

Association Between Enamel Pearl Prevalence And Characteristics of on Cone Beam Computed Tomography With Supernumerary Teeth

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Abstract

Background

Enamel pearls are enamel outgrowths that may occur in tooth furcations or on root surfaces near the cemento-enamel junction. This developmental anomaly may contribute to periodontal problems and tooth displacement or delayed eruption. This study aimed to determine the prevalence and characteristics of enamel pearls on cone-beam computed tomography (CBCT) images and assess their associations with tooth location, tooth number, tooth type, jaw, gender, and supernumerary teeth.

Methods

In this retrospective observational-analytical study, CBCT images of 12,874 teeth from patients referred to a private oral and maxillofacial radiology center and Babol University of Medical Sciences were evaluated. Reconstructed panoramic, multiplanar, and cross-sectional images (0.5-mm sections) were examined. The presence, location, involved tooth, tooth type, jaw, gender, and supernumerary teeth were recorded. Statistical analyses were performed using SPSS version 22, with Chi-square and Fisher's exact tests at a significance level of 0.05.

Results

Six enamel pearls were identified among 12,874 teeth, yielding a prevalence of approximately 0.05%. Two (33.3%) were located cervically and four (66.7%) in furcation areas. No supernumerary teeth were identified. No significant association was found between gender and enamel pearl occurrence ($P = 0.687$), whereas significant associations were observed with tooth type ($P = 0.004$) and tooth number ($P = 0.015$). All enamel pearls occurred in molars, with the second and third maxillary molars most frequently affected.

Conclusions

Enamel pearls had a prevalence of 0.05% and were not associated with gender. Their predominance in molars and furcation areas highlights the importance of their detection due to potential periodontal and tooth displacement complications.

Introduction

Developmental dental anomalies comprise a heterogeneous group of abnormalities that may affect tooth number, size, shape, structure, and eruption. These anomalies may occur independently or as part of a syndrome and can have clinical consequences, including aesthetic problems, malocclusion, caries susceptibility, periodontal complications, and disturbances in tooth eruption (1, 2).

Enamel pearl is a developmental anomaly characterized by a localized enamel projection or outgrowth occurring on the root surface, particularly near the cemento-enamel junction or in the furcation region of multirooted teeth (3, 4). Although enamel pearls are relatively uncommon, their presence may have clinical significance because their morphology and location can facilitate plaque accumulation and compromise periodontal health (4).

The reported prevalence of enamel pearls varies considerably among populations and studies. This variation may be related to differences in study populations, sample size, diagnostic methods, and whether the evaluation is based on radiographic, microscopic, or histologic examination. Enamel pearls have been reported more frequently in permanent molars than in other tooth groups, and particularly in maxillary molars (1, 5–8).

Cone-beam computed tomography (CBCT) has become an important imaging modality in dentistry because it provides three-dimensional information about dental and maxillofacial structures. Compared with conventional two-dimensional radiography, CBCT may facilitate the detection and localization of anatomical variations and developmental anomalies by allowing examination in multiple planes (9).

A possible association between enamel pearls and supernumerary teeth has also been investigated. In particular, a previous CBCT study reported a significant association between these two dental findings and suggested that the presence of supernumerary teeth may be accompanied by an increased likelihood of enamel pearls (4).

Considering the limited number of CBCT-based studies assessing enamel pearls in Iranian populations, the present study was conducted to determine the prevalence and characteristics of enamel pearls on CBCT images and to investigate their association with gender, tooth type, tooth number, jaw, and supernumerary teeth in a population from northern Iran.

Materials and Methods

Study Design and Population

This retrospective observational-analytical study was conducted using CBCT images obtained from patients referred to a private oral and maxillofacial radiology center and the School of Dentistry of Babol University of Medical Sciences.

Sample Size Calculation

This study evaluated 12,874 teeth from 1,003 CBCT scans, drawing on findings from similar studies (8, 10). The sample size for each group was determined using the following formula, based on the results of previous studies investigating the prevalence of enamel pearls in the population (8) and assuming a 95% confidence level ($\alpha = 0.05$):

$$N = \frac{(Z_{1-\frac{\alpha}{2}})^2 P (1-P)}{d^2}$$

$$n \geq \frac{1.96^2 0.0071 (1 - 0.0071)}{(0.0071 \times 0.2)^2} = 13459$$

A total of 12,874 teeth were evaluated on CBCT examinations.

Image Acquisition and Evaluation

The CBCT images were acquired using a NewTom device (Verona, Italy). Initially, a reconstructed panoramic image was prepared for each patient using similar reconstruction settings.

The panoramic images were examined for possible enamel pearls (Fig. 1). In cases where an enamel pearl was suspected, the corresponding region was further evaluated using multiplanar reconstruction (MPR) and cross-sectional views (Fig. 4). Sagittal, coronal, and axial views were examined to confirm the presence and determine the precise location of the anomaly (Figs. 2 and 3). Cross-sectional images with a thickness of 0.5 mm were used for detailed assessment.

The presence or absence of enamel pearls, their location, involved tooth, tooth number, tooth type, jaw, and gender were recorded.

Inclusion and Exclusion Criteria

CBCT images suitable for evaluation were included. Exclusion criteria included patients with more than four missing teeth, root canal-treated teeth, and CBCT images of inadequate quality. Missing teeth and root canal-treated teeth were replaced by other teeth under comparable conditions when necessary for the study design (8).

Variables

The primary variables included:

- • Gender
- • Tooth type
- • Tooth number
- • Presence of enamel pearl
- • Location of enamel pearl
- • Presence of supernumerary teeth

Tooth type was categorized as anterior teeth, premolars, and molars.

Statistical Analysis

Data were analyzed using SPSS version 22. The associations between enamel pearl occurrence and gender, tooth type, tooth number, and jaw were evaluated using the Chi-square test and Fisher's exact test as appropriate. A P-value < 0.05 was considered statistically significant.

The study protocol was approved by the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.REC.1402.199).

Results

A total of 12,874 teeth were evaluated. Of these, 5,108 teeth (39.7%) belonged to male patients and 7,766 teeth (60.3%) belonged to female patients. Regarding tooth type, 5,130 teeth (39.8%) were anterior teeth, 3,204 (24.9%) were premolars, and 4,540 (35.3%) were molars. Characteristics of the teeth included in the study are presented in Table 1 and Fig. 5.

Six teeth were identified as having enamel pearls. None of the examined cases had supernumerary teeth. Of the six enamel pearls, two (33.3%) were located in the cervical region and four (66.7%) were located in the furcation region.

Association with Gender

Three enamel pearls were identified among teeth belonging to male patients and three among teeth belonging to female patients. Statistical analysis showed no significant association between gender and the presence of enamel pearls ($P = 0.687$). (Table 2)

Association with Tooth Type

A statistically significant association was found between tooth type and enamel pearl occurrence ($P = 0.004$). All six enamel pearls were observed in molars. No enamel pearls were identified in anterior teeth or premolars. (Table 2)

Association with Tooth Number

A significant association was also observed between individual tooth number and enamel pearl occurrence ($P = 0.015$). Among the six enamel pearl-containing teeth, two cases involved the maxillary second molar, two involved the maxillary third molar, one involved the maxillary first molar, and one involved the mandibular second molar.

Association with Supernumerary Teeth

No supernumerary teeth were identified among the evaluated cases. Consequently, no positive association between enamel pearls and supernumerary teeth could be demonstrated in this sample.

Table 1
Characteristics of the teeth included in the study

Variable		Percentage	Frequency
Tooth type	Anterior teeth	39.8	5130
	Premolar	24.9	3204
	Molar	35.3	4540
Jaw	Maxilla	50.1	6449
	Mandible	49.9	6425

Table 2
Assessment of the association between the presence of enamel pearls and the sex of the participants, affected tooth, and affected jaw

Enamel pearl		Yes		No		P-value
		Number	Percentage	Number	Percentage	
Gender	Male	3	0.1	5105	99.9	0.687*
	Female	3	0.0	7763	100.0	
Tooth type	Anterior teeth	0	0.0	5130	100.0	0.004**
	Premolar	0	0.0	3204	100.0	
	Molar	6	0.1	4534	99.9	
Jaw	Maxilla	4	0.1	6445	99.9	0.687*
	Mandible	2	0.0	6423	100.0	
*Fisher's Exact Test						
**Chi-square						

Discussion

Enamel pearls are developmental enamel anomalies that may have clinical importance because their location can promote plaque accumulation and potentially contribute to periodontal disease. Their recognition on dental imaging is therefore relevant, particularly when they occur in furcation regions (11, 12).

In the present study, six enamel pearls were identified among 12,874 evaluated teeth, resulting in an estimated prevalence of approximately 0.05%. This prevalence was considerably lower than that reported in some previous studies. For example, Chrcanovic et al. reported a prevalence of 0.82% in a human tooth bank sample. The difference may be attributable to variations in sample size, population characteristics, and especially the diagnostic methodology used in different investigations (11, 13).

The prevalence reported in the present study was also higher or lower than some CBCT-based studies depending on the population and methodology. A previous study by Moshfeghi et al., which evaluated CBCT images from 150 patients, reported one enamel pearl, corresponding to a prevalence of approximately 0.02% in the studied population (8). In contrast, Zengin et al. reported a higher prevalence of enamel pearls and identified a significant association between enamel pearls and supernumerary teeth (4).

The relatively low prevalence observed in the present study should be interpreted in light of the study design and the limited number of positive cases. Histological and microscopic investigations may identify enamel pearls that are not readily detectable radiographically. Therefore, differences in diagnostic sensitivity may contribute substantially to the variation in reported prevalence (12, 13).

An important finding of the present study was the exclusive occurrence of enamel pearls in molars. This finding agrees with previous reports indicating that enamel pearls occur predominantly in permanent molars. In particular, the second and third maxillary molars were the most frequently affected teeth in the present study. A previous CBCT investigation by Akgül et al. similarly reported enamel pearls predominantly in molar teeth, including maxillary and mandibular molars (3, 11, 13).

The location of enamel pearls is also clinically relevant. In the present study, four of the six enamel pearls (66.7%) were located in furcation regions, whereas two (33.3%) were located in cervical areas. The predominance of furcation involvement is consistent with previous observations and may be important from a periodontal perspective because furcation areas are difficult to clean and may facilitate plaque retention (11, 13).

No significant association was identified between gender and enamel pearl occurrence ($P = 0.687$). The equal distribution of the six observed cases between males and females supports the absence of a detectable gender-related difference in this sample. Previous studies have reported inconsistent findings regarding gender, and differences among populations and diagnostic methods may explain these variations (3, 4).

In the current study, no supernumerary teeth were detected. Therefore, unlike previous CBCT research reporting an association between enamel pearls and supernumerary teeth, the present study could not demonstrate such a relationship. Because the number of enamel pearl-positive cases was very small and no supernumerary teeth were identified, this finding should not be interpreted as evidence that no association exists in the general population (4).

From a clinical perspective, early identification of enamel pearls may be important because these structures can contribute to periodontal problems and, in some cases, may be associated with disturbances in tooth eruption or displacement. CBCT can provide valuable three-dimensional information for identifying and localizing these anomalies, particularly when conventional radiographic views do not clearly demonstrate their exact position (3, 4, 13, 14).

The present study has several limitations. First, bilateral comparison of enamel pearl prevalence was not performed. Second, permanent and primary teeth were not separately analyzed. Third, age-group comparisons were not conducted. These limitations should be considered when interpreting the findings.

Conclusion

Within the limitations of the present study, the prevalence of enamel pearls in the evaluated CBCT sample was approximately 0.05%. No statistically significant association was found between enamel pearl occurrence and gender. However, enamel pearls were significantly associated with tooth type and tooth number, and all detected enamel pearls occurred in molars.

The maxillary second and third molars were the most frequently affected teeth, while furcation involvement was more common than cervical involvement. No supernumerary teeth were identified in the evaluated sample; therefore, an association between enamel pearls and supernumerary teeth could not be established.

Because enamel pearls may have periodontal and developmental consequences, their recognition on CBCT images may be clinically relevant. Further investigations with larger sample sizes and separate analyses of primary and permanent dentitions, age groups, and bilateral tooth distribution are recommended.

Declarations

Ethics Approval

The study was approved by the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.REC.1402.199).

Conflict of Interest

The authors declare that they have no competing interests.

Funding

Not applicable.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

Amirhossein Aghajanzadeh and Ehsan Moudi contributed to the conception and design of the study, collection the study data, and writing the manuscript. Nazmehr Vahdani Amoli interpreted the study data. Seyedali Seyedmajidi analyzed the study data. Ehsan Moudi and Ariana Rezaei Majd reviewed the article. All authors contributed to critical review and final approval of the version to be published.

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Figures

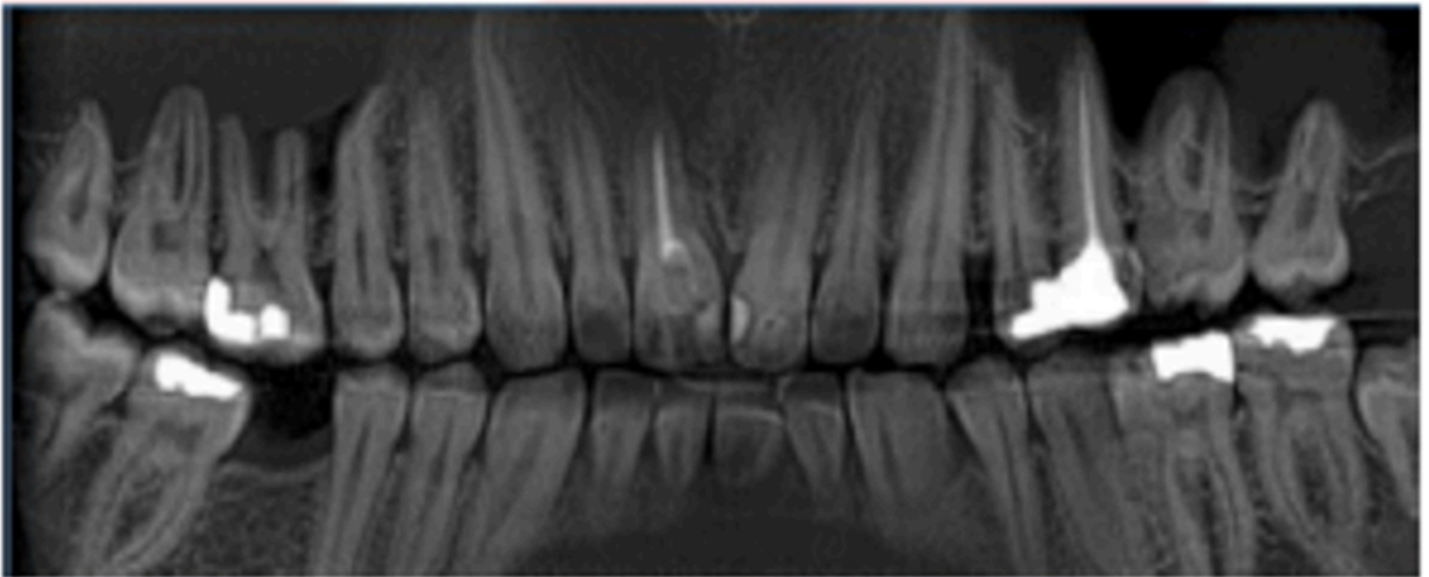


Figure 1

Reconstructed panoramic view of CBCT images

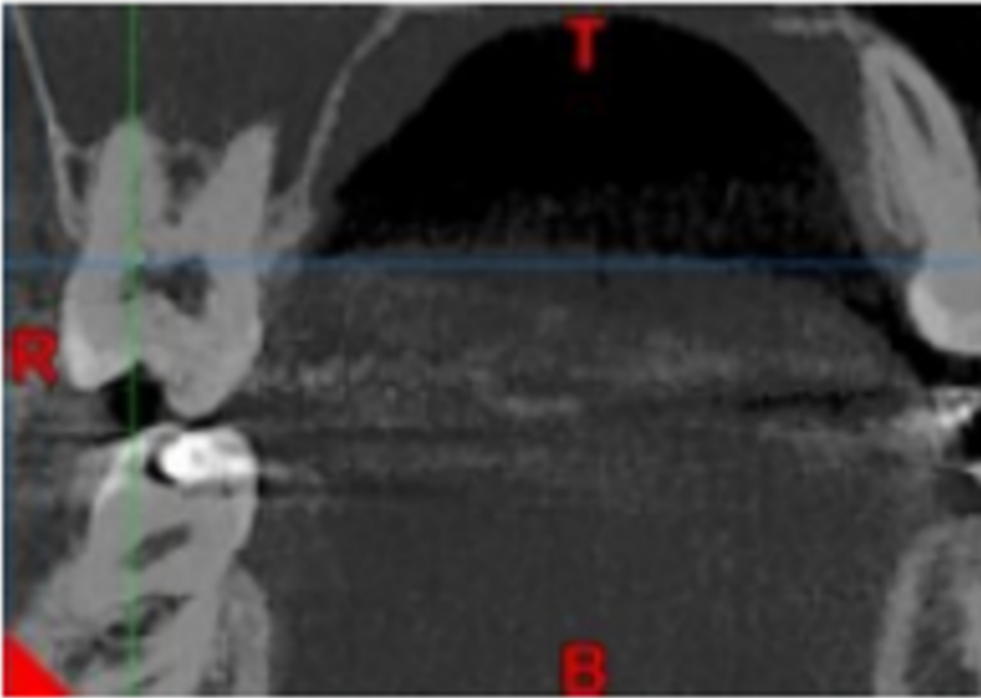


Figure 2

Visualization of the enamel pearl anomaly in the sagittal plane on MPR view

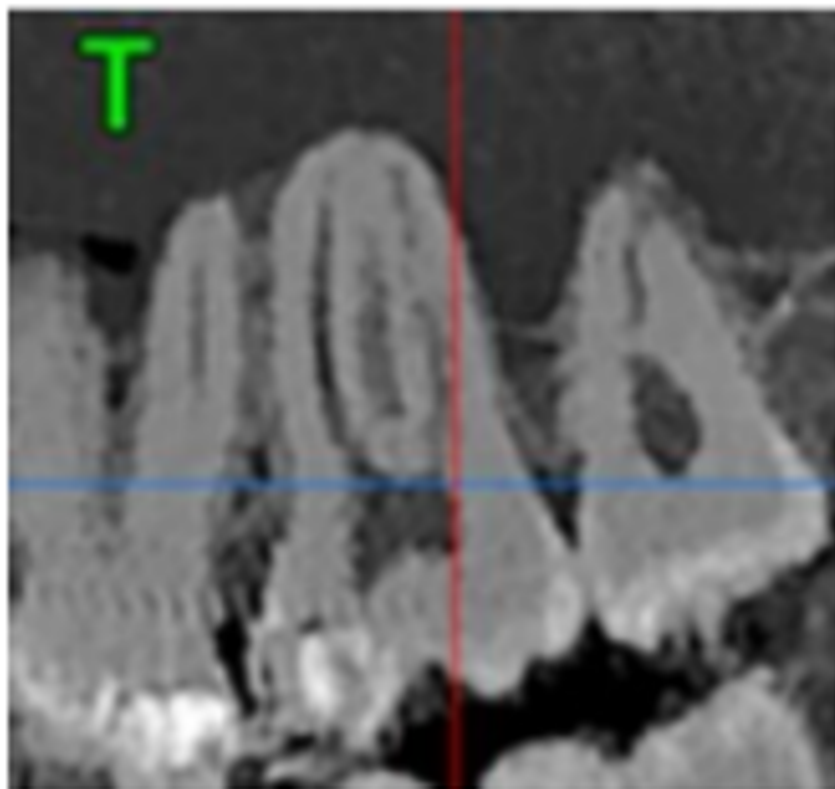


Figure 3

Visualization of the enamel pearl anomaly in the coronal plane on the MPR view

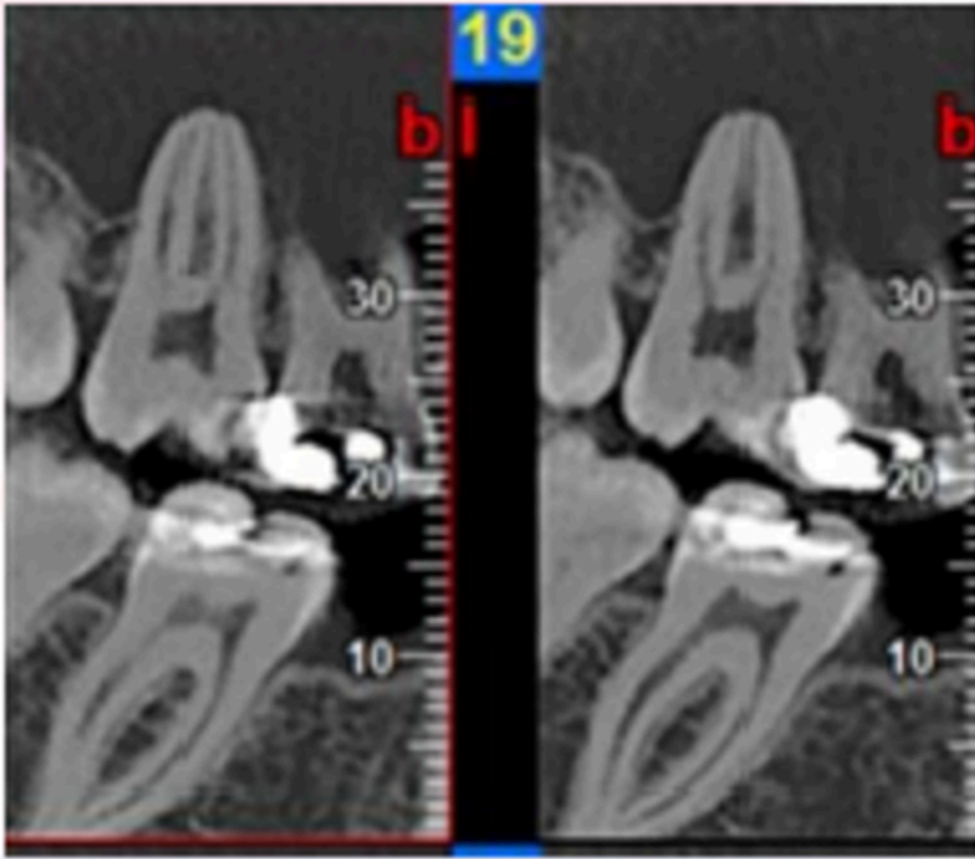


Figure 4

Visualization of the enamel pearl anomaly in the upper right second molar on the multiplanar view

Figure 5. Gender of the study participants

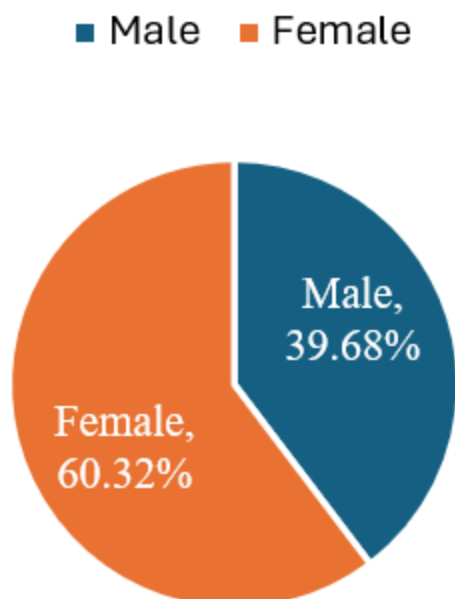


Figure 5

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