CASE REPORT

# Intentional Replantation of a Second Premolar with Internal Resorption and Root Fracture: A Case Report

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## Abstract

**Aim:** This case aims to detail intentional replantation as a last resort to save an otherwise hopeless premolar with perforated internal resorption and root fracture.

**Background:** Internal root resorption, progressive destruction of intraradicular dentin, is a condition that sometimes renders a tooth non-restorable. In the rare cases reported where severe internal resorption leads to root fracture, extraction of the tooth seemed to be a common treatment of choice, and a few literatures had reported endodontic surgery as an alternative treatment option. To date, there had been no report of treating internal root resorption using intentional replantation.

**Case description:** A 20-year-old male presented swelling at the buccal region of his left maxillary second premolar (#13). Clinical examination revealed a sinus tract and fractured dens evaginatus at the occlusal surface of the tooth. Radiographically, a large area of radiolucency was detected within the middle third of the root, where root fracture was present, leaving a triangular-shaped mature root apex. The condition was diagnosed as internal root resorption and root fracture. Endodontic surgery was excluded from treatment choices due to potential damage of periodontal bone. Instead, intentional replantation was performed, with the application of biomaterials including mineral trioxide aggregate (MTA) and platelet-rich fibrin (L-PRF). The tooth achieved satisfactory healing and remained asymptomatic after 2 years of follow-up.

**Conclusion:** The successful outcome of the case suggests that intentional replantation could preserve a fractured tooth caused by internal root resorption. Incorporated application of biomaterials, such as MTA and L-PRF, might as well improve the chances of saving this otherwise hopeless tooth.

**Clinical significance:** Through careful planning and execution, intentional replantation is a viable alternative treatment option to preserve a fractured tooth caused by internal root resorption, while leaving periodontal bone architecture almost intact.

**Keywords:** Biomaterials, Intentional replantation, Internal resorption, Root fracture.

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## Background

Internal root resorption is the progressive destruction of intraradicular dentin and dentinal tubules along the middle and apical thirds of the canal walls as a result of clastic activities.[1] Asymptomatic at early stages, internal resorption can hardly be detected without radiological examinations.[2] However, clinical signs, such as pain and swelling, can be noticeable when internal resorption develops to advanced stages.[3] In extreme cases, resorption perforates the root canal system, and the tooth becomes susceptible to fracture.[4]

When the defect of internal root resorption is limited to the root canal, root canal treatment (RCT) is the treatment of choice by arresting the destructive process of internal resorption.[2] When internal resorption perforates the external root surface, endodontic surgery has been suggested as the treatment of choice.[5] However, surgical endodontics involves removing a significant amount of cortical bone, which might compromise periodontal prognosis.[6]

Intentional replantation is a clinical technique in which atraumatic tooth extraction is performed followed by extraoral endodontic manipulation and subsequent reinsertion of the extracted tooth.[7] It has been reported in the treatment of periodontally compromised teeth, external root resorption,[8] dental trauma,[9] periapical periodontitis,[10] and root fractures.[11] In comparison to endodontic surgery, intentional replantation does not involve extensive removal of cortical bone, which is beneficial for the preservation of periodontal bone. Therefore, intentional replantation could be considered as a last resort to conserve a fractured tooth caused by internal resorption whilst preserving periodontal architecture. In our search of the literature, to date, there has been no report describing intentional replantation in the treatment of perforated internal resorption.

Here, we report the successful application of intentional replantation in saving an otherwise hopeless premolar with perforated internal resorption and root fracture, with the help

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of biomaterials including mineral trioxide aggregate (MTA) and leukocyte and platelet-rich fibrin (L-PRF).

## Case Description

A 20-year-old man was referred to the Department of General Dentistry, West China Hospital of Stomatology (Sichuan University, China), presenting swelling at the buccal region of the left maxillary second premolar (#13). The patient stated that swelling and occasional pus discharge at the current site had been observed recurrently for around 5 years. No specific medical, familial, and psychosocial history were reported.

Clinical examination revealed a sinus tract with pus discharge at the buccal region of tooth #13 (Fig. 1A). A fractured dens evaginatus was observed at the occlusal surface of the tooth. The tooth showed slight discoloration but had no caries or fillings (Fig. 1B). The tooth was not tender to percussion or palpation, nor did it respond to thermal and electrical pulp testing. The probing depth of the tooth was normal.

A periapical radiograph of the tooth revealed a large area of radiolucency extending from the pulp chamber to the middle third of the root, where a midroot fracture was present. A large radiolucent area was also noted periapically, enclosing a radiopaque object which resembled a pivoted root apex fragment (Fig. 1C). Cone-beam computed tomography (CBCT) imaging revealed a radiolucent tunnel beginning at the occlusal surface of the tooth that extends to the pulp chamber. It grew wider along the long axis of the tooth till the point of root fracture, followed by a high-density cone-shaped object surrounded by circumscribed bone rarefaction (Figs. 1D and E). Based on these findings, the lesion was preliminarily diagnosed as pulp necrosis and chronic apical abscess with internal root resorption and root fracture.

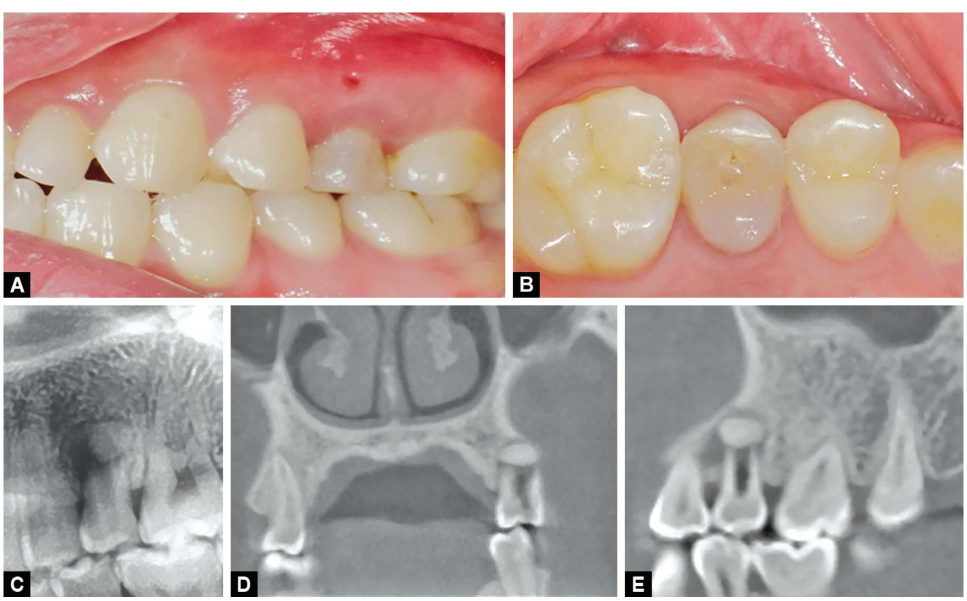
The optional treatment plans were tooth extraction followed by dental implantation, RCT followed by endodontic surgery, and RCT followed by intentional replantation.

After being advised of the risks and benefits, the patient expressed his interest in dental implantation, but could not afford it at the time of consultation. Thus, he chose RCT followed by intentional replantation to retain a partially functional tooth at the current stage while retaining the damage to periodontal bone architecture at a minimum, to create more feasible bone architecture for potential dental implantation in the future.

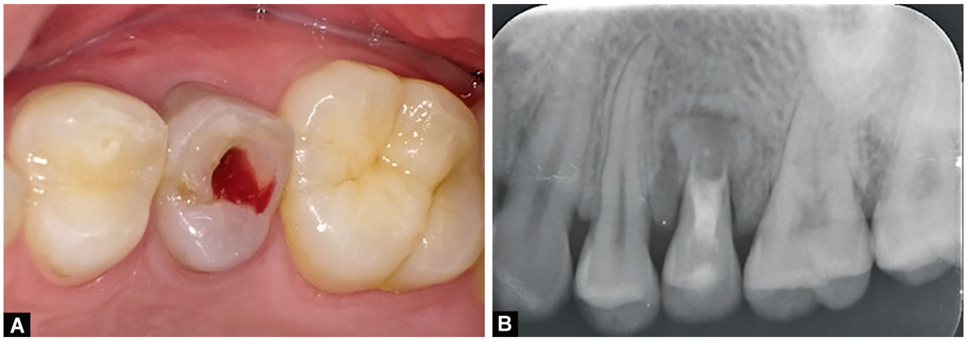
Root canal debridement and disinfection were performed. Disinfecting the apical lesion through the root canal would to a certain extent reduce the inflammatory condition, and improve the prognosis of subsequent intentional replantation of the tooth. At the 14-day follow-up of the root canal procedure, the degree of inflammation appeared mitigated, and the sinus tract had disappeared. However, bleeding exudates were still observable from the perforation of the pulp cavity (Fig. 2).

The intentional replantation of the tooth was performed afterward. Before the surgery, an L-PRF clot was prepared using 20 mL of blood collected from the median cubital vein of the patient (Fig. 3A). After local anesthesia, tooth #13 and the apical fragment were removed (Figs. 3B and 3C), and a definitive diagnosis of root fracture was made by histopathological examination which revealed that the fragment was a fractured root apex (Fig. 3D). Following tooth extraction, the periapical lesion was removed. We curetted the most apical portion of the socket, while avoided curettage of the socket walls, to protect the remaining periodontal ligament (PDL). The socket was then copiously irrigated with sterilized saline and the cavity of the curetted lesion was filled by an L-PRF clot.

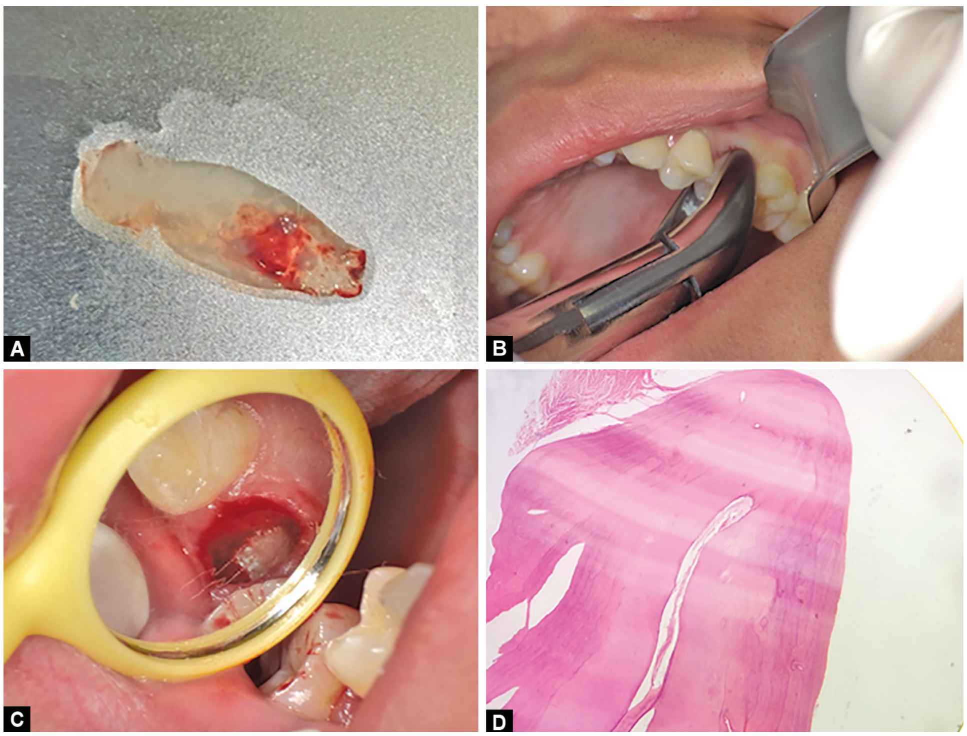
The extraoral manipulation included root canal cleaning and reverse obturation. During the procedure, utmost care was taken to protect the root surface so as not to damage the attached PDL. The root was held using a sterilized cotton wool ball moisturized by saline (Fig. 4A). The canal was irrigated with 2.5% sodium hypochlorite NaOCl activated by ultrasound, followed by copious saline irrigation to remove remaining calcium hydroxide dressing.



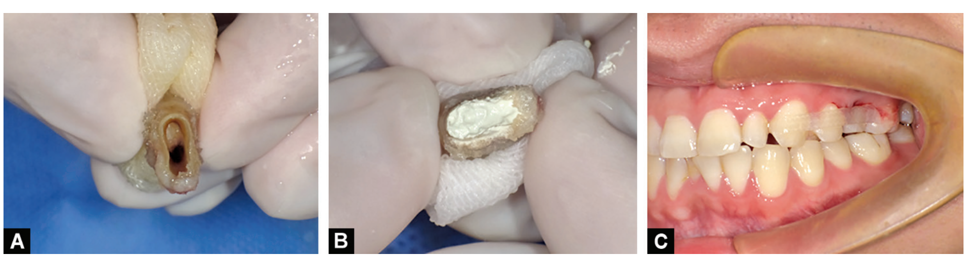

**Figs 1A to E:** (A) A sinus tract with pus discharge at the buccal region of tooth #13; (B) A fractured dens evaginatus at the occlusal surface of tooth #13; (C) Preoperative periapical radiograph; (D) Cone-beam computed tomography (CBCT) sagittal image; (E) CBCT coronal image



**Figs 2A and B:** (A) Bleeding exudates after RCT; (B) Periapical radiograph after RCT



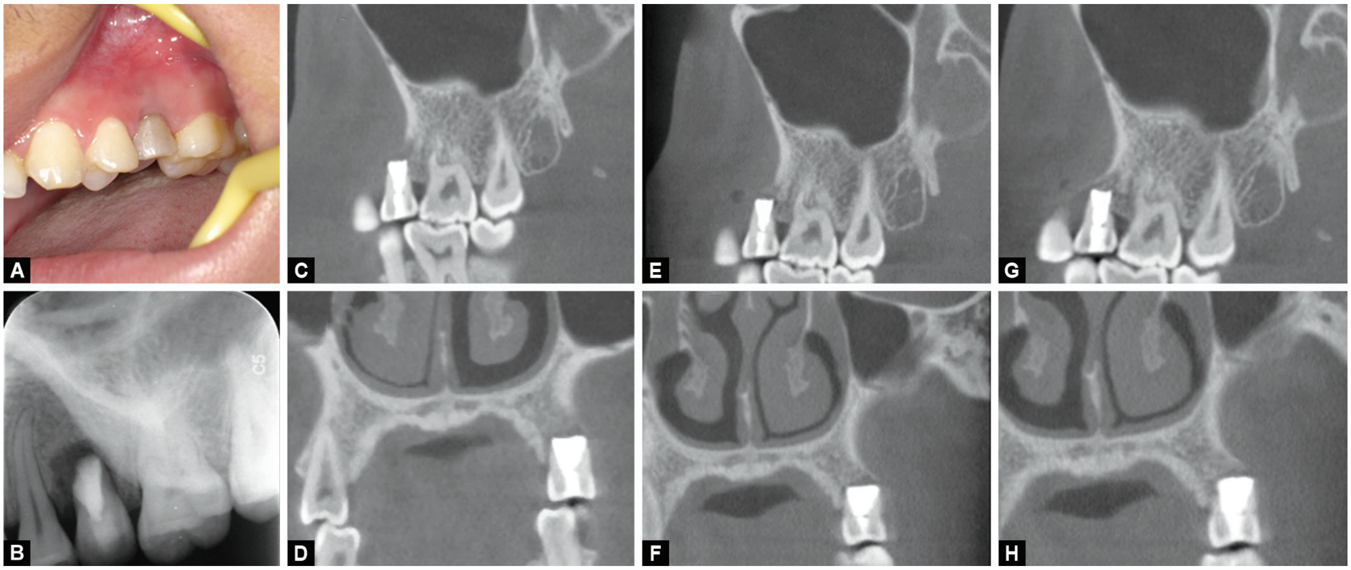
**Figs 3A to D:** (A) L-PRF clot; (B) Atraumatic extraction of tooth #13; (C) Fractured root apex observed through extraction socket; (D) Histopathological examination of the root apex of tooth #13



**Figs. 4A to C:** (A) Root was gently held using a sterilized cotton wool ball moisturized by saline; (B) Reverse root canal obturation by MTA; (C) Fiber splints after replantation

The NaOCl irrigation was done cautiously to avoid rinsing the root surface. Afterward, glass-ionomer cement was then filled into the access cavity for restoration. The root canal was subsequently reversely obturated with MTA up to the cementoenamel junction (CEJ) (Fig. 4B).

After extraoral manipulation, the tooth was gently replanted into its original position. The whole procedure was done as quickly as possible, within less than 15 min. Finally, the tooth was splinted using fiber splints to adjacent teeth for 2 weeks (Fig. 4C).




**Figs. 5A to H:** (A) Two-week clinic follow-up; (B) Periapical radiograph at 2-week follow-up; Sagittal and coronal CBCT image at (C, D) six-month follow-up; (E, F) One-year follow-up; (G, H) Two-year follow-up, respectively

Follow-ups were made at 2 weeks, 1 month, 6 months, 1 year, and 2 years from the last procedure. At a 2-week follow-up when the splints were removed, the patient became free of clinical symptoms, such as swelling or exudates, while the replanted tooth #13 showed class II mobility (Fig. 5A). At a 4-week follow-up, tooth mobility turned class I and the periapical radiograph showed a decrease in radiolucency around the tooth (Fig. 5B). The patient continued to remain asymptomatic till the 6-month follow-up when the replanted tooth showed no mobility, no metallic sound upon percussion, or excessive periodontal probing depth. Radiographically, successful bone healing was suggested by increased radiopacity at the preoperative periapical lesion site (Figs. 5C and D). At one-year and two-year follow-up, radiographic examination showed satisfying results. No sign of further root resorption or ankylosis was observed (Figs. 5E to H).

## Discussion

This case report describes the treatment of a maxillary premolar with internal resorption and root fracture using intentional replantation. The follow-up lasted for 2 years after treatment, which seemed sufficient to indicate a positive long-term prognosis, as most complications of intentional replantation occur within 1-year post-replantation,[12] including ankylosis and replacement resorption. Furthermore, as the patient might undergo dental implantation in the future, the replanted tooth, even under ankylosis or replacement resorption scenario,[13] would still help to maintain the size and volume of the alveolar ridge, creating a more feasible environment for dental implantation.

The tooth, in this case, displayed a widened root canal radiographically, which somewhat showed similarity to the characteristics of an immature tooth with an open apex. Our diagnosis was internal resorption instead of an immature tooth for the following reasons. First, Oishi[11] and Saoud et al.[14] had reported cases of an immature tooth with an open apex associated with root fracture. In their cases, the fractured roots were ring-shaped. In contrast, the fractured root apex in our case appeared to be cone-shaped, both by preoperative CBCT and histopathological examinations, which was coherent to a previous case of internal resorption with fractured root apex reported by Mohan et al.[15] Furthermore, we observed a slim trail of root canal from the fractured root apex, implying complete maturation of the root, which was highly unlikely seen in situations with an open apex.

To date, RCT had been widely reported as the treatment of choice for internal root resorptions.[1] In cases where the resorptive lesion appeared to be inaccessible, Nilsson et al. reported endodontic surgery to be an alternative approach.[5] In our case, high-density debris existed apical to the tooth treated, which was impossible to be removed through conventional RCT. Meanwhile, it was also challenging to achieve satisfactory root canal sealing by surgical endodontics given how wide the apical opening of the root canal was connected to the periodontal lesion. Besides, endodontic surgery involved extensive removal of cortical bone, which might jeopardize the stability of periodontal bone architecture.

Considering the potential prognosis and costs of the different treatment modalities, intentional replantation was opted. It was a technique previously reported in treatment of the avulsed tooth,[9] external root resorption,[8] and root fracture,[11] with an average survival rate of as high as 88%.[7] Unlike previous reports where intentional replantation was done in a single operation visit,[8,9,11,16] we disinfected the root canal and applied $Ca(OH)_2$ two weeks prior to the replantation surgery. This approach aimed at controlling the inflammatory condition at the apical area of the tooth. An inflammatory periodontal environment, especially with the presence of a sinus tract, would appear hazardous for the prognosis of the replanted tooth. Our early treatment through root canal had successfully eliminated the sinus tract and provided us with a less inflammatory periodontal environment, which would favor bone regeneration.[17–19]

In the present case, a lot of care was taken to preserve the vitality of the PDL cells. Duration of the extraoral manipulation was minimized within 15 min, based on the consensus that less extraoral time helped preserve PDL vitality, to reduce the chances of ankylosis after replantation.[20] The operations were done by two experienced operators. While one operator was preparing the extraction socket, the other performed root canal cleaning and root-end filling of the tooth, during which the root surface was constantly remoisturized by saline to avoid desiccation. A low concentration NaOCl solution was used for root canal irrigation to protect PDL from cytotoxicity.[21–23] Furthermore, NaOCl irrigation was done under a surgical microscope, with the tooth held vertically, to avoid unwanted contact of the disinfectant with the remaining PDL.

Historically, amalgam was used to fill the root-end preparations and perforations. In recent studies, alternative filling materials, such as super ethoxybenzoic acid (SuperEBA), MTA, glass ionomer, and calcium silicate cements, were reported.[7] MTA was an ideal filling material in the present case, given its bactericidal properties, compatibility, and bioactivity by promoting cementum formation and PDL regeneration.[24–26] However, certain drawbacks related to MTA filling required to be overcome. First, MTA contained bismuth oxide,[27,28] which could react with collagen and consequently form greyish discoloration.[29,30] To avoid discoloration of the crown, we filled MTA from the root end up to CEJ only. Second, it took around 3 h for MTA to completely set.[31] In contrast, the extraoral manipulation lasted no longer than 15 min in the present case, time duration far shorter than setting time of MTA. To prevent MTA from leaking through the midroot opening, we placed biocompatible L-PRF beneath the replanted tooth as a scaffold to accommodate unsetting-MTA. L-PRF was an autologous and biodegradable matrix of fibrin with favorable mechanical properties.[32] Besides providing mechanical support to MTA, L-PRF could also release growth factors to facilitate bone and soft tissue regeneration,[33] and help microbial killing to prevent post-operative infection.[34] Thus, L-PRF served as an ideal scaffold material in our case for its rigidness, osteogenic potential, and antibacterial property.

The major risk of the current treatment modality was fracture of the weakened root caused by previous internal root resorption or endodontic failure caused by leakage of unset MTA. However, the tooth remained its post-operative integrity and showed convincing signs of healing by 2 years of follow-up.

## Conclusion

Intentional replantation is a viable alternative treatment option to preserve a fractured tooth caused by internal root resorption while leaving periodontal bone architecture almost intact. Incorporated application of biomaterials, such as MTA and L-PRF, as well improve the chances of saving this otherwise hopeless tooth.

## Clinical Significance

Through careful planning and execution, intentional replantation can serve as an alternative treatment option for internal resorption in cases when RCT alone could not produce satisfactory outcomes.

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