

Treating Vertical Root Fracture Using Plasma-Rich Fibrin: A Case Report

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Abstract

Regenerative Endodontic Procedures (REP) are used to treat apical periodontitis in immature necrotic teeth and promote root maturation. Recently, REP has been speculated to arrest inflammatory external root resorption. Herein, we report the complicated treatment of apical root fracture using Plasma-Rich Fibrin (PRF) in a 12-year-old boy with a history of trauma to the right maxillary central incisor. The tooth was diagnosed to have necrotic pulp accompanied by symptomatic apical periodontitis and was treated with REP using PRF as a scaffold and restored. The tooth was asymptomatic at the 9-month follow-up; however, a sinus tract was detected on the buccal side. Retreatment was performed, and the tooth was filled with an apical plug of mineral trioxide aggregate and gutta-percha. Following the root canal, an apicoectomy was performed. During the surgery, a Vertical Root Fracture (VRF) was detected on the lateral aspect of the root extending to the middle third. The surface of the fracture was cleaned meticulously with a high-speed fine round diamond bur. The VRF was covered with PRF mixed with autologous bone. A follow-up at 57 months revealed a symptomless functioning tooth. This case highlights the importance of making every acceptable effort to preserve a hopeless tooth with VRF in a youngster for a few years and thereby preserve the surrounding alveolar bone.

Keywords: Apicoectomy • External inflammatory root resorption • Mineral trioxide aggregate • Regenerative endodontics • Plasma-rich fibrin • Vertical root fractures

Introduction

Recently, Regenerative Endodontic Procedures (REP) have become an accepted and popular treatment option for immature teeth with apical periodontitis [1, 2]. REP has been recommended by many authors as the treatment of choice for immature teeth with necrotic pulp [3, 4]. Most reported cases of REP have shown positive clinical outcomes such as healing of the periapical area, lengthening and widening of the root canal walls, and apical closure [5-7].

The most common reason for REP failures is persistent infection [4, 8-10]. Discoloration of the tooth and problems in achieving a

stable blood clot scaffold following REP have also been reported [11-15]. However, to the best of our knowledge, REP failure due to Vertical Root Fracture (VRF) has not been reported before.

Herein, we present a case of failure of REP due to a late diagnosis of apical VRF, which required a complicated treatment, and describe the outcomes of a long-term follow-up. As the actual cause of the late failure could not be clinically established, we performed root canal retreatment followed by

apicoectomy to determine the etiology of failure and remove the infected tissue, thus prolonging tooth survival.

Case Presentation

A 12-year-old healthy boy was referred to the office for treatment of the right maxillary central incisor that had undergone trauma several years ago. No further details regarding the past trauma were obtained from the parents. Clinical examination revealed normal soft tissue (Figure 1a), negative vitality test result for 11th tooth, and sensitivity to palpation.



Figure 1a. Clinical picture of the tooth and surrounding tissue.

The tooth was tender on percussion, and the mobility test results were normal. Radiographic examination revealed a wide root canal space, with a wide-open apex facing distally. A periapical radiolucency of 5-mm diameter was observed (Figure 1b).



Figure 1b. Diagnostic periapical radiograph

Pulp necrosis with symptomatic apical periodontitis was diagnosed. The parents were provided treatment options of apexification or REP, and they chose REP. Informed consent was obtained from the parents on behalf of the patient. The patient was treated using a surgical operating microscope (LaboMed, Prima, NY, USA). At the first visit, tooth isolation and access

opening were performed. The root canal was irrigated with 3% NaOCl, dried, and dressed with calcium hydroxide for 2 weeks. At the subsequent visit, the access cavity was reopened under local anesthesia (lidocaine 2% 1:1000000 epinephrine; Safco, IL, Buffalo Grove, USA). The root canal was irrigated, as described above, and a mixture of Triple Antibiotic Paste, which consists of equal parts (250 mg each) of the following three antibiotics: metronidazole (Sanofi-aventis, France), cefuroxime axetil (Zinnat, GSK, UK), and ciprofloxacin (Dexcel, Israel), was placed in the canal for a period of 3 weeks. The antibiotic tablets were crushed and then dissolved in saline to achieve a creamy paste consistency, which was introduced into the root canal by Centrix AccuDose 20ga Needle Tubes (Shelton, CT, USA) and endodontic B&L pluggers (Biotech, Virginia, USA) to control the depth of insertion. The tooth was temporarily restored using an interim restorative material (IRM; Dentsply, Sirona, Germany). Examination at the third visit 3 weeks later revealed a symptomless tooth. Plasma-Rich Fibrin (PRF) was prepared using 40 mL of blood drawn from the patient's cubital vein on the right forearm. The Choukroun Duo Quattro PRF Centrifuge was used in this study. The blood was centrifuged for 8 min at 1300 rpm according to the manufacturer's instructions [16]. The patient was anesthetized with 3% mepivacaine without vasoconstrictors (Septodont, Ontario, Canada). Under rubber dam isolation, the temporary restorative material was removed, and the root canal was irrigated with 20 mL of 17% ethylenediamine tetraacetic acid and dried with paper points. PRF was cut into small pieces and inserted into the root canal using endodontic pluggers up to the cementoenamel junction. A resorbable collagen plug (Collagen Matrix, New Jersey, USA) was placed above the PRF and covered with a bioceramic material (Biodentine, Septodont, France). The access cavity was sealed with glass ionomer cement (Fuji IX GC, Tokyo, Japan; Figure 2a).



Figure 2a. Radiograph was taken upon completion of the regenerative endodontic procedure.

At the 4-month follow-up, the tooth was asymptomatic and tested negative on percussion and palpation. Radiography revealed a reduction in the size of the periapical radiolucency and thickness of the mesial root canal wall. Some calcified tissue was observed inside the root canal (Figure 2b). At the 9-month follow-up, a sinus tract was detected on the buccal side, with no other signs or symptoms (Figure 3a and 3b).



Figure 2b. A 4-month follow-up radiograph



Figure 3a. Clinical picture.



Figure 3b. A 9-month follow-up radiograph. Tracing with gutta-percha

Considering the treatment options, we decided to perform conservative root canal treatment (RCT) and seal the pathogenic perforation at the apical side of the root with bioceramic material, followed by apicoectomy. Under local anesthesia (lidocaine 2% 1:1000000 epinephrine; Safco, IL, Buffalo Grove, USA), the access cavity was reopened, and the root canal was rinsed with 3% NaOCl and dried with paper points. A mineral trioxide aggregate (MTA) plug (MTA; Angelus, Londrina, Brazil) was used to fill the perforation site. The apical end was obturated with TotalFill BC RRM (root repair material) (FKG Dentaire, Le Crêt-du-Loche, Switzerland) using a special spatula instrument of company G. Hartzell & Son Model no. CA6CH) (Jacksonville, Florida, USA), and the remaining root canal was obturated with gutta-percha using a vertical condensation technique (B&L pluggers) with BC Sealer (FKG Dentaire, Le Crêt-du-Loche, Switzerland). The access cavity was filled with composite material (3M CenterSt. Paul, M) (Figure 4).



Figure 4. Radiograph taken upon completion of the root canal.

Immediately after the RCT, a subperiosteal flap was raised. On exploration, a VRF was found extending from the apical area to the coronal third of the root (Figure 5a). Granulation tissue was removed with a surgical curette. The apical portion of the tooth, which showed partial resorption, was removed with a surgical bur (Figure 5a).



Figure 5a. Clinical picture of the root after raising a flap. The fracture line can be noticed on the buccal surface of the root.

The area of the VRF on the buccal surface of the root was gently cleaned with diamond bur and covered with allogeneous bone graft: freeze-dried bone allograft (German Institute for Cell and Tissue Replacement (DIZG), Koenicker Strasse 325, Berlin, Germany) and PRF membrane. The bone cavity was filled with the same material (Figure 5b).



Figure 5b: Clinical picture of the graft.

The flap was sutured using a slow-resorbing suture Neosorb (Medipac, Kilkis 61100, Greece). Follow-up examination after 57 months revealed a symptomless functioning tooth, complete healing of the periapical area, and a traceable periodontal ligament surrounding the entire root surface (Figure 6a).



Figure 6a. Radiographic examination at 57 months of follow-up. Complete healing of the periapical area and traceable periodontal ligament surrounding the entire root surface can be seen.

Discussion

REP is a common treatment method for immature necrotic teeth [17]. Nearly 100% complete periapical healing has been reported in the majority of the studies, with a high rate of tooth maturation, root widening and lengthening and even arresting of external inflammatory root resorption [18, 19]. The causes of failure of REP can be divided into three main categories: inability to get enough blood into the root canal or blood clot scaffold collapse tooth discoloration and lack of adequate root canal disinfection [4, 8-15].

In the present case, there were no reasons to suspect a VRF. At first, there were no signs. Sometimes, VRF is difficult to diagnose and thus often goes undetected even in Cone-Beam Computed Tomography (CBCT) examinations [20, 21]. The sinus tract was first observed after 9 months in our case. No other signs that could help diagnose the VRF were detected, and no relevant contributory factors from the parents regarding the nature of the trauma. VRF was detected during apicectomy, which explained the failure. It was assumed that inability to achieve proper disinfection enabled the embedded microorganisms to flourish in the narrow space of the VRF. Despite the known poor prognosis of treating a VRF, the treatment was completed, considering the child's young age, in an attempt to save the tooth even if for a few years until the boy completed his adolescence. Thorough curettage of the fracture line and using human cortical freeze-dried bone and PRF enabled us to overcome the infection for many years.

Early detection of VRF prevents unnecessary frustration, inappropriate endodontic treatment, and extensive damage to the supporting tissues. In the present case, the first sign of VRF was noticed 9 months after the REP. It is very rare to find VRF in young roots because of their thin walls, and such teeth tend to have more often cervical fractures than VRF. The detection of the sinus tract as an early sign of apical pathology led to surgery, which revealed the existence of VRF. This early detection helped avoid the massive bone loss encountered around a long-lasting untreated VRF and enabled the preservation of the tooth until today with a fair prognosis despite the fracture.

A similar case was described by Silva, wherein after surgically exposing the fracture, the fracture line was cleaned with an ultrasonic tip and filled with a composite resin, followed by continued treatment with five sections of low-power laser [22]. They used synthetic hydroxyapatite grafts to fill the bone cavity. The patient was followed up for 2 years, and no signs or symptoms were noted. Another case has been described by Pandey, wherein the fracture line was sealed with MTA cement [23]. In both these cases, the fracture line was widened prior to sealing. In the present case, no widening of the fracture line was performed, and meticulous cleaning of the superficial surface and sealing of the defect was performed with no further intervention, thus minimizing the damage to the root surface. The follow-up period in the present case was 57 months. Follow-up CBCT performed after 2 years demonstrated no pathology (Figure 6b). In further follow-ups, evaluation was performed using periapical radiographs to avoid the exposure of the patient to the high dose of radiation in CBCT.

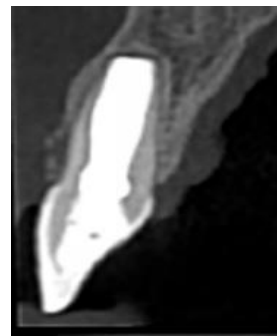


Figure 6b. Cone-beam computed tomography of the tooth at 24 months of follow-up.

Further research and better knowledge about alternative treatments for VRFs are required to provide a basis for more accurate and diagnostic evidence and enable more conservative treatment solutions and preservation of teeth.

Conclusion

All efforts should be made to save a natural tooth in young children when implants are not an option. Our treatment protocol included only

disinfecting the fracture line and using alograft and PRF membrane instead of foreign materials; this seems to be a promising approach for the treatment of VRFs.

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