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Endodontic Revascularization of an Immature Mandibular Second Premolar: A Case Report

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ABSTRACT

In recent years, pulp revascularization has emerged as a novel approach to treat periapical disease in young permanent immature teeth. The protocol focuses on thorough irrigation and disinfection with minimal mechanical instrumentation, thereby allowing stem cells from apical papilla (SCAP) to repopulate the canal and facilitating continued root development, with consistently favorable outcomes. This case report describes the management of a necrotic immature left mandibular second premolar of 16 year old female. The clinical examination, radiographic assessment, and cone-beam computed tomography (CBCT) findings indicated an immature mandibular left second premolar with periapical radiolucency, which was managed using a revascularization procedure with Platelet-rich fibrin as the scaffold. At 3, 6 and 12 months follow-up, patient was asymptomatic clinically and showed significant radiographic healing and reduction in size. This case report highlights the importance of an alternative modality for managing periapical lesions in immature permanent teeth.

Keywords: Immature teeth; mineral trioxide aggregate; platelet-rich fibrin; pulp revascularization; regenerative endodontics.

INTRODUCTION

The immature permanent teeth that develop pulpal infections secondary to caries, traumatic injury or developmental anomalies often present a substantial therapeutic dilemma. These teeth characteristically exhibit thin dentinal walls and wide, funnel-shaped apices, which compromise structural integrity and complicate traditional endodontic procedures. The absence of a natural apical constriction prevents predictable working length control, while the delicate radicular dentin is highly susceptible to fracture during instrumentation. Historically, apexification has been advocated as a viable treatment strategy, aiming to induce the formation of a hard-tissue apical barrier to facilitate subsequent obturation and create an artificial apical stop.[1]

More recently, regenerative endodontic procedures, specifically pulp revascularization has emerged as biologically driven alternative, designed to leverage the residual vitality and proliferative

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capacity of dental pulp stem cells and apical papilla stem cells. These cells can contribute to continued root development, allowing for both longitudinal root extension and circumferential thickening of dentinal walls, thereby enhancing long-term tooth prognosis.[2] Successful regenerative endodontic therapy relies on three key elements: stem cells, signaling molecules, and a three-dimensional scaffold. Together, these components support the migration and formation of new tissues from the periapical region into the disinfected canal space. Various scaffolds such as a natural blood clot, collagen, Platelet-Rich Fibrin (PRF) and Platelet-Rich Plasma (PRP) have been evaluated for their suitability in revascularization procedures.[3] Revascularization protocols by American Association of Endodontists (AAE) 2022, focuses on disinfection with minimal or no mechanical instrumentation, followed by stimulation of bleeding into the canal to introduce a stem-cell rich scaffold capable of supporting tissue growth and sustained maturation.[4]

The present case report describes the management of immature permanent mandibular second premolar with periapical radiolucency. Through a revascularization-based approach, periapical healing and progressive root development were achieved, demonstrating the therapeutic potential of regenerative endodontics in immature teeth and periapical lesion.

CASE REPORT

Patient written informed consent was signed for publication of this case report. A 16-year-old female presented to the Department of Conservative Dentistry and Endodontics at Kantipur Dental College with a complaint of pain in the lower left posterior tooth region for the past 2–3 days. The pain was insidious in onset, throbbing in nature, of moderate to severe intensity, radiating towards ear, aggravated while chewing hard food, and temporarily relieved with medication. The patient reported intermittent episodes of similar pain over the past 2–3 years and had a history of trauma while playing (ball) about 3 years back, but the tooth was asymptomatic and her medical history was noncontributory.

On extraoral examination, no remarkable findings were observed. Intraoral examination revealed tenderness to percussion and vestibular palpation with respect to tooth #35 and intraoral periapical radiograph demonstrated an immature tooth with an open apex, thin dentinal walls, and a distinct periapical radiolucency (Figure 1). The involved tooth was non-responsive to both thermal and electric pulp sensibility tests. To further know the full extent of the lesion and reevaluation, cone-beam computed tomography (CBCT) was performed, sagittal and coronal view revealed an immature root apex associated with a large periapical lesion (Figure 2, Figure 3). Based on clinical and

Figure 1: Pre-operative RadioVisioGraphy (RVG)

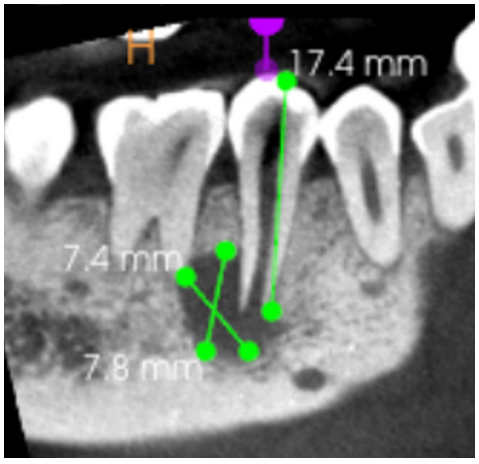

Figure 2: Pre-operative CBCT (Coronal view)

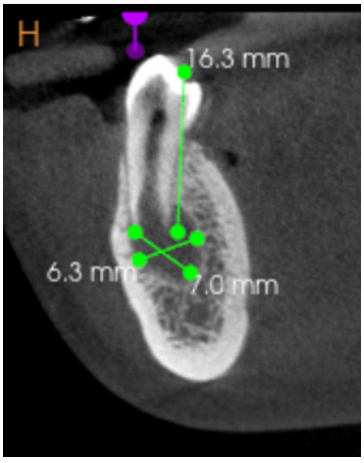

Figure 3: Pre-operative

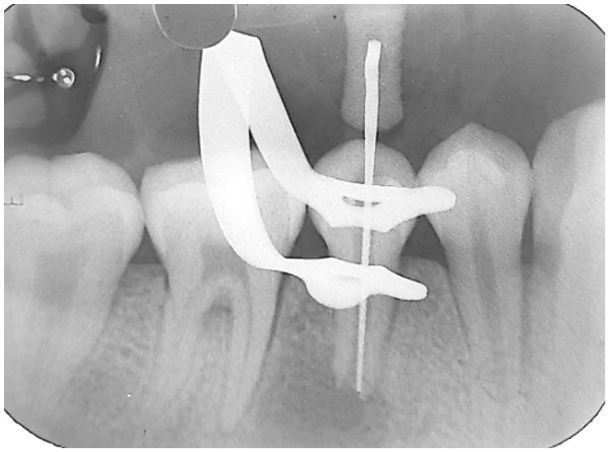

Figure 4: Working Length Determination

radiographic findings, the tooth was diagnosed as immature necrotic teeth with symptomatic apical periodontitis and was planned for regenerative endodontic therapy.

At the same appointment, access opening was performed under local anesthesia and rubber dam isolation. An Endo Access bur (Dentsply Maillefer, Switzerland) mounted on a high-speed air-turbine handpiece was used for cavity preparation. The working length was determined using # 30 K-file (Mani, Mani Inc. Japan) (Figure 4). The disinfection of the canal was carried out following American Association of Endodontists (AAE) guidelines for regenerative endodontic procedures.[5]

The minimal circumferential filing was performed to remove bacterial biofilm and avoid weakening of already thin root canal walls. The canal was irrigated sequentially with 20 ml of 3% sodium hypochlorite followed by 20 ml of normal saline for five minutes using a 30-gauge side-vented needle positioned 2 mm short of the working length. After drying the canal with sterile paper point, a bonding agent was applied in pulp chamber, and freshly prepared Triple Antibiotic Paste (TAP) consisting of ciprofloxacin, metronidazole, and minocycline in a 1:1:1 ratio by weight was mixed with propylene glycol as a vehicle. The paste was placed below the cementoenamel junction to serve as an intracanal medicament with lentulospiral and was sealed with a sterile cotton pellet and restored temporarily using light-cure resin-modified glass ionomer cement.

Two weeks later, during the second visit, the tooth was asymptomatic with no sensitivity to percussion or palpation. Platelet-rich fibrin (PRF) was prepared to serve as a biological scaffold. Approximately 20 ml of the patient's venous blood was collected from the antecubital vein into sterile, non-heparinized tubes without any anticoagulant and centrifuged at 2700 rpm for 12 minutes. The resulting PRF clot was removed using sterile tweezers and compressed in a PRF box to form a membrane (Figure 5). Under local anesthesia and proper isolation, the intracanal medicament was removed by thorough irrigation with 3% sodium hypochlorite, sterile saline, and finally 20 ml of 17% EDTA for one minute using passive ultrasonic activation to promote growth factor release, followed by drying with sterile paper points.

The bleeding was induced by inserting a size 40 K-file approximately 2 mm beyond the apex until the canal was filled with blood up to the level just below the cementoenamel junction (Figure 6). The prepared PRF membrane was placed over the blood clot using a hand plugger, approximately 3mm below the cementoenamel junction. A >3 mm thick Mineral Trioxide Aggregate (MTA) (BioStructure MTA, SafeEndo, India) plug was then placed directly over the PRF scaffold, and the access cavity was sealed with Resin-modified Glass Ionomer Cement (SafeEndo ReGlass LC, India). Finally, a definitive composite restoration was placed to achieve coronal sealing (Figure 7).

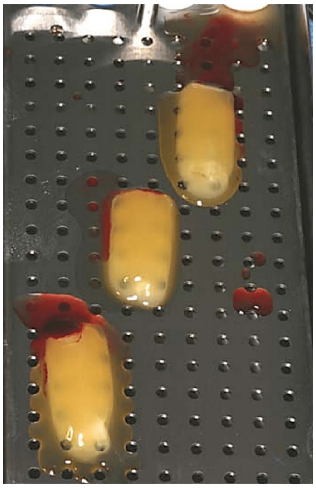

Figure 5: Platelet-rich fibrin

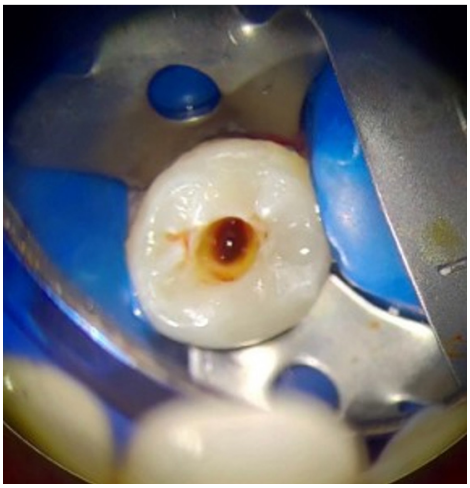

Figure 6: Bleeding induced in canal

Figure 7: 3 months follow-up

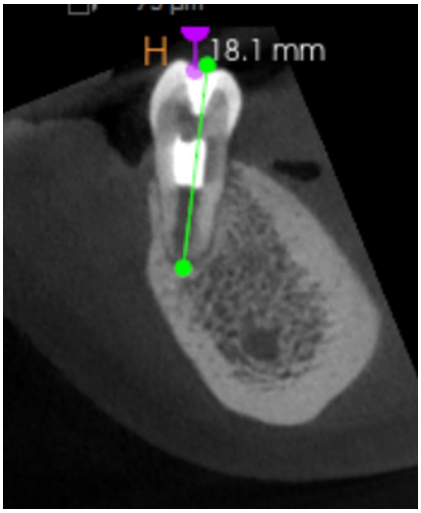

Figure 8: 6 months follow-up RVG

Figure 9: 12 months follow-up CBCT (Coronal view)

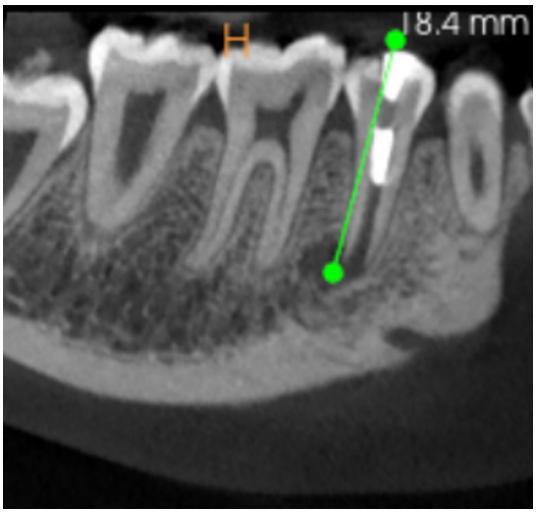

Figure 10: 12 months follow-up

Patient was reviewed at 3, 6 and 12 months and remained asymptomatic. Both thermal and electric pulp sensibility tests showed no response and radiographs at 3 and 6 months revealed periapical healing. At 12 months, patient was clinically asymptomatic, CBCT sagittal and coronal views confirmed increased bone density, periapical healing, approximately 1–2 mm root elongation, apical narrowing, and dentinal wall thickening. (Figure 8, Figure 9).

DISCUSSION

Regenerative endodontic therapy (RET), first described by Banchs and Trope in 2004, offers a biologically based approach for managing traumatized, necrotic immature teeth which promotes continued root maturation and apical closure even in non-vital teeth, leading to the formation of thicker dentinal walls, elongation of the root, and improved apical development. These structural

improvements enhance the tooth's resistance to fracture and contribute to a more favorable long-term prognosis.[6] The various scaffolds have been used in pulp revascularization, with the blood clot being the most commonly used due to its natural reservoir of bioactive growth factors. However, the use of a blood clot alone is considered to support healing rather than true pulp regeneration. Platelet-rich fibrin (PRF) has emerged as a promising scaffold, offering a dense concentration of platelets and leukocytes that release a sustained supply of growth factors, thereby enhancing tissue repair and regeneration.[4] PRF scaffolds acts as barrier and limits pushing of MTA.

A critical step for successful regenerative endodontics is thorough canal disinfection. In the present case, necrotic remnants were eliminated through copious irrigation with 20 mL of 3% sodium hypochlorite, followed by the placement of TAP as the intracanal medicament, adhering to the AAE 2022 protocol. It has been shown to effectively sterilize infected root dentin, and prevent damage to remaining pulp tissue and apical papilla.[5] Before inducing periapical bleeding, a final rinse with 17% ethylenediaminetetraacetic acid (EDTA) was performed. EDTA plays a vital role in regenerative therapy by releasing growth factors embedded within dentin, which promote the recruitment, migration, and differentiation of stem cells involved in tissue repair and regeneration.[7]

Linsuwanont et al. (2017) demonstrated conventional periapical radiographs often underestimate changes in root development compared to CBCT.[8] Therefore, in this case, CBCT was employed both preoperatively and postoperatively to assess periapical healing and to more accurately evaluate root maturation. The CBCT findings revealed a significant reduction in periapical lesion size and an increase in bone density after 12 months, consistent with results reported by Demirci et al. (2020), who also observed clear periapical healing in cases treated with blood clot and PRF scaffolds.[9]

Published data show that 50–60% of teeth regain positive pulp sensibility after REPs.[5] Although studies with more than 12–15 months follow-up report positive Electric pulp test (EPT) responses, the present case remained non-responsive at 12 months. This is consistent with histologic evidence showing that root thickening after revascularization mainly results from bone-like or cementum-like tissue, not true dentin. As these tissues lack dentinal tubules, nerve fibers that may regenerate nearby often fail to produce detectable responses in standard sensibility tests.[10]

SUMMARY

Regenerative endodontic therapy performed using PRF as a scaffold in this case, resulted in clinical success, restored tooth function, apical closure, and root maturation, emphasizing PRF's potential to enhance clinical outcomes. Continued long-term follow-up and further histologic studies are necessary to confirm true regeneration of pulpal tissue.

Conflict of interest: None

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