

Long term radiographic study of bilateral second premolars with immature root treated by apexogenesis and apexification

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A ten-year-old girl broke the central cusps of the mandibular second premolars. The mandibular right second premolar was treated with apexification and the left with apexogenesis. These methods were chosen in view of the presented clinical symptoms, radiographic findings, and outcome of bacterial cultures of root canal samples. At postoperative 2 years 8 months, disappearance of the focus, closure of the root canal, and formation of the root apex were observed in both mandibular premolars. The mandibular left second premolar demonstrated a nearly normal root formation and root apex morphology. Immediately beneath the extracted pulp, regular, uniform, and thick hard tissue was formed. Meanwhile, in the mandibular right second premolar, root growth was suspended, making the root short, and the contour was constructed in such a way that it encircled the distal apical area from the mesial side forming the root apex.

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INTRODUCTION

Dens evaginatus is an anomalous tooth development arising during morphodifferentiation.¹ It is caused by abnormal proliferation of the inner enamel epithelium into the stellate reticulum of the enamel organ.^{2,3} Prevalence ranges from 1 to 4%.⁴ Dens evaginatus occurs predominately in mandibular premolars.^{5,6} The occurrence is five times more frequent in the mandible than in the maxilla.⁷ Frequently, attrition or trauma to the tubercle may lead to pulp exposure with subsequent pulp infection.⁸⁻¹⁰ During pulpal treatment for an immature permanent tooth with an immature root, it is well known that the healing mor-

phology of the apical area is greatly affected by the technique employed.^{11,12} We treated a case in which pulpitis was induced by breakage of the central cusp of the permanent second premolar with an immature root, which gave rise to acute apical periodontitis in an identical oral cavity.

The method for treatment was selected in view of clinical and radiographic findings, as well as results of culturing of bacterial samples from the root canal. Radiographic and clinical observations during the course of treatment revealed interesting findings.¹

CASE REPORT

The subject was a 10-year 8-month old girl, who came to us on December 7, 1998, after noticing cold pain and occlusal pain in the area of the second premolar the day before.

An oral examination revealed bilateral fracture of the central cusp of the second premolars in the mandible. In addition to cold pain, percussion pain was also demonstrated. A fistula had formed in the distal apical area of the right second premolar and drainage was also seen.

The treatment and medication (material used for temporary root canal filling) were selected in view of clinical findings and radiographic findings (of the focus and root developmental stage), as well as results of bacterial cultures of samples taken during the root canal. Treatment was given under infiltration anesthesia. The mandibular left second premolar was treated under

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Figure 1. Mandibular left second premolar before treatment. The root is completed to about two-thirds of the root length. The apical area has opened widely like a trumpet and opacity is increased in the surrounding area.



Figure 2. Mandibular left second premolar before treatment. Immediately after extracting the pulp in the center with a Zipperer reamer, the root canal was temporarily filled with Calcipex.



Figure 3. Mandibular right second premolar. The root is completed to the same extent as that of the mandibular left second premolar. Radiolucency can be seen around the distal end of the root apex showing abscess formation.



Figure 4. Mandibular right second premolar. After extracting the pulp in the direction of the distal apical end with an engine reamer, the root canal was temporarily filled with and confirmed by a point radiographic examination.



Figure 5. Mandibular left second premolar, radiographic taken 9 months after treatment. Root formation has advanced from the mesiodistal root apex, making the contour distinct.



Figure 6. Mandibular right second premolar 2 days after treatment. The contour of the apical end is being formed as Hertwig's epithelial sheath on the mesial apical end becomes elongated.

rubber dam dry field technique by apexogenesis using a partial pulpectomy with Calcipex for medication. Apexification was done to the mandibular right second premolar using Vitapex. The premolars were regularly observed radiologically to confirm healing and root formation (apical stop). Treatment was completed with permanent root canal filling and restoration by gutta-percha. Her prognosis has been favorable at the time of this report (Figures 1 - 14).

DISCUSSION

Pulpal infection is induced by occlusal trauma in the

central cusp and often requires endodontic treatment.⁸⁻¹⁰ However, there is no known report that includes long-term follow-up findings of a case that received endodontic procedures such as apexogenesis and apexification for pulpal infection due to bilateral mandibular fractures of the central cusps in immature permanent teeth.

In the present patient, we considered that acute pulpitis might be induced in the mandibular left second premolar, while induction of acute suppurative apical periodontitis in the mandibular right premolar as a result of fracture of the central cusp was also likely. For



Figure 7. Mandibular left second premolar, radiographic taken 15 months after treatment. An apical stop is confirmed.



Figure 8. Mandibular right second premolar, radiographic taken 9 month after treatment. The contour line of the root apex has become more definite and radiolucency around the root has disappeared.



Figure 9. Mandibular left second premolar, radiographic taken 16 month after treatment. After confirming the apical stop, permanent root canal filling was performed using soft gutta-percha (Obtura II system).



Figure 10. Mandibular right second premolar, radiographic taken 16 month after treatment. An apical stop is confirmed.



Figure 11. Mandibular left second premolar. After root canal filling was performed, the inlay was restored.



Figure 12. Mandibular right second premolar. Permanent root canal filling was performed using soft gutta-percha (Obtura II system), after which the inlay was restored.

treating the affected teeth, apexogenesis using a partial pulpectomy was done for the mandibular left second premolar, because the inflammation was mild and had not spread to the apical pulp. For medication, Calcipex, a calcium hydroxide preparation that possesses constant antibacterial activity and shows an affinity to the tissue along with excellent hard tissue formation potential, was used as a temporary root canal filling. Meanwhile, apexification was performed for the mandibular right second premolar in expectation of bone healing of the apical periodontal tissue, because we considered that inflammation might spread to the apical pulp, as a fistula had formed with a small amount of drainage around the distal apical area of the buccal side root.

During the treatment, pulpal tissue was selectively

extracted from around Hertwig's epithelial sheath on the mesial apical side, in an area that reached around the distal apical area of the buccal side root where the fistula was observed. For medication, Vitapex was used for temporary root canal filling, as it is mainly consists of a calcium hydroxide preparation that demonstrates strong bacteriocidal properties and iodoform and Vitapex induced hard tissue closure of the coronal area in previous reports.^{13,14} The results of bacterial cultures of samples taken during the root canal performed after the pulpectomy procedure revealed that the degree of infection corresponded with the clinical evaluation of both second premolars of the bilateral mandible. Later, disappearance of the foci, root canal closure (confirmation of apical stop), and root apex formation were con-



Figure 13. Mandibular left second premolar, radiographic taken 2 year 8 month after treatment. The root is seen completed in a nearly normal condition. The periodontal membrane space and lamina dura have become definite. The inside of the root canal from immediately beneath the root canal filling material to the root apex has been replaced by opacity. The trabecula around the root can also be clearly seen.



Figure 14. Mandibular right second premolar, radiographic taken 2 year 8 month after treatment. The root has completed its shape and is slightly shorter than a normal root. The periodontal membrane space and lamina dura are reproduced and have become definite. Radiolucency can be observed in the root apex and a part of the mesial side of the root, with the contour seen encircling it. Root apex formation has entered the final stage, with the trabecula around the root clearly outlined.

firmed during regular radiological observations. Further, radiographic findings at 8 months 2 years after the procedure revealed a significant difference in root length and root apex morphology, as well as the morphology of the hard tissue immediately beneath the extracted pulp between the 2 premolars.

The mandibular left second premolar demonstrated a nearly normal root formation and root apex morphology. Immediately beneath the extracted pulp, regular, uniform, and thick hard tissue was formed. Meanwhile, in the mandibular right second premolar, root growth was suspended, making the root short, and the contour was constructed in such a way that it encircled the distal apical area from the mesial side forming the root apex. We considered that these differences in healing morphology might be greatly affected by endodontic treatment technique suitable for the pathology and preservation of the pulp tissue around active Hertwig's epithelial sheath as much as possible to enhance reproducibility of the tissue.

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