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Case Report

The usefulness of three-dimensional imaging for prognostication in cases of intentional tooth replantation

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Abstract: This paper describes the utility of three-dimensional (3D) images obtained with cone beam computed tomography (CBCT) for prediction of successful clinical outcome in two cases of intentional tooth replantation (IR). IR was performed for teeth affected by vertical root fracture and root perforation with local application of blood clot and oxy-tetracycline antibiotic. High-resolution 3D images demonstrated no evidence of ankylosis, but did reveal the presence of alveolar bone regeneration, suggesting a good long-term prognosis. Our observations in these cases suggested that local application of the above two materials might help to induce the regeneration of lost periodontal tissues in IR. (J Oral Sci 54, 355-358, 2012)

Keywords: intentional replantation; blood clot; oxy-tetracycline; 3D images.

Introduction

Intentional tooth replantation (IR) should be considered as a last treatment option for preservation of natural dentition in situations where other treatment procedures would probably fail. The indications for performing IR include teeth with vertical root fracture, procedural accidents such as root perforation, and refractory apical periodontitis that is unresponsive to conventional root canal treatment (1-3).

In recent years, 4-META/MMA-TBB resin (Super Bond C&B, Sun Medical Co., Shiga, Japan), which has good sealing ability and biocompatibility, has been used as an adhesive material (2,4).

Various studies have reported that application of growth factors such as platelet-rich plasma (PRP), enamel matrix derivative (EMD), and blood clots at surgical sites might promote tissue regeneration, including bone formation, in periodontal defects (5,6). The antibiotic oxy-tetracycline might also be therapeutically useful for retarding pathologic breakdown of periodontal tissue.

The main causes of failure in cases of IR are said to be external root resorption and ankylosis caused by damage to the periodontal ligament. Therefore, intentional replantation of vertically fractured roots or perforated roots after reconstruction with 4-META/MMA-TBB resin has included the application of a blood clot and oxy-tetracycline.

Conventional intraoral radiographs do not always provide sufficient information for detecting the presence of root resorption and ankylosis, or for revealing evidence of bone regeneration because of the superimposition of adjacent tissues in 2D images. Recently, CBCT has been widely used in various fields of dentistry, as it is capable

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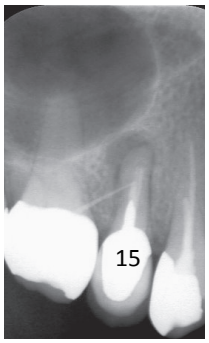

Fig. 1 Pre-treatment conventional intraoral radiograph of the right maxillary second premolar shows expansion of the periradicular lesion.

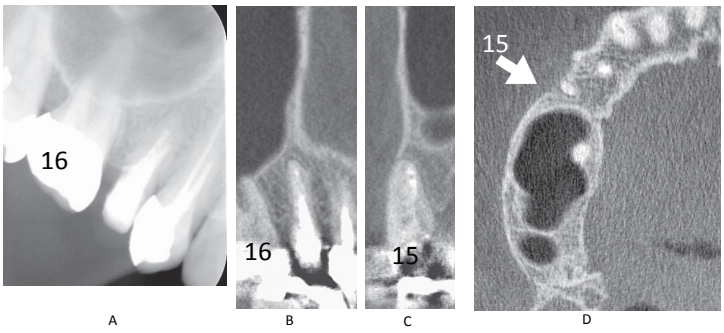

Fig. 2 Twelve months after the operation.
(A) Conventional intraoral radiograph of the right maxillary second premolar shows osseous healing of the peri-apical radiolucency.
High-resolution 3D images; (B) Coronal image of the right maxillary second premolar. (C) Sagittal image of the second premolar shows regeneration of alveolar bone around the affected root. (D) Axial image of the second premolar shows regeneration of alveolar bone around the affected root (arrowed).

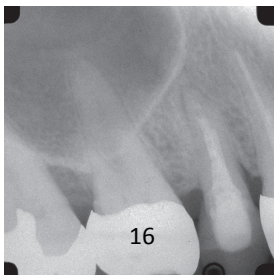

Fig. 3 Conventional intraoral radiograph taken 41 months after replantation.

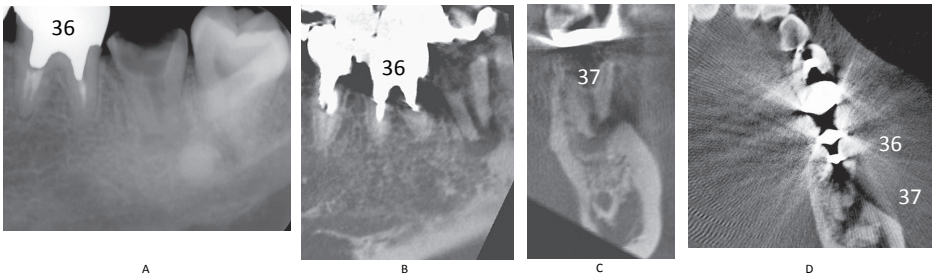

Fig. 4 Pre-treatment images.
(A) Conventional intraoral radiograph of the left mandibular second molar shows expansion of the periradicular lesion.
High-resolution 3D images; (B) Sagittal image of the left mandibular second molar shows expansion of the periradicular lesion. (C) Coronal image of the left mandibular second molar shows expansion of the periradicular lesion. (D) Axial image of the left mandibular second molar shows expansion of the periradicular lesion.

of producing detailed, high-resolution, 3D images of oral structures (7,8).

Here we report the utility of high-resolution 3D images obtained using CBCT for prediction of successful clinical outcome in two cases of IR.

Case Report

Case 1

A 45-year-old woman was referred to the periodontic clinic of Kyushu University Hospital for assessment of a fistula on the buccal gingival of the right maxillary second premolar, which was causing slight persistent pain when the tooth was used for biting. Her medical history was non-contributory and she reported no allergies or medication use. She had undergone endodontic and prosthetic treatment of the right maxillary second premolar seven years earlier. Periodontal examination revealed a 7-mm probing depth in the distal pocket of the second premolar and an intraoral fistula on the buccal side of the tooth. There was no tooth mobility. When an accessory gutta-percha point was inserted into the sinus tract, intraoral radiography showed that the tip had not reached the apex, but only the middle part, of the second premolar root. The lesion had expanded along the distal side of the root of the second premolar, revealing a radiolucent area around the middle part of the root (Fig. 1). These findings led us to speculate that a vertical root fracture might be present.

The patient's oral hygiene condition was good. We explained the benefits and risks of replantation as a treatment procedure, and thereafter the patient made an informed decision to undergo IR.

The treatment procedures were carried out under local anesthesia. A flap operation was performed on the tooth. After reflection of the flap, the fractured tooth was gently

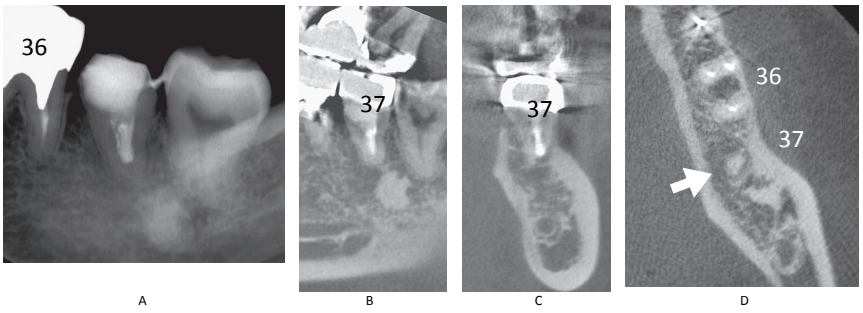

Fig. 5 Twenty months after the operation.
(A) Conventional intraoral radiograph of the left mandibular second molar shows osseous healing of the peri-apical radiolucency.
High-resolution 3D images; (B) Sagittal image of the left mandibular second molar shows regeneration of alveolar bone around the treated root. (C) Coronal image of the left mandibular second molar shows regeneration of alveolar bone around the treated root. (D) Axial image of the left mandibular second molar shows regeneration of alveolar bone around the treated root (arrowed).

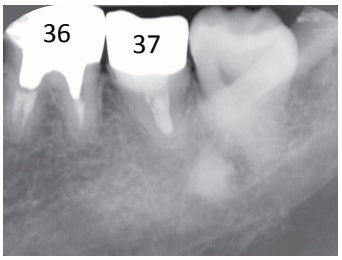

Fig. 6 Conventional intraoral radiograph taken 30 months after replantation.

extracted to cover the periodontium. The fracture line was identified by microscopy on the distal side of the root. The socket walls were curetted and rinsed with sterile saline solution to remove granulation tissue and debris. The granulation tissue on the surface of the fractured root was entirely removed under microscopic observation. 4-META/MMA-TBB resin was used to seal the crack after preparation of the fracture line. Oxy-tetracycline was then locally applied to the socket before it was filled with a blood clot. Thereafter, the reconstructed tooth was replanted into the original socket as carefully as possible to minimize any traumatic occlusal force. The tooth was stabilized using 4-0 silk suture, and the flap was then repositioned and sutured. A periodontal pack was used as a semi-rigid splint because a certain degree of mobility should be allowed during initial periodontal healing. The patient returned 7 days later for suture removal. Thereafter, the replanted tooth was splinted to the adjacent teeth with 4-META/MMA-TBB resin for one to two weeks to reduce its mobility and minimize any possible traumatic occlusal force.

Clinical and radiographic follow-up has continued. The reconstructed tooth shows no radiographic evidence of root resorption or ankylosis (Fig. 2A-D). In addition, bone regeneration around the affected root was observed even on 3D images 12 months after the IR procedure (Fig. 2D, arrowed).

The patient has remained clinically asymptomatic, with normal occlusal function, for 41 months after the IR procedure. Periodontal probing has been within normal limits. Radiographic examination has revealed osseous healing of the peri-apical radiolucency (Fig. 3).

Case 2

A 35-year-old woman was referred to the periodontic clinic of Kyushu University Hospital for assessment of a fistula on the buccal gingiva of the left mandibular second molar. She complained of pain on biting. Her medical history was non-contributory, and she reported no allergies or medication use. She had undergone root canal treatment of the tooth in question 10 years earlier. Her oral hygiene was good, and periodontal examination revealed slight mobility, with a probing depth within normal limits. The affected tooth was tender to percussion and biting. Conventional intraoral radiography demonstrated previous root canal treatment with a large periapical radiolucency. In addition, sagittal and coronal CT images revealed a large periapical radiolucency associated with the root perforation site in the left mandibular second molar (Fig. 4A-D). IR was performed after obtaining the patient's informed consent for therapy, as this case involved a large periapical lesion with a fistulous tract that had not resolved after conventional root canal treatment. The treatment procedure was similar to that used in case 1. A root perforation cavity was prepared and sealed with 4-META/MMA-TBB resin.

Clinical and radiographic follow-up was continued for 20 months after IR, during which time the replanted tooth remained functional and clinically asymptomatic. Periodontal probing was within normal limits, and there was no mobility. Currently, the treated tooth shows no radiographic evidence of root resorption or ankylosis on the lingual or labial surfaces (Fig. 5A-D). Bone regeneration around the affected root was observed even on 3D images (Fig. 5D, arrowed). At the 30-month recall, periapical healing around the root was observed radio-

graphically (Fig. 6).

Discussion

Numerous cases of IR showing a good clinical outcome have been reported, although other procedures, including dental implantation, have higher success rates and more predictable outcomes (1-3). However, the success of IR, in combination with techniques to shorten extraoral working time and minimize the trauma of extraction to preserve the periodontal ligament seems to rely on the maintenance of aseptic conditions and local application of growth factors such as PRP, PDGF, and EMD, which have been reported to be critical for reliable tissue regeneration in periodontal surgery (5,6). Blood clots also act as a growth factor that can promote tissue healing and regeneration. The antibiotic oxy-tetracycline is thought to reduce inflammation caused by bacteria and to inhibit collagenase and osteoclastic activity.

In the present cases, the reconstructed teeth were neither mobile nor tender to percussion, and probing depths were within normal limits. In addition, high-resolution images showed osseous healing of radiolucency around the treated root. These results suggest that the good clinical outcomes we observed were attributable to local application of the above two materials, which might have helped to maximize the healing potential of the residual tissues through maintenance of aseptic conditions and regeneration of tissue that had been lost in the circumferential periodontal defects surrounding the affected teeth. In addition, high-resolution 3D images obtained with CBCT appear to be very effective for detecting root resorption and ankylosis, and for revealing evidence of bone regeneration on the labial or lingual surface of roots that might otherwise be overlooked when relying on 2D images obtained by conventional intraoral radiography, in which buccal and palatal structures are superimposed (7,8). The absence of ankylosis and the presence of bone regeneration demonstrated by radiography suggested a good long-term prognosis.

In conclusion, CBCT was shown to be a valuable diagnostic tool at various stages of treatment in the two present cases of IR. Local application of blood clots and oxy-tetracycline might be desirable in order to promote tissue regeneration in the circumferential periodontal defect. However, further long-term studies of treatment outcomes are needed in order to understand the possible impact of IR procedures on tissue healing and alveolar bone regeneration.

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