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Endodontic Management of a Chronic Periapical Abscess in a Maxillary Central Incisor with an Immature Root Apex Using Platelet-Rich Fibrin: A Case Report

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ABSTRACT

Platelet-rich fibrin (PRF) has been used for several treatments in dentistry. The present study reports the clinical and radiographic outcomes of a root canal treatment of a necrotic immature maxillary central incisor using PRF. A 15-year-old female patient presented with a diagnosis of maxillary left central incisor pulp necrosis with open apex and periapical radiolucency and extraoral sinus tract. Two months after a two-visit root canal treatment using calcium hydroxide as a root canal dressing, no clinical symptoms were observed, and the previous sinus tract at the patient's nostril had completely disappeared. In the subsequent visit, the PRF was prepared and delivered into the root canal. The PRF layer was covered with collagen membrane and then sealed with white mineral trioxide aggregate. One year later, the patient remained asymptomatic. Radiological examination using cone beam computed tomography (CBCT) showed that the destructive buccal alveolar bone was completely repaired.

Keywords: Cone beam computed tomography, immature root apex, platelet-rich fibrin

HIGHLIGHTS

- This case report presents the successful management of necrotic immature tooth with periapical radiolucency by using PRF.
- PRF may be a potential biomaterial for necrotic immature tooth.
- Growth factors in PRF may promote apical hard tissue.

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INTRODUCTION

Root canal treatment of the teeth with immature roots is challenging (1). The main success criteria for the treatment are radiographic detection of apical closure of the root canal and absence of clinical signs and symptoms. One report has described the favourable clinical outcomes, resolving the infection and promoting root development of revascularization procedures (2). The outcome was assessed by clinical evaluation, sensibility tests, and radiological images. Recently, there has been an increasing interest in applying the concept of tissue engineering in endodontics. Tissue engineering is the science of design and manufacture of new tissue to replace that which is impaired or damaged (3). The key ingredients for tissue engineering are stem cells, morphogens, or growth factors that regulate their differentiation and a scaffold of extracellular matrix that constitutes the microenvironment for their growth (4).

The use of a suitable scaffold is crucial in tissue engineering. A proper scaffold motivates cell attachment, proliferation, migration, and differentiation (5). Scaffolds can be classified as artificial (synthetic) or natural. Natural scaffolds are usually more biocompatible and have the advantage of providing specific cell interactions (6).

Choukroun et al. (7) introduced PRF, which is a natural scaffold, derived from an autogenous preparation of concentrated platelets from human blood. It has been widely used in clinical dentistry as a reservoir for many kinds of cell growth factors. Several types of PRF were introduced with different properties. Leukocyte–platelet-rich fibrin (L-PRF) is a polymerized fibrin clot that contained a high quantity of platelets and leukocytes (8). PRF has been used for several treatments in dentistry, such as socket preservation, sinus lift, and bone grafting (8–12). Huang et al. reported that PRF can stimulate cell proliferation and differentiation on cultured primary dental pulp cells (13). Clinically, PRF shows a high recovery rate of the healing process

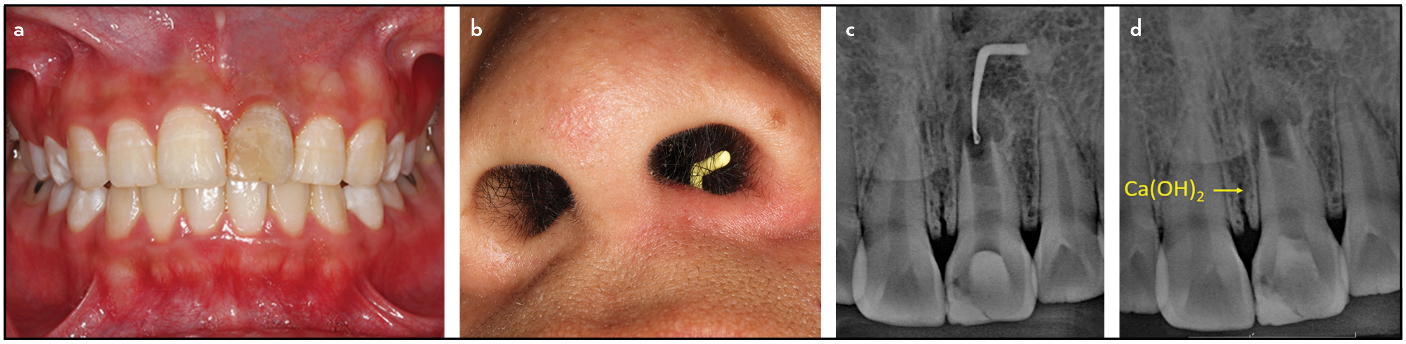

Figure 1. Extraoral photographs and initial radiographs. (a) Intraoral examination. (b) Sinus tract tracing from the nostril. (c) Radiograph of guttapercha tracing. (d) Radiograph of calcium hydroxide hard packing medication

in socket preservation after tooth extraction (11). This clinical report aimed to discuss the endodontic management of a necrotic maxillary central incisor with an immature apex using PRF.

CASE PRESENTATION

A 15-year-old female patient was referred to the dental hospital for endodontic management of a maxillary left central incisor with an immature apex. She had no history of allergy or medication. The patient was healthy. Her chief complaint was a toothache at the apical area of the maxillary left central incisor. The patient reported a yellowish secretion with a foul odor coming from the left nostril every morning. The tooth showed history of trauma. Clinical examination showed that the tooth had a large mesiobuccal composite restoration that has been lasting >5 years. The patient reported pain and swelling with recurrent exudates during those 5 years. A sinus tract was found in the left nostril above the apical area of the left maxillary central incisor. Radiographic examination using a gutta-percha point to trace the sinus tract revealed that the origin of the sinus tract was the root apex of the left maxillary central incisor (Fig. 1). The tooth did not respond to thermal and electric pulp tests.

On radiographic examination, the maxillary left central incisor showed an immature root apex with a diameter of >2.0 mm. Radiographic examination showed an incomplete root formation associated with a 6×8 mm circumscribed radiolucency around the root apex. The diameter of the apical foramen was approximately 3 mm mesiodistally. The maxillary left lateral incisor and right central incisors had intact crowns, normal root canals, and an intact lamina dura.

The soft tissue swelling at the apical area of the left maxillary central incisor was treated by opening the canal for drainage. A cone beam computed tomography (CBCT) scan (DentiiScan; NSTDA, NECTEC, Phahon Yothin, Thailand) was performed to examine the sagittal cross-section of the affected left central incisor. The CBCT scan showed a perforation of the buccal bone plate related to the tooth (Fig. 2). Based on clinical and radiographic findings, necrotic pulp with chronic apical abscess was diagnosed. After a comprehensive discussion of treatment options, potential risks, complications, and possible outcomes of the treatment, the decision was made to conduct a root canal treatment and regenerative endodontic therapy using L-PRF. The treatment was explained to the parent of the patient. Parental written consent was obtained.

Under local anesthesia using 2% lidocaine with 1:100.000 epinephrine, the maxillary left central incisor was isolated with a rubber dam. Access preparation was performed, and a single orifice with a wide canal was disclosed. A purulent exudate was observed in the pulp chamber and root canal. The canal was carefully and gently cleaned both mechanically and chemically using 0.9% normal saline, 5% sodium hypochlorite (NaOCl), and K-file #40 (Kerr, CA, USA). Freshly mixed calcium hydroxide paste was prepared and delivered to the canal with a lentulo spiral (approximately 1 mm short of the working length). A sterile cotton pellet was placed, and the access was sealed using Cavit (3M, MN, USA) and glass ionomer filling material (GI) (Vitrebond; 3M, MN, USA) The patient was scheduled for clinical evaluation and further treatment after 2 weeks.

At the second visit, the patient showed significant improvement, the sinus tract had disappeared, and the tooth was asymptomatic. The tooth was isolated with a rubber dam,

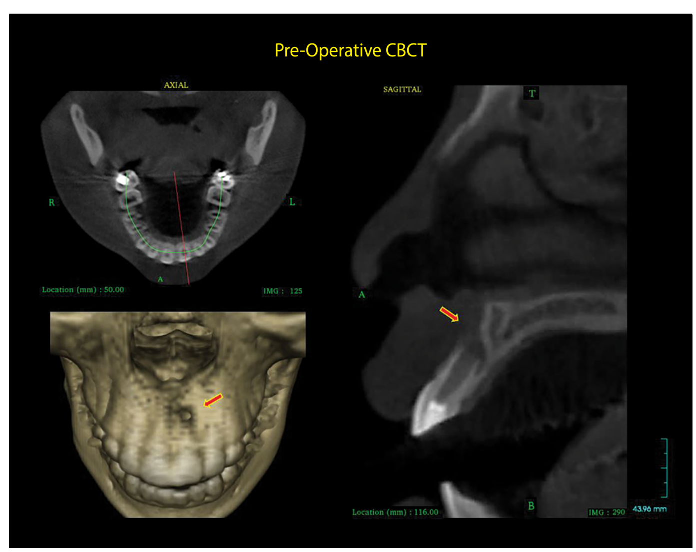

Figure 2. Preoperative CBCT. (a) Cross-sectional view with intersection transverse line on the midline of the left maxillary central incisor. (b) 3D reconstruction image indicates no labial cortical plate at the apical part of the root.(c) Sagittal view image reveals an open apex of the toot hand no labial cortical plate

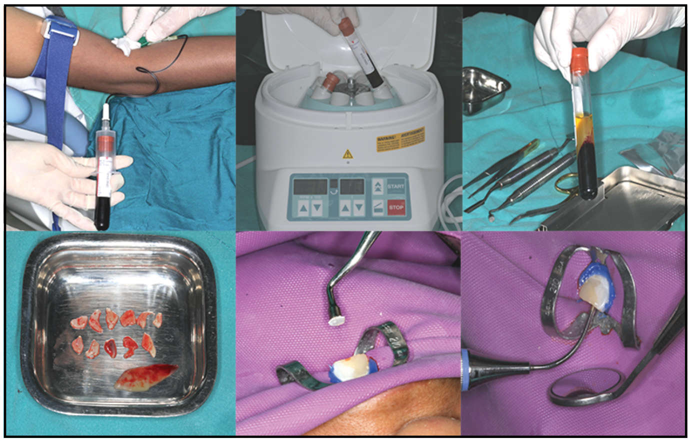

Figure 3. PRF preparation. (a) Collection of blood from the mediancubital vein. (b) Delivery of the blood tube to a PRF centrifugal machine. (c) PRF formation in the blood tube. (d) PRF small pieces. (e) Collagen membrane. (f) Delivery of MTA by a Messing gun

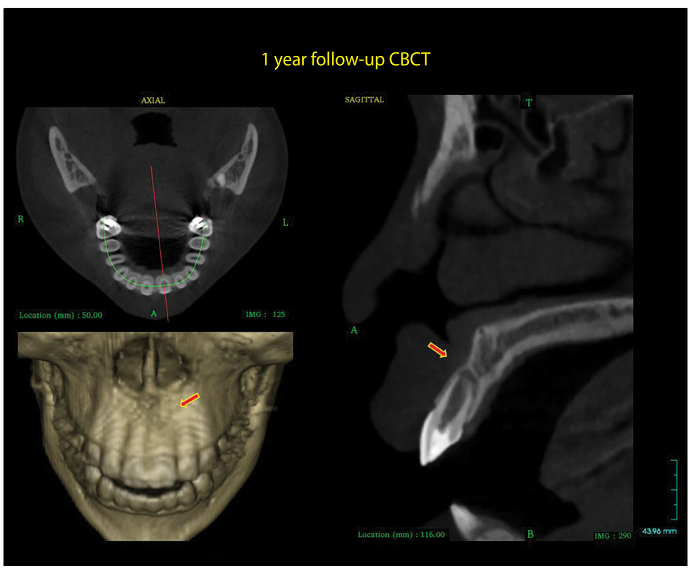

Figure 4. Postoperative CBCT. (a) Cross-sectional view within tersection transverse line on the midline of the left maxillary central incisor. (b) 3D reconstruction image shows the labial cortical plate at the apical part of the root. (c) Sagittal view image reveals labial cortical plate formation and incomplete healing of the apex of the tooth

and after the temporary restoration and calcium hydroxide dressing were removed, the canal was thoroughly instrumented using K-files #40 with a circumferential filing technique. The canal was copiously and passively ultrasonically irrigated using a K-25 ultrasonic tip (Satelec; Acteon, France) with 2.5% NaOCl, followed by 10 mL 17% ethylenediaminetetraacetic acid (EDTA) for 1 min, 0.9% normal saline, and then 2% chlorhexidine solution to enable complete debridement of inaccessible areas of the root canals. After the canal was dried with sterile paper points, calcium hydroxide mixed with distilled water was delivered by lentulo spiral, and the canal was double sealed using Cavit and GI.

After 2 months of follow-up, the maxillary left central incisor showed no clinical symptoms. The tooth was isolated with a rubber dam. After the temporary restoration and calcium hydroxide dressing were removed, the canal was chemically cleaned again with sequential passive ultrasonic irrigation using 2.5% NaOCl, followed by 10 mL 17% EDTA for 1 min, 0.9% normal saline, and 2% chlorhexidine solution. The canal was dried with sterile paper points. L-PRF was prepared according to the method described by Choukroun et al. (7). Blood was obtained from the patient's median cubital vein and transferred to a sterile centrifuge tube (10 mL) without anticoagulant (Fig. 3). Then, blood was centrifuged at 2700 revolutions per minute for 10 min using a specific centrifuge machine for PRF (IntraSpin™, Intra-Lock, Nice, France). Three layers of centrifuged blood were produced: a pale yellow, upper layer containing platelet-poor plasma; a deep yellow, middle layer containing a PRF clot; and a red, lower layer containing red blood cells. The PRF clot was isolated from the middle layer of the centrifuged tube. The PRF was then pressed with a metal sheet on a PRF chamber. The PRF membrane was cut into small pieces. Small pieces of PRF were soaked with blood, sequentially delivered into the root canal, and condensed beyond the apex using a sterile root canal plugger. When the build-up of PRF reached 2 mm below the cementoenamel junction (CEJ) level, a collagen membrane was inserted to cover the PRF at the coronal level of the root canal. Then, white ProRoot mineral trioxide aggregate (MTA; Tulsa, OK, USA) was prepared and packed against the membrane to the CEJ level. The access was sealed with a moist cotton pellet followed by Cavit and GI.

At 1 week of follow-up, no clinical symptoms were observed. The temporary filling was still intact. The tooth was isolated with a rubber dam, and the temporary filling and cotton pellet were removed. The MTA was checked by gentle blunt probing to ensure that it was completely set. The access cavity was filled with resin composite. The patient was then scheduled for follow-up appointments.

At 3 months of follow-up visit, the patient showed no clinical symptoms. No tenderness to percussion or palpation was noted, and periodontal examination revealed no periodontal probing depths >2 mm around the teeth. First degree mobility was still observed. A periapical radiograph revealed no change. The patient was advised to return for a follow-up appointment.

At 6 months of follow-up visit, the patient remained asymptomatic. Clinically, the resin composite of the tooth was intact, whereas the buccal resin composite was discoloured. Periodontal examination revealed periodontal probing depths around the teeth not >2 mm with normal physiological mobility. There was a slight change in the periapical radiograph compared with the original radiograph. There was a reduced periapical radiolucency, indicating some degree of healing. The patient was scheduled for another appointment to manage the buccal tooth discolouration.

At 12 months of follow-up, CBCT images demonstrated healing of the buccal cortical bone plate. CBCT reconstruction showed a reduced periapical radiolucency, suggesting continued healing. An apical closure was also evident (Fig. 4). The tooth also responded to electric pulp test (Elements Diagnostic Element, SybronEndo, Anaheim, CA, USA).

DISCUSSION

Stem cells are considered to be valuable cells for regenerative medicine. Even in necrotic teeth, stem cells from the apical papilla (SCAPs) may survive, porliferate and differentiate once inflammation is eliminated (14). In this case, an extraoral sinus tract of odontogenic origin was observed. Such a tract is often diagnosed late because the patient suspects a skin lesion rather than a lesion of dental origin (15).

NaOCl and EDTA were used in this treatment as chemical disinfection agents. NaOCl is the most effective irrigant in eliminating microorganisms. However, this solution may interfere with the ability of the pulp to regenerate (16). Therefore, the subsequent irrigation with normal saline may reduce the adverse effects of NaOCl. EDTA appears to promote pulp regeneration. The use of EDTA causes the release of sequestered growth factors from dentinal walls and may promote the proliferation and differentiation of SCAPs (17). Chlorhexidine solution was used as the final irrigation because of its antimicrobial substantivity effect.

Calcium hydroxide and triple antibiotic paste (TAP) have been used as intracanal medication in immature teeth. However, more SCAPs survive when calcium hydroxide is applied compared to TAP as shown in a previous study (18). Furthermore, TAP can cause tooth discolouration, which is unaesthetic for the anterior teeth. Previous studies show that re-growth of new tissue from the apical area cannot occur in an empty canal space. Therefore, extracellular matrix in the canal space is essential for cell migration (19, 20).

PRF is a natural biomaterial that is safe to apply to patients. There are many clinical applications for PRF in dental surgery, implantology, and periodontology. Many studies have shown that PRF increases cell proliferation and differentiation in the dental pulp (13–21). Keswani et al. (22) examined the evaluation of PRF and MTA as pulpotomy agents in permanent teeth with incomplete root development and found comparable results. PRF has also an advantage in prolonged release of growth factors, such as platelet-derived growth factor and transforming growth factor beta. These growth factors are released for a period of between 1 and 4 weeks (8, 13, 23).

According to the American Association of Endodontics, the primary goals of regenerative endodontic treatment are the elimination of symptoms and evidence of bony healing (24). In this case, after a 2-week medication with calcium hydroxide, the extraoral fistula tract was closed without pain or swelling.

At one year follow-up, the tooth responded positively to electric pulp test, and CBCT images showed a positive prognosis for further apical and surrounding bone healing.

Up to date, there is no appropriate method to detect revascularization in the root canal. Although laser Doppler flowmetry has been introduced to detect revascularization, the limitation is that only blood flow in the pulp chamber can be detected. Similarly, in this case, the tooth contained restorative material that would prevent the laser Doppler light from passing through the pulp chamber.

CONCLUSION

Regenerative endodontic treatment using PRF may provide favourable treatment outcomes for necrotic immature teeth with periapical radiolucency.

Disclosures

Conflict of interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Chande KP, Manwar NU, Chandak MG, Lokade J. Retreatment of a mutilated tooth with open apex by using PRF, MTA and anatomic post. International Journal of Prosthodontics and Restorative Dentistry 2013; 3(3):105–10.
2. Wigler R, Kaufman AY, Lin S, Steinbock N, Hazan-Molina H, Torneck CD. Revascularization: a treatment for permanent teeth with necrotic pulp and incomplete root development. J Endod 2013; 13;39(3):319–26.
3. Hargreaves KM, Diogenes A, Teixeira FB. Treatment options: biological basis of regenerative endodontic procedures. J Endod 2013; 39(3 suppl):129–40.
4. Langer R, Vacanti JP. Tissue engineering. Science 1993; 260(5110):920–6.
5. Goldberg M, Septier D, Bourd K, Menashi S. Role of matrix proteins in signalling and in dentin and enamel mineralisation. General Palaeontology (Palaeobiochemistry) 2004; 3(6-7):573–81.
6. Kim BS, Mooney DJ. Development of biocompatible synthetic extracellular matrices for tissue engineering. Trends Biotechnol 1998; 16(5):224–30.
7. Choukroun J, Adda F, Schoeffler C, Vervelle A. Une opportunité en paroimplantologie: Le PRF. Implantodontie 2001; 42:55–62.
8. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101(3):e37–44.
9. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101(3):e45–50.
10. Dohan DM, Choukroun J, Diss A, Dohan SL, Dohan AJ, Mouhyi J, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part III: leucocyte activation: a new feature for platelet concentrates? Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:e51–5.
11. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101(3):e56–60.
12. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part V: histologic evaluations of PRF effects on bone allograft maturation in sinus lift. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 101(3):299–303.
13. Huang FM, Yang SF, Zhao JH, Chang YC. Platelet-rich fibrin increases proliferation and differentiation of human dental pulp cells. J Endod 2010; 36(10):1628–32.
14. Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: New treatment protocol? J Endod 2004; 30(4):196–200.
15. Satish Kumar K, Subbiya A, Vivekanandhan P, Prakash V, Tamilselvi R. Management of an Endodontic Infection with an Extra Oral Sinus Tract in a Single Visit: A Case Report. J Clin Diagn Res 2013; 7(6):1247–9.

16. Ring KC, Murray PE, Namerow KN, Kuttler S, Garcia-Godoy F. The comparison of the effect of endodontic irrigation on cell adherence to root canal dentin. J Endod 2008; 34(12):1474–9.
17. Graham L, Cooper PR, Cassidy N, Nor JE, Sloan AJ, Smith AJ. The effect of calcium hydroxide on solubilisation of bio-active dentine matrix components. Biomaterials 2006; 27(14):2865–73.
18. Ruparel NB, Teixeira FB, Ferraz CC, Diogenes A. Direct effect of intracanal medicaments on survival of stem cells of the apical papilla. J. Endod 2012; 38(10):1372–5.
19. Torneck CD. Reaction of rat connective tissue to polyethylene tube implants. I. Oral Surg Oral Med Oral Pathol 1966; 21(3):379–87.
20. Torneck CD. Reaction of rat connective tissue to polyethylene tube implants. II. Oral Surg Oral Med Oral Pathol 1967; 24(5):674–83.
21. Kim JH, Woo SM, Choi NK, Kim WJ, Kim SM, Jung JY. Effect of Platelet-rich Fibrin on Odontoblastic Differentiation in Human Dental Pulp Cells Exposed to Lipopolysaccharide. J Endod 2017;43(3):433–8.
22. Keswani D, Pandey RK, Ansari A, Gupta S. Comparative evaluation of platelet-rich fibrin and mineral trioxide aggregate as pulpotomy agents in permanent teeth with incomplete root development: a randomized controlled trial. J Endod 2014; 40(5):599–605.
23. He L, Lin Y, Hu X, Zhang Y, Wu H. A comparative study of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) on the effect of proliferation and differentiation of rat osteoblasts in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009; 108(5):707–13.
24. American Association of Endodontists. AAE clinical considerations for a regenerative procedure. Available at: www.aae.org/Dental_Professional/Considerations for Regenerative Procedure.aspx. Accessed August 12, 2017.