Calcifications of the pulp chamber, known as pulp stones, are common and may be adhered or not to dentin. These changes are detected during routine radiographic evaluations as single or multiple circular or ovoid radiopaque images measuring more than 200  $\mu\text{m}$ . Used in Endodontics, cone-beam computed tomography (CBCT) may demonstrate root and coronary anatomy and detect calcifications, which may help to make an accurate diagnosis. **Objective:** This study assessed the prevalence of pulp stone on CBCT scans retrieved from the collection of the Radiology Center of the School of Dentistry — São Leopoldo Mandic. **Methods:** A total

of 181 images were analyzed by means of multiplanar reconstructions. Results were subjected to biostatistics. **Results:** The prevalence of pulp stones was 55%. Prevalence was highest in the 31-40 year age group (89.7%) and in the group of teeth that had been restored (61%). Teeth #16 was the most affected, at a prevalence of 12.8 %, followed by #17 (10.3%). **Conclusion:** The prevalence of patients with pulp stones was 55%. Pulp stones were not associated with aging. Most teeth with pulp stones were maxillary permanent molars, and tooth restoration may be the cause of stone formation.

**Keywords:** Dental pulp diseases. Dental pulp calcification. Cone-beam computed tomography.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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## Introduction

Calcifications of the pulp chamber, known as pulp stones, are common lesions that may be adhered or not to dentin. Their size may range from microscopic to large masses that obliterate almost the entire pulp chamber.<sup>1-5</sup> The causes and process of stone formation have not been fully clarified, but stones seem to be associated with several factors: patient's age, low-intensity stimuli, caries, occlusal trauma, orthodontic movement, periodontal problems, epithelial rests, dental abnormalities and systemic disorders.<sup>4,6,7</sup>

Pulp stones, detected during routine radiographic examinations, are seen as single or multiple circular or ovoid radiopaque images. The prevalence of pulp stones ranges from 8% to 90%, and only lesions greater than 200  $\mu\text{m}$  are detectable.<sup>8-12</sup>

The use of cone-beam computed tomography (CBCT) in Dentistry has made it possible to obtain different planar views of a region of interest and to identify anatomic details without superimpositions. Therefore, this method has greater specificity and accuracy in comparison to conventional radiographs and are indicated for preoperative planning. They have become essential in endodontic treatment because accurate images of root and coronary anatomy, as well as of calcifications, increases treatment success.<sup>13,14,15</sup>

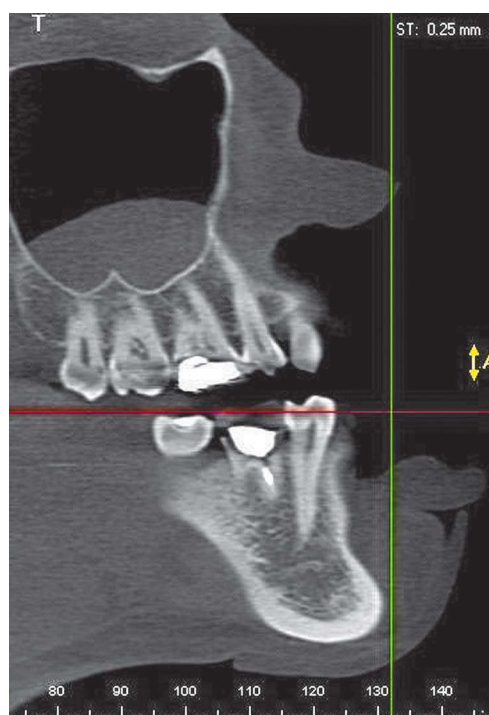
This study assessed the presence of pulp stones on CBCT scans retrieved from the collection of the Radiology Center of the School of Dentistry — São Leopoldo Mandic in Campinas, Brazil, in 2012.

## Material and methods

This study was conducted in the Radiology Center of the School of Dentistry — São Leopoldo Mandic. A total of 181 CBCT scans were retrieved and assessed in 2012 (March 2012 to December 2012).

Male and female patients of all ages were included, whereas edentulous patients were excluded. The sample included restored, carious, impacted and healthy teeth.

CBCT scans were obtained by means of an I-CAT scanner (Imaging Sciences International, Inc, Hatfield, PA) set at standardized parameters: 40 s exposure, 13 cm fov, 0.25 mm voxel, 120 kV and 36.15 mAs. All cases included treatment plan with implant placement or surgeries in maxilla or mandible. Images were assessed in a dimly lit room by two examiners (radiologists) using a specific computer and monitor



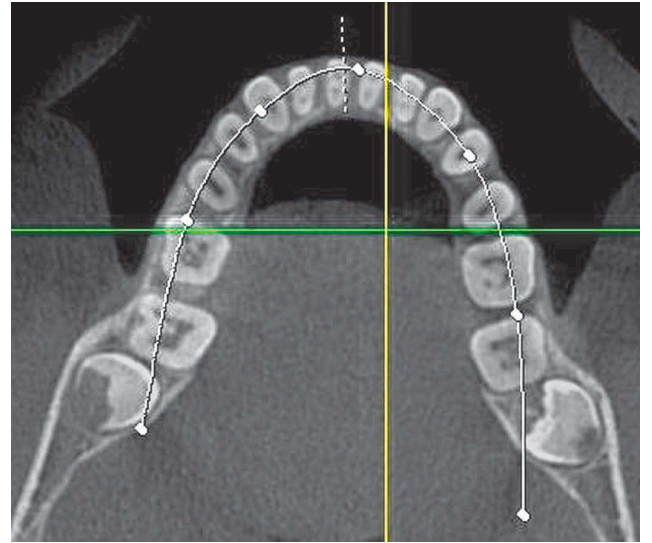
**Figure 1.** Computed tomography multiplanar reconstructions evincing pulp stone in tooth #17. Sagittal view.



**Figure 2.** Computed tomography multiplanar reconstructions evincing pulp stone in tooth #46. Sagittal view.



**Figure 3.** Computed tomography multiplanar reconstructions evincing pulp stone in tooth #27. Sagittal view.



**Figure 4.** Computed tomography multiplanar reconstructions evincing pulp stone in teetg #36, 37,46 and 47. Axial view.



**Figure 5.** Computed tomography multiplanar reconstructions evincing pulp stone in teeth #26 and 27 (unerupted ), #37 (recently erupted). Sagittal view.



**Figure 6.** Computed tomography multiplanar reconstructions evincing pulp stone in tooth #21. Sagittal view.

and who were calibrated before the beginning of the study. The scans were assessed using multiplanar reconstruction of 1-mm cross-sectional slices in the Xoran software (Xoran Technologies, Ann Harbor, MI) and its zoom tool when necessary.

Opaque masses in the pulp chamber and inside the root were diagnosed as pulp stones.

Data were organized in Excel spreadsheets and analyzed statistically.

## Results

This study assessed the prevalence of pulp stones on CT scans of 122 patients (67.5% women) (Fig 7). Patients' age ranged from 10 to 76 years with mean age ( $\pm$  standard deviation) of  $42.74 \pm 16.72$  years.

CT scans revealed that 55% of patients had pulp stones. The highest prevalence (89.7%) was found in the 31-40 year age group, followed by 88.3% in the 41-50 year group and 85% in the 21-30 year group. Table 1 shows the prevalence of pulp stones according to patients' age.

The greatest prevalence was found for teeth with restorations. However, in the 10-20-year-old group, pulp stones were diagnosed in 63.5% of healthy teeth. This was the only group in which healthy teeth had the highest prevalence of pulp stones (Table 2).

Moreover, out of all teeth with stones, tooth #16 was most frequently affected (12.8%), followed by tooth #17 (10.3%) (Table 1).

## Discussion

Pulp stones are detected by means of conventional or digital imaging techniques such as bitewing, panoramic and bisecting angle techniques. However, they are only detectable when lesions are greater than 200  $\mu$ m. The prevalence of pulp stones ranges from 8% to 90% probably due to the different techniques used in different studies.<sup>4,8,16,17,18</sup>

To overcome radiographic limitations, such as superimposition of structures and poor resolution or accuracy, CBCT has been included the armamentarium for endodontic diagnoses. CBCT was used in this study and revealed greater prevalence (55%) of pulp stones in comparison to other studies using conventional imaging methods (Hamasha and Darwazeh,<sup>4</sup> Baghdady et al,<sup>8</sup> Tamse et al,<sup>16</sup> and Ranjitkar et al.<sup>17</sup>

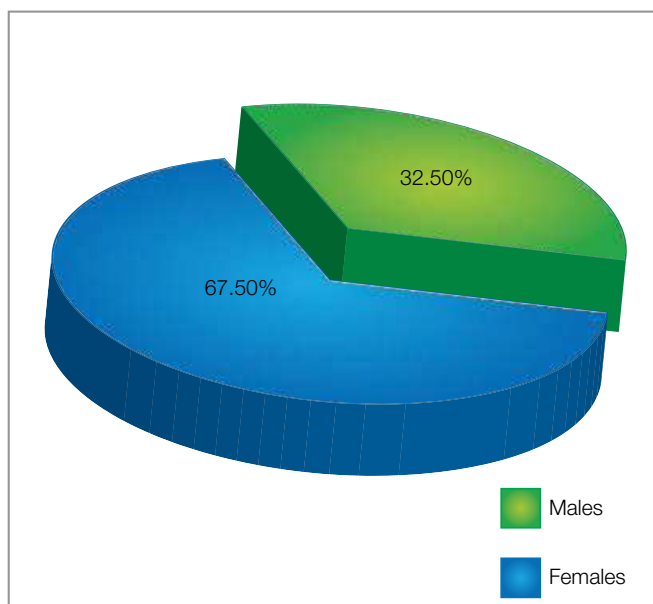


Figure 7. Patients distribution according to sex.

The etiology of pulp stones has been intensively discussed, and different authors have found associations with low-intensity local irritants (carious lesions and restorations). Our biostatistics results revealed a prevalence of 61% in restored teeth. In contrast, the prevalence in healthy teeth was 63.5% in the 10-20 year age group, thereby confirming the controversy about the origin of these stones. This is in agreement with findings by Hamasha and Darwazeh,<sup>4</sup> Edds et al,<sup>6</sup> and Nayak et al,<sup>7</sup> who assigned the presence of stones to other factors and systemic disorders.

The age group with the highest prevalence of pulp stones was the 31-40-year-old group, in which 89.7% of teeth had stones. This finding is in disagreement with the studies conducted by Gulsahi et al,<sup>10</sup> Tamse et al,<sup>16</sup> Shafer<sup>19</sup> and Seltzer and Bender,<sup>20</sup> who found an association between age and calcifications. Conversely, it confirms findings reported by Hamasha and Darwazeh<sup>4</sup> who reported no association with age.

As in most studies (Hamasha and Darwazeh,<sup>4</sup> Baghdady,<sup>8</sup> Tamse,<sup>16</sup> and Ranjitkar<sup>17</sup>), molars were the teeth most often affected, with 12.8% of the total prevalence.

The presence of free stones or stones adhered to dentin does not greatly affect patient's teeth, but the high prevalence found in our study suggests that their detection using CBCT imaging studies may aid endodontic treatment planning.

**Table 1.** Prevalence of pulp stones according to patients' age.

Tooth	10 - 20 years	21 - 30 years	31 - 40 years	41 - 50 years	51 - 60 years	61 - 70 years	71 years up	Total
11	1	0	0	0	0	0	0	1 (0.4%)
13	0	0	2	2	1	0	0	5 (2%)
16	6	8	9	9	2	1	0	35 (12.8%)
17	3	5	8	7	3	2	0	28 (10.3%)
18	0	2	2	2	5	1	1	13 (4.8%)
21	1	0	0	0	0	1	0	2 (0.7%)
22	1	0	0	0	0	0	0	1 (0.4%)
23	0	0	1	1	0	0	0	2 (0.8%)
26	7	5	2	2	3	0	1	20 (7.1%)
27	3	2	4	4	3	4	0	20 (7.3%)
28	0	1	3	3	0	2	0	9 (3.3%)
31	1	0	0	0	0	0	0	1 (0.4%)
32	1	0	0	0	0	0	0	1 (0.4%)
33	1	0	3	3	2	0	0	9 (3.3%)
34	1	1	1	1	0	1	0	5 (2%)
35	1	0	3	3	1	0	0	8 (2.9%)
36	3	2	2	2	6	0	0	15 (5.5%)
37	1	2	6	5	9	1	0	24 (8.8%)
38	0	0	3	3	1	1	0	8 (2.9%)
41	1	0	1	1	0	0	0	3 (1.1%)
42	1	0	1	1	0	0	0	3 (1.1%)
43	1	0	1	1	2	0	0	5 (2%)
44	0	0	2	2	0	0	0	4 (1.5%)
45	1	0	4	4	0	0	0	9 (3.3%)
46	3	1	3	3	2	0	0	12 (4.4%)
47	3	2	5	5	3	0	0	18 (6.6%)
48	0	3	4	4	0	0	0	11 (4%)
Total	41	34	70	68	43	14	2	272 (100%)

**Table 2.** Status of teeth with pulp stones. Presence of pulp stones according to age.

	10 - 20 years (n = 41)	21 - 30 years (n = 34)	31 - 40 years (n = 70)	41 - 50 years (n = 68)	51 - 60 years (n = 43)	61 - 70 years (n = 14)	71 years up (n = 2)	Total (n = 272)
Healthy	26 (63.5%)	15 (44.1%)	29 (41.4%)	16 (23.5%)	10 (23.2%)	2 (14.3%)	0 (0%)	98 (36%)
Restoration	12 (29.3%)	18 (52.9%)	40 (57.1%)	51 (75%)	31 (72.2%)	12 (85.7%)	2 (100%)	166 (61%)
Caries	1 (2.4%)	0 (0%)	1 (1.4%)	0 (0%)	1 (2.3%)	0 (0%)	0 (0%)	3 (1.1%)
Unerupted	2 (4.8%)	1 (3%)	0 (0%)	1 (1.5%)	1 (2.3%)	0 (0%)	0 (0%)	5 (1.9%)

## Conclusion

In this study, the prevalence of pulp stones was 55%. The presence of pulp stones was not associated with aging. Maxillary permanent molars were the teeth most frequently affected. Most teeth with stones had restorations; however, given that the cause of restoration was not identified, a causal relation between restorations and stones could not be established.



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