

## Case Report

# Cervical Enamel Projections in Unusual Locations: A Case Report and Mini-Review

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**Background:** Periodontitis is primarily a bacteria-induced disease that can be modified by tooth-related local factors. Cervical enamel projections (CEPs) are a common tooth anomaly that can act as contributing factors in the development of periodontitis. They are most commonly found at the buccal surfaces of mandibular molars.

**Methods:** A 57-year-old female was referred to our clinic for treatment of chronic periodontitis. A clinical examination revealed moderate attachment loss that was localized to the palatal side of the maxillary second molars. The rest of the dentition was less affected, with a diagnosis of generalized slight chronic periodontitis. An initial non-surgical periodontal treatment was provided followed by apically positioned flap surgery in the maxillary right and left posterior areas. At the time of surgery, CEPs were found where the periodontium was most affected.

**Results:** Because surgical intervention exposed the CEPs, they were not removed. After the active therapy, which resulted in inflammation resolution and maintainable probing depths, the patient was placed on a 3-month recall for periodontal maintenance.

**Conclusions:** CEPs were found in an unusual location on the palatal roots of maxillary second molars. The findings of this case report confirm the role of CEPs as a local contributing factor in localized chronic periodontitis. J Periodontol 2010;81:789-795.

### KEY WORDS

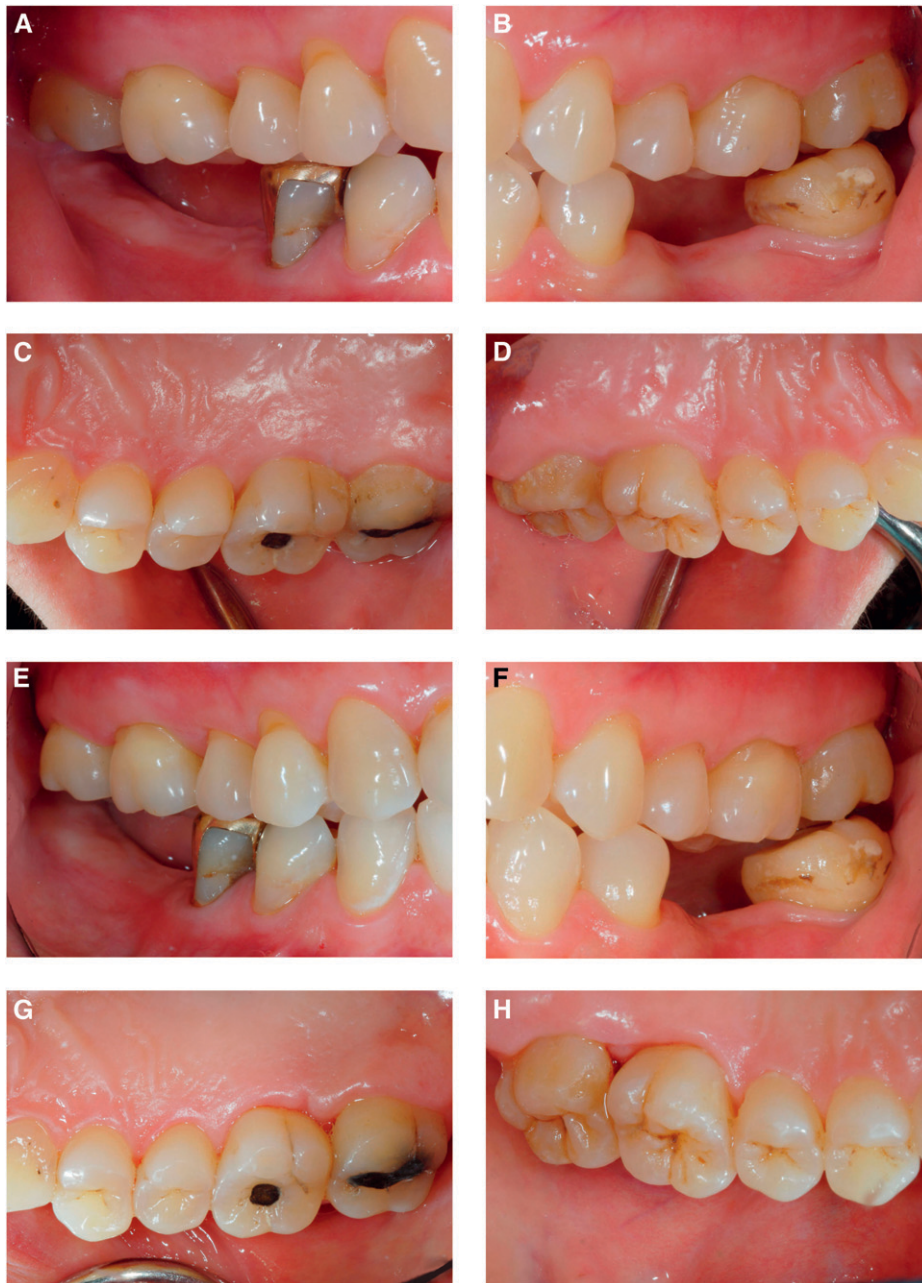
Dental enamel/abnormalities; furcation defects/etiology; molar/abnormalities; prevalence and periodontal disease/pathology; tooth abnormalities.

Because periodontitis is primarily a dental plaque-induced inflammatory disease, local factors that facilitate the accumulation of bacteria may contribute to the progression of the disease. Factors such as tooth anatomy and restorative and endodontic considerations have been linked to gingival inflammation and attachment and tooth loss.<sup>1</sup> Of all anatomic factors, the cervical enamel projection (CEP) is probably the most common and associated with attachment loss in the molar furcation area. It is defined as a dipping of enamel from the cemento-enamel junction (CEJ) of a molar toward and often into the furcation area.<sup>2</sup>

Several studies<sup>2-10</sup> reported the prevalence of CEPs ranging from 8.6% to 85%. The variations might have resulted from different study designs and ethnic populations. A study by Grewe et al.<sup>3</sup> generated the largest sample size (5,230 extracted molars) and found the CEP prevalence to be 25.2% in mandibular molars and 15.8% in maxillary molars. Furthermore, they found the most common site was the buccal side of the mandibular second molar. Bissada and Abdelmalek<sup>2</sup> reported the lowest CEP prevalence of 8.6% after assessing 1,138 molars from Egyptian skulls. In the study, the second mandibular molar was the most common site. Hou and Tsai<sup>4</sup> examined mandibular molars with Class III furcation involvement in a Taiwanese population and reported the highest prevalence of CEPs at 85%. They<sup>4,5</sup> found CEPs most commonly on mandibular first molars.

The other category of ectopic enamel formation, the enamel pearl, presents a lower prevalence compared to CEPs. The enamel pearl is defined as an ectopic globule of enamel that is often connected to coronal enamel by a CEP.<sup>11</sup> Risnes<sup>12</sup> studied 8,854 extracted molars and reported that 2.28% had enamel pearls. The enamel pearls occurred more commonly on the roots of maxillary molars, especially third molars. Another study<sup>13</sup> using radiographs to examine the presence of enamel pearls found a similar prevalence (1.6%). However, in contrast to the study of

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**Figure 1.** Clinical photographs at baseline (A through D) and reevaluation (E through H).

Risnes,<sup>12</sup> the most common site of the enamel pearls was on the roots of first molars.<sup>13</sup>

During normal tooth development, ameloblasts lose their activity after crown formation and become part of Hertwig's epithelial root sheath. Occasionally, for unknown reasons, ameloblasts retain their enamel competence, resulting in prolonged (CEPs) or delayed (enamel pearls) ectopic enamel production. This phenomenon was supported by structure analysis revealing that CEPs and enamel pearls have characteristics of enamel including enamel rods, striae of Retzius,

Hunter-Schreger bands, and areas of prism-free enamel.<sup>14-16</sup> However, the enamel structure of CEPs is more irregular, resembling the cervical enamel. On the other hand, enamel pearls generally exhibit structure comparable with, although somewhat more irregular than, coronal enamel. Based on these structure studies, it can be implied that amelogenesis in CEPs is a continuation of cervical enamel formation. In contrast, amelogenesis of enamel pearls may follow a similar pattern as in the crown from the dentinal tip to the cervical region.

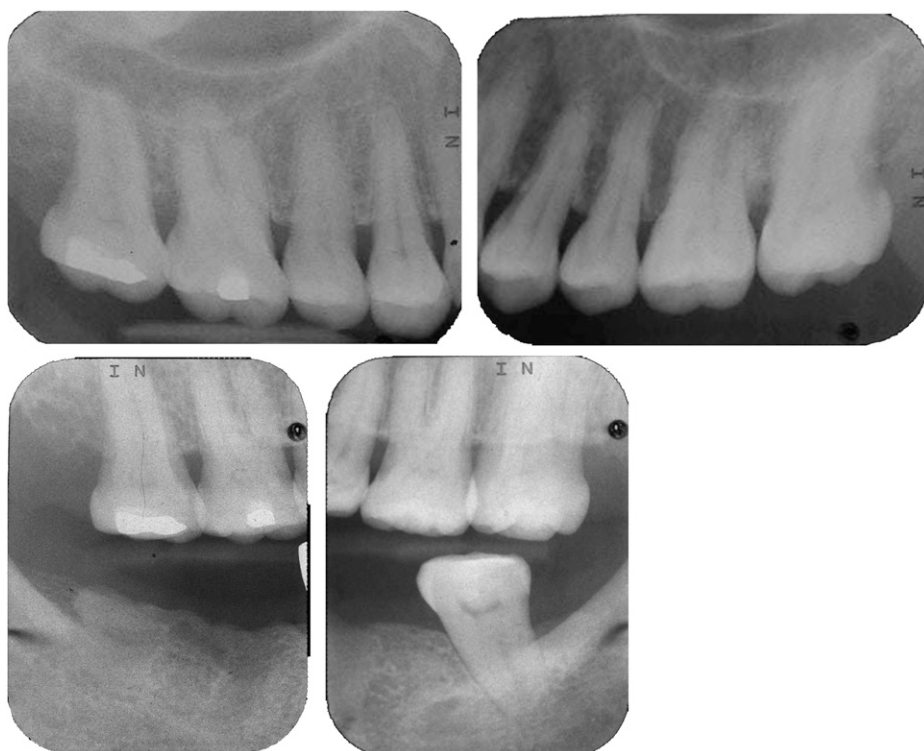
The current periodontal disease classification endorsed by the American Academy of Periodontology recognizes tooth aberration as a contributing factor.<sup>17</sup> The purpose of this article was to present a case with CEPs in an unusual position. The findings of this report also substantiated that the CEP is a local contributing factor to periodontal disease. In addition, pertinent literature regarding CEPs and enamel pearls was reviewed.<sup>2-13,18</sup>

## MATERIALS AND METHODS

### *Clinical Examination and Initial Periodontal Therapy*

A written informed consent was obtained prior to the disclosure of the patient's information. A 57-year-old Chinese American female was referred from a community dental clinic to the Graduate Periodontics Clinic at the University of Michigan

School of Dentistry in March 2009. Her medical history was reviewed using a questionnaire and verbal confirmation. Medically, she was healthy and reported no allergies or medication use. Her dental history included amalgam restorations, a crown, extractions, endodontic therapy, and a failing three-unit fixed bridge that prompted her initial visit to the community dental clinic. Periodontally, her previous treatment was restricted to prophylaxis. Her chief complaint was, "My general dentist referred me here for my gum disease."



**Figure 2.**

Baseline posterior periapical and vertical bitewing radiographs; 5% to 10% horizontal bone loss was notified around maxillary molars.

A comprehensive periodontal examination was completed including extraoral, intraoral, radiographic, and periodontal evaluations (Figs. 1 and 2). Missing teeth included #1, #16, #17, #19, #20, and #30 through #32. A significant arch discrepancy was noted, with her maxilla being much wider than her mandible. Periodontally, her oral hygiene was poor, with an O'Leary plaque index of 48%.<sup>19</sup> Notably, supragingival plaque formation was present on the palatal aspect of the maxillary molars. In that area, the gingiva was characterized by erythematous and edematous interdental papillae, rolled gingival margins, and pseudopocketing (with a gingival margin 2 and 3 mm coronal to the CEJ) on teeth #2 and #15 (Fig. 1). The full-mouth bleeding score<sup>20</sup> (FMBS) was 32%. Generalized mild gingival recession (1 to 2 mm) was present, although keratinized gingiva was adequate throughout the dentition. Probing depths ranged from 2 to 7 mm, with the deepest site on tooth #15P (P indicates palatal surface) (Fig. 3). Clinical attachment loss ranged from 0 to 4 mm.

Generalized slight and localized moderate (teeth #2 and #15) chronic periodontitis was diagnosed according to the 1999 International Workshop for the Classification of Periodontal Diseases and Conditions.<sup>17</sup> An overall favorable prognosis, with a questionable prognosis for teeth #2 and #15, was assigned.<sup>21</sup>

Initial periodontal treatment consisting of oral hygiene instructions and localized scaling and root planing on the maxillary molars was completed in May 2009. Bone sounding was performed during the initial phase and revealed a probe penetration of 11 mm on tooth #15P and 9 mm on tooth #2P.

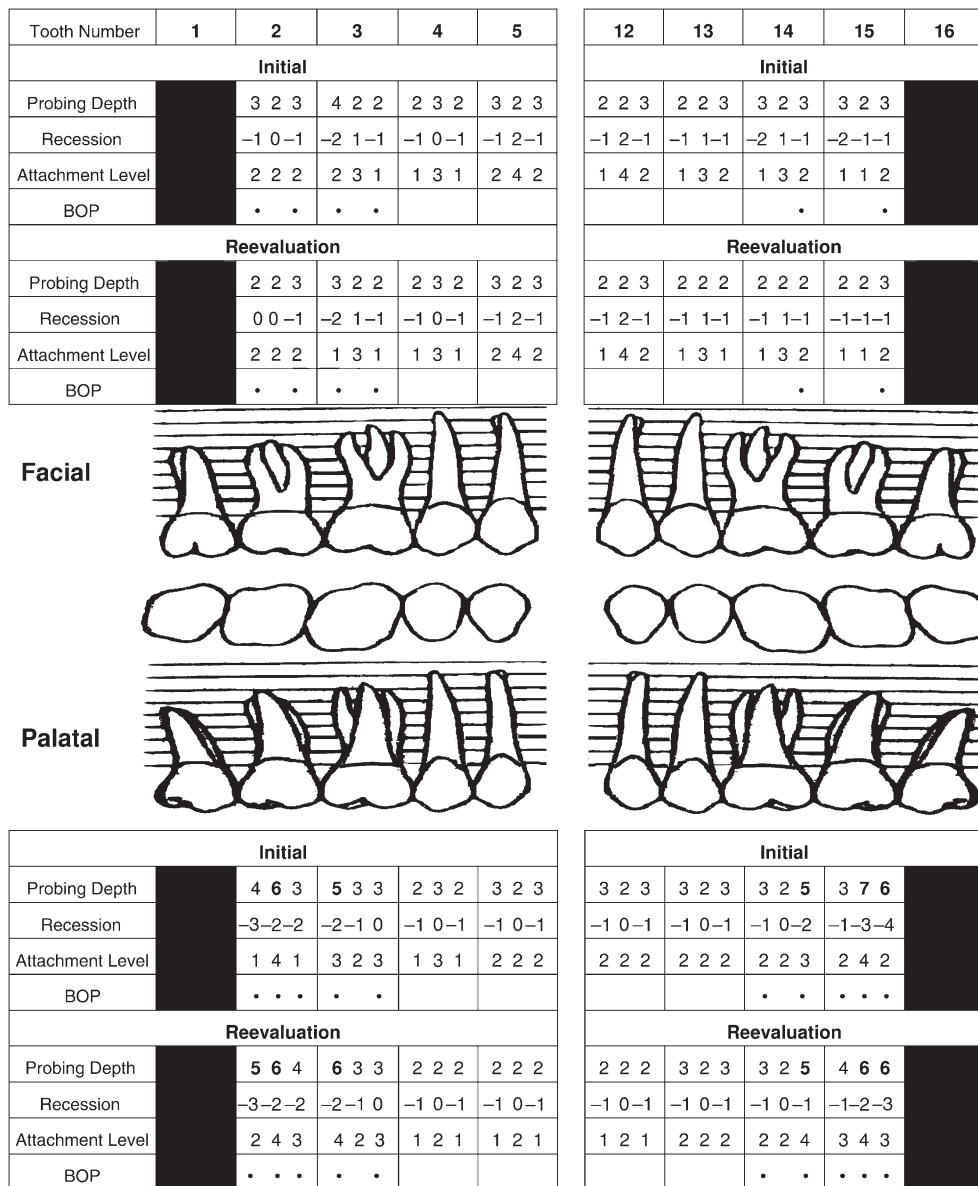
### **Reevaluation and Periodontal Surgeries**

At the reevaluation appointment, a generalized improvement was noted with a plaque index of 21% and an FMBS of 18%. However, probing depths at the maxillary molars remained deep, especially on the palatal side of tooth #15 (6 mm) because of, in part, the bulkiness of gingival tissue in the area (Figs. 1 and 3). As a result, surgical interventions of right and left maxillary posterior sextants were recommended with the aim of

achieving access and pocket elimination.

### **Surgical Phase**

Surgery was performed in the maxillary left quadrant in July 2009 and in the maxillary right quadrant in September 2009. After the flaps were reflected under local anesthesia, an enamel projection was found on the palatal root of tooth #15 measuring 4 mm apically from the CEJ (Fig. 4). The location of this enamel projection was consistent with the area of the deepest probing depth and bone sounding. The palatal alveolar bone had a small infrabony defect surrounding the projection. Furthermore, there appeared to be a concavity on the palatal root apical to the enamel projection; thus, the possibility of two palatal roots could not be ruled out. The surgical site was thoroughly debrided, and flaps were reapproximated and sutured. The enamel projection was not removed because it was fully exposed. A similar surgical approach was adopted in the maxillary right sextant where an enamel projection was found in a symmetrical location on the palatal root of tooth #2 but on a smaller scale (Fig. 5). The surgeries resulted in the resolution of periodontal inflammation, pocket reduction to a maintainable level ( $\leq 4$  mm), and the exposure of CEPs. The patient is currently on a 3-month periodontal maintenance recall and planning on dental implant therapy to replace her missing mandibular teeth.



**Figure 3.** Baseline and reevaluation periodontal chartings. BOP = bleeding on probing. Dots indicate the presence of BOP on a specific site. Boldface numbers indicate sites where the probing depths were  $\geq 5$ mm.

**DISCUSSION**

Studies on CEPs and enamel pearls are summarized in Tables 1 and 2, respectively.

**Association Between CEPs and Periodontal Disease**

Masters and Hoskins<sup>7</sup> were the first to suggest the association of the CEP with periodontal disease. They also classified the projections into three grades based on the location of adjacent CEJs and furcations, which are still widely used today. Grade I indicates a short but distinct change in the contour of the CEJ extending toward the furcation, Grade II designates when the

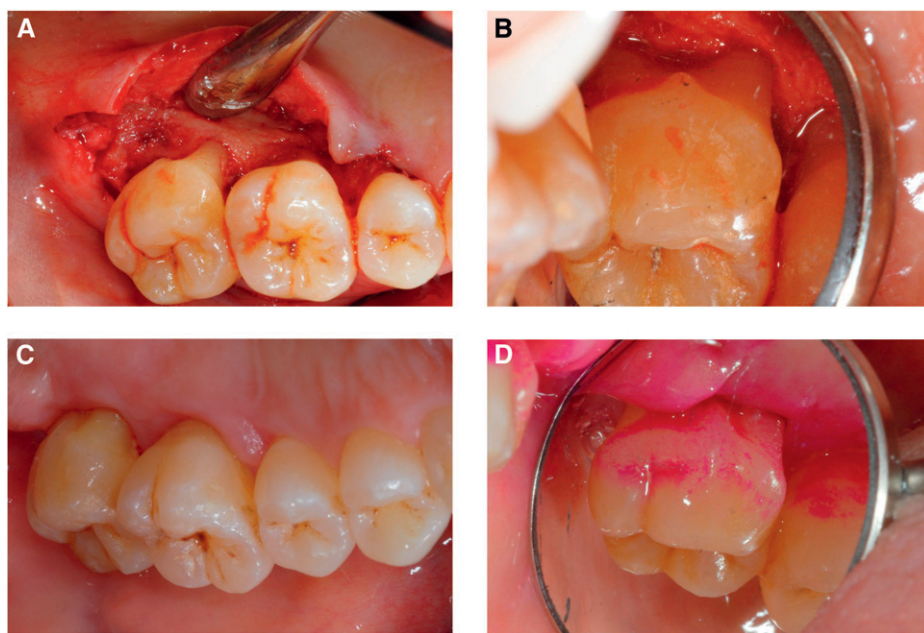
CEP approaches the furcation without making contact with it, and Grade III denotes that the CEP extends into the furcation. Most studies<sup>2-5,9,18,22</sup> agree with Masters and Hoskins<sup>7</sup> on the positive association between CEPs and furcation involvement except those by Leib et al.<sup>6</sup> and Zee et al.<sup>10</sup> These conflicting results could be attributed to small sample sizes and the differences in methodologies.

Grewe et al.<sup>3</sup> found a statistically significant relationship between periodontally involved molars and CEPs. Bissada and Abdelmalek<sup>2</sup> reported that ~50% of teeth with CEPs had furcation involvement. Similarly, Hou and Tsai<sup>4</sup> examined 719 molars with periodontal disease and reported that 82.5% of teeth with CEPs had furcation involvement. In that study,<sup>4</sup> a higher grade of CEP was significantly associated with a higher degree of furcation involvement. Swan and Hurt<sup>8</sup> evaluated 2,000 molars from 200 Indian skulls and found only Grade II and III CEPs to be significantly associated with furcation involvement, suggesting that Grade I CEPs do not always need to be removed.

Enamel pearls were associated with localized periodontitis in some case reports.<sup>23-25</sup> The most common location of enamel pearls was on the proximal surfaces of maxillary molars where localized periodontal destruction was found. Because of the low prevalence of enamel pearls, these case reports<sup>23-25</sup> provide the only available evidence implying an association between enamel pearls and periodontal disease.

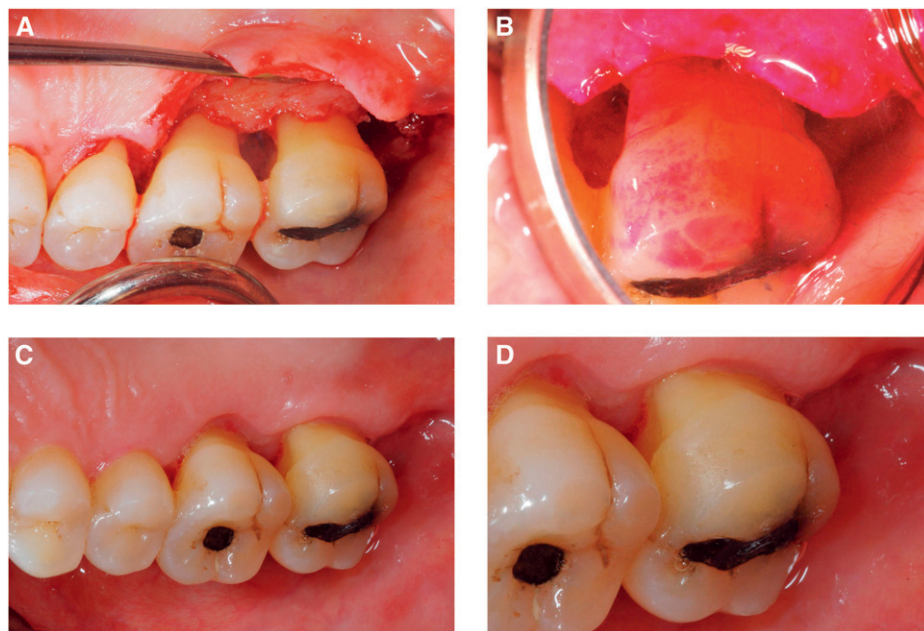
**Possible Pathogenesis**

Connective tissue cannot form an attachment to enamel.<sup>26</sup> Instead, the junctional epithelium is present in these areas and consists of hemidesmosomes



**Figure 4.**

Clinical photos at surgery (A and B) and 1 month after surgery (C and D) on the maxillary left sextant depicting a pronounced enamel projection on the palatal root of tooth #15. A disclosing agent was used for better contrast in D.



**Figure 5.**

Clinical photos at surgery (A and B) and 1 month after surgery (C and D) on the maxillary right sextant. The photos depict an enamel projection on the palatal root of tooth #2. D is a magnification of C. A disclosing agent was used for better contrast in B.

and basal lamina. As a result, when enamel forms on roots, it may predispose the area to increased probing depths in the presence of gingival inflammation. Goldstein<sup>15</sup> described this attachment as a “locus minori resistente” and hypothesized that this form of attachment would constitute an area of less resistance to plaque-associated inflammatory degradation. Together with its plaque retentive nature, ectopic enamel might enhance periodontal breakdown.

**Treatment**

Ectopic enamel removal is generally recommended during periodontal surgeries to allow new attachment to form.<sup>15</sup> One study<sup>27</sup> showed that mandibular molars with Class II furcation involvement and CEPs could achieve similar results when enamoplasty/odontoplasty was performed as compared to those without CEPs using various surgical modalities. Machtei et al.<sup>18</sup> found that, although CEPs were associated with deeper probing depths at baseline, teeth with CEPs gained more attachment after enamoplasty/odontoplasty in conjunction with guided tissue regeneration procedures than teeth without CEPs that received the same surgical approaches. However, the removal of ectopic enamel may have disadvantages in that the development of dentin hypersensitivity is a possibility. In the present case, the CEPs were not removed because they were fully exposed after surgery, thus avoiding any potential hypersensitivity.

**CONCLUSIONS**

Recently, two cases of composite enamel pearls occurring bilaterally at identical sites involving multiple molars in two female siblings were reported, suggesting the possibility of a hereditary association.<sup>28</sup> CEPs were most likely found on the

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**Table I.**  
**Studies on CEPs**

Reference	Sample Size	Study Population	Prevalence of CEPs	Prevalent Site	Degree of Furcation Involvement	Association With Furcation Involvement
Grewe et al. <sup>3</sup>	5,230 extracted molars	United States	Mandibular molars: 25.2% Maxillary molars: 15.8%	Mandibular second molar	Significant association between furcation involvement and presence of CEP.	Yes
Leib et al. <sup>6</sup>	270 and 301 extracted molars*	United States	Mandibular molars: 25.4% Grade I: 78.8% Buccal surfaces: 72% Maxillary molars: 21.9% Grade I: 70% Buccal surfaces: 68.4%	Mandibular second molar	25% with CEP had furcation involvement. 22.9% without CEP had furcation involvement.	No
Bissada and Abdelmalek <sup>2</sup>	1,138 molars in skulls	Egyptian	8.6%	Mandibular second molar	50% with CEP had furcation involvement.	Yes
Swan and Hurt <sup>8</sup>	2,000 molars (200 skulls)	Asian Indian	32.6% molars	Mandibular second molar	Grade II and III CEP were significantly associated with furcation involvement.	Yes (Grade II and III)
Hou and Tsai <sup>4</sup>	719 molars (78 patients)	Taiwanese	67.9% individuals 45.2% molars	Mandibular first molar	82.5% with CEP had furcation involvement. 17.5% with CEP had no furcation involvement. 53.7% with Grade I, 83.1% with Grade II, 97.5% with Grade III CEP had furcation involvement.	Yes
Hou and Tsai <sup>5</sup>	87 hopeless mandibular molars (Class III furcation involvement)	Taiwanese	85%	Mandibular first molar	Deeper mean probing depth and more attachment loss in molars with CEP.	Yes
Machtei et al. <sup>18</sup>	37 mandibular molars (Class III furcation involvement)	Israeli	82.1%	Data not available	Most Class II furcation involvements had CEP. CEP had deeper probing depths.	Yes
Zee and Bratthal <sup>9</sup>	834 molars (133 dry skulls)	Eskimo	72%	Mandibular second molar	Significant association between CEP and furcations.	Yes
Zee et al. <sup>10</sup>	78 molars (30 patients)	Scandinavian	42%	Data not available	No significant association between CEP and furcations.	No

\* A total of 270 molars for the prevalence exam and 301 molars for the correlation exam.

buccal surfaces of molars,<sup>2,10</sup> and enamel pearls were most likely found on the mesial or distal surfaces of molars.<sup>12,13</sup> In the present case report, the two enamel projections were more or less symmetrically located on the palatal roots of maxillary secondary molars, which, to our knowledge, is a location never documented in the literature. The periodontal involvement was mild in this patient elsewhere except where the enamel projections were found at the time of the surgery, which was associated with moderate periodontal destruction. This finding supports a possible hereditary cause for ectopic enamel projection. In addition, the enamel projection as a contributory

anatomical factor in the progression of localized periodontal disease is substantiated. The surgeries resulted in the resolution of periodontal inflammation, pocket reduction to a maintainable level, and the exposure of CEPs. It is important to recognize the role that local anatomic factors play in disease progression, which can be further elucidated by additional research in this field.

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**Table 2.**  
**Studies on Enamel Pearls**

Reference	Sample Size	Prevalence	Prevalent Site
Risnes <sup>12</sup>	8,854 extracted molars	2.28%	Maxillary third molar
Darwazeh and Hamasha <sup>13</sup>	819 dental records	1.6%	First molar

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