CASE REPORT

Retreatment of a Failed Regenerative Endodontic Treatment in an Immature Tooth with a Horizontal Root Fracture: A Case Report

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Abstract

Regenerative endodontic treatment (RET) has been suggested for the treatment of traumatized necrotic immature teeth. There are only a few reports of using RET to treat a horizontal root fracture. The aim of this paper is to describe successful regenerative retreatment in a tooth with a horizontal root fracture and dens invaginatus.

A 9-year-old boy presented with a horizontal root fracture in a central incisor. Pulp necrosis and inflammatory root resorption were observed. The tooth was treated by RET, including calcium hydroxide dressing between visits. After bleeding was allowed into the canal space, a collagen plug was placed as a barrier, and covered by a bioceramic material. At the completion of treatment, the resolution of the radiolucent lesion was evident. During follow-up, the tooth exhibited recurrent pathology at the fracture line. The patient was scheduled for retreatment of the tooth. Repeated RET included additional ultrasonic irrigation and calcium hydroxide dressing. One year after the completion of retreatment, the periradicular lesion resolved with continued maturogenesis of the apical fragment and approximation of the coronal and apical fragments that were attached by a calcified tissue and surrounded by the continuous periodontal ligament.

Conclusion: This rare case report of retreatment after failed RET is notable for the repeated use of a regenerative procedure subsequent to a recurrent traumatic injury to the tooth. The repeated regenerative endodontic procedure (REP) resulted in the resolution of the periapical lesion and the reunion of the apical and coronal fragments.

Clinical significance: Failure of an already successful RET due to a recurrent traumatic injury may be successfully treated by repeating the RET, particularly when the alternative treatment option is extraction.

Keywords: Case report, Failure, Horizontal root fracture, Immature tooth, Regenerative endodontics, Reunion.

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Introduction

Horizontal root fractures (HRF) affect approximately 1% of permanent teeth. This rare injury involves the cementum, dentin, and pulp.[1] The maxillary central incisors are particularly prone to HRF.[2] Three healing types may be expected: healing by hard tissue, interposition of connective tissue, or healing with bone and connective tissue. Nonhealing is defined as the presence of granulation tissue between root fragments and necrotic pulp, usually with the widening of the gap between the fragments.[3]

Regenerative endodontic treatment (RET) has been suggested for the treatment of traumatized necrotic immature teeth.[4,5] The expected treatment outcomes are the resolution of signs and symptoms, root elongation and widening of the dentinal walls, and a positive response to sensibility testing.[6,7]

Only a few case reports describe the use of RET for treating HRF.[8,9] Following this procedure, one tooth showed healing by calcified tissue, while the other showed a combination of fibrous and hard tissues.[8] Failed RET can be successfully treated by either apexification, conventional root canal treatment, or repeated RET.[10]

This case report describes a successful repeated regenerative treatment for an incisor with dens invaginatus and an HRF after the reemergence of the periapical lesion that had already healed at the end of the initial RET.

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Case Description

A 9-year-old healthy boy was referred for treatment following extrusion of the right central maxillary incisor 4 days prior to his arrival. One day after the trauma, the teeth were splinted, using a flexible metal splint, and the boy was prescribed amoxicillin 400 mg twice daily for 1 week. Upon arrival, a clinical examination revealed

an uncomplicated crown fracture. The tooth exhibited sensitivity to percussion and palpation, displaying class I mobility despite the splint and negative response to sensibility tests.

Radiographic examination revealed dens invaginatus type II,[11] a wide root canal, mid-root horizontal fracture, and a large radiolucency between the fragments and signs of inflammatory root resorption (Fig. 1). The patient's parents declined a cone beam computed tomography (CBCT) scan due to concerns about unnecessary radiation exposure for their young child. The diagnosis for the coronal fragment was pulp necrosis and symptomatic apical periodontitis, while the apical fragment was considered vital. RET was planned because of the wide and thin-walled canal in the short coronal fragment. Informed consent for the procedure was obtained from the parents.

The procedure was performed in accordance with the American Association of Endodontists (AAE) guidelines for RET.[12] At the first visit, following local anesthesia with 3% mepivacaine without a vasoconstrictor (Mepvastesin™, 3M ESPE, Seefeld, Germany) and rubber dam isolation, the dens invaginatus was removed. The canal was debrided using K-files up to the fracture line, irrigated with 1.5% sodium hypochlorite, dried with paper points, and dressed with calcium hydroxide (Metapaste; Meta Biomed, Chungbuk, South Korea). The access cavity was sealed with Fuji Triage (GC Corporation, Leuven, Belgium).

The patient was scheduled for treatment in 2 weeks due to inflammatory root resorption. At the second appointment, repeated dressing of the root was done.

Six weeks later, the tooth was asymptomatic. Following mepivacaine infiltration and rubber dam isolation, the temporary filling was removed. The canal was irrigated with 20 mL of 17% ethylenediaminetetraacetic acid (EDTA) and normal saline. A pre-bent #20 K-file was inserted beyond the coronal fragment to stimulate bleeding into the canal space. CollaPlug (Zimmer Biomet, Florida, United States) was placed on top of the blood clot, followed by a plug of EndoSequence® BC RRM™ (Brasseler, United States). The access cavity was sealed with Fuji Triage. At this stage, it was observed that the periapical lesion had already healed (Fig. 2).

The tooth remained symptom-free at the 3-month follow-up, but class I mobility persisted. Radiographic examination revealed apical radiolucency that reemerged after RET completion (Fig. 3). Considering the unfavorable prognosis of the tooth, attributed to the poor crown-to-root (coronal fragment) ratio, the patient was scheduled for retreatment of the tooth. Informed consent was obtained from the patient's parents after explaining the prognosis of the tooth and alternative treatment options, which included extraction. During the next visit, the tooth was isolated with a rubber dam. After gaining access the bioceramic plug was removed, and disinfection of the canal was repeated using 1.5% sodium hypochlorite. To enhance the biomechanical preparation, we performed additional ultrasonic irrigation (Satelec Acteon, United States) for 3 minutes before

Fig. 2: Completion of the REP—a 5 mm bioceramic plug in the middle of the canal. The access cavity is sealed with Fuji Triage glass ionomer restorative material. Upon completion of the regenerative procedure, normal bone can be observed around the coronal part of the root. A small fracture line can be seen in the middle of the incisal edge

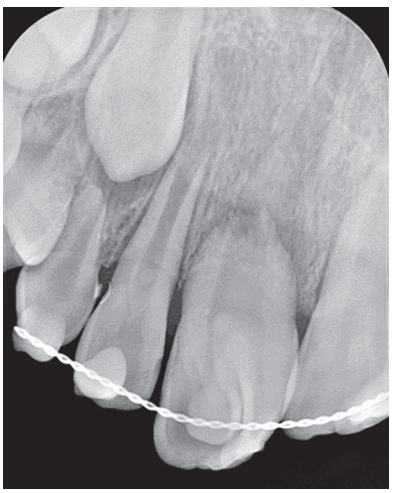

Fig. 1: Diagnostic radiograph—dens invaginatus* class I can be observed extending to the coronal third of the root. Notice the wide root canal with signs of inflammatory root resorption on the distal aspect of the root. A horizontal root fracture separates the apical third of the root from the coronal part

Fig. 3: Three-month follow-up radiograph—reemerging disease can be observed at the apical end of the coronal fragment of the root 3 months after completion of the REP. The apical and coronal fragments are separated by a 3 mm wide gap

Fig. 4: One-year follow-up—complete resolution of the radiolucent lesion. The coronal and apical fragments are connected by a calcified tissue. The continued maturogenesis of the apical fragment of the root. A continuous periodontal ligament surrounds the root. Bone-like tissue occupies the pulp canal space in the coronal fragment, and pulp canal obliteration is observed in the apical fragment

applying intracanal medication with calcium hydroxide. The access cavity was sealed with Fuji Triage. Six weeks later, the second phase of the RET was repeated, in the same procedure described above.

One year after RET, complete healing of the radiolucent lesion is observed. The gap between the coronal and apical fragments of the root has reduced significantly. Fusion of the coronal and apical fragments that were attached by a calcified tissue was seen. A continuous periodontal ligament surrounded the root fragments (Fig. 4). Bone-like tissue was observed in the coronal fragment's pulp space, and the apical fragment exhibited continued development. The tooth did not respond to sensibility tests.

Discussion

Failures of RET have been attributed to persistent infection[13] and inadequate root canal disinfection without mechanical debridement.[14] Histologic analysis demonstrated bacterial biofilm on the canal walls.[5] The current case report presents a RET failure in a tooth with dens invaginatus, combined with traumatic dental injury. In a recently published systematic review, 39% of the failures were identified 2 years after completion of the procedure. Fifty nine percent of the failures were following dental trauma and 30% occurred in teeth with dens invaginatus. A second RET was used in only three cases after the radiolucent lesion did not heal (5%).[9] However, a meta-analysis of 455 teeth undergoing RET showed no significant correlation between etiology (dens invaginatus, trauma, or caries) and successful regeneration.[15]

Healing of the radiolucent lesion was observed at the end of the regenerative treatment, after 8 weeks of calcium hydroxide dressing (Fig. 2). Rapid healing of periapical lesions in children was already observed in several case reports[16–18]: a large radiolucency surrounding the mandibular incisor teeth in a 12-year-old boy, treated 5 years after trauma, has resolved completely after only 3 months. Calcium hydroxide was used as the intracanal medicament and was replaced weekly for 6 weeks.[16] Healing of periapical lesions in four molar teeth in 10–13-year-old patients was observed as early as immediately after the dressing period or after a 3-month follow-up.[17]

In the current case, it was noted that a new lesion had appeared during the 3-month follow-up. It was reported that failures are detected within 3 weeks and up to 8 years after the initiation of RET.[19] Hence, it is necessary to conduct a prolonged follow-up after RET.

Failure of an already healed lesion has been attributed to the reconstitution of a persistent bacterial infection after a temporary reduction in the bacterial load[7] or as a result of recurrent traumatic injury. In a study of 534 incisor teeth after root fracture, a secondary luxation injury was reported in 47 teeth.[3] Indeed, signs of fracture at the incisal edge (Fig. 2) were indicative of recurrent trauma, which might have contributed to the bacterial infection.

Due to the thin dentinal walls and unfavorable crown-to-root ratio, extraction was the only alternative option. Additional ultrasonic irrigation was performed during the treatment to compensate for the lack of mechanical debridement and disrupt any bacterial biofilm, which may have left residual bacteria in the canal.[2,9]

In a study of RET in immature permanent teeth better results were observed in younger patients (9–13 years of age) and in teeth with an apical diameter larger than 1 mm compared to older patients and a smaller apical diameter.[19] The favorable outcome reported can be attributed to the patient's young age and the large canal diameter at the fracture line.

The formation of hard tissue adjacent to the fracture line is usually a characteristic of the healing of immature teeth after horizontal root fracture and is likely due to the high healing capacity of the pulp.[3] Bone ingrowth was observed in the pulp space of the coronal fragment after 1 year. Considering the initial diagnosis of pulp necrosis, it may be assumed that the bone-like tissue that was found in the root canal in the current case report is the result of the regenerative procedure.[20] Fusion between the fragments is also more typical of immature teeth that heal after HRF without complications.[3] Therefore, in the case reported above, it can be the result of the recovery of pulp cells after the RET.

During follow-up, complete healing and continued maturation of the apical fragment were observed, fulfilling the aims of RET, despite negative sensibility test results.[21] It may be suggested that a tooth with a large bioceramic plug in the canal would not elicit any response during a cold test. Similar findings were observed in a study that described the outcome of RET in traumatized incisors. All teeth survived at the 12-month follow-up, but none of them responded to sensibility tests, despite a successful RET.[4] However, opposing results were found in 86% of immature necrotic teeth that were treated with RET, and showed a positive response to sensibility tests. Nonetheless, the authors observed that initial positive response was faster in teeth treated with a platelet pellet, platelet-rich plasma, or platelet-rich fibrin as scaffolds than after the induction of a blood clot.[22]

To the best of our knowledge, this is the first report of successful retreatment following a horizontal root fracture that had already healed and failed again, probably due to recurrent traumatic injury. When a regenerative procedure fails, repeating the procedure should be considered a viable treatment option.

Clinical Significance

Failure of an already successful RET due to a recurrent traumatic injury may be successfully treated by repeating the RET, particularly when the alternative treatment option is extraction.

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