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Case Report

Dentistry Section

Non Surgical Management of Immature Teeth with Large Periapical Radiolucency using Combined Regenerative and Conventional Endodontic Therapy: A Case Report with 2-year Follow-up

AMRITA GHOSH[1], NIRMALYA CHATTERJEE[2], BINAYAK SAHA[3], KUNTAL CHOWDHURY[4]

ABSTRACT

Treatment of immature permanent teeth with blunderbuss apices and thin dentinal walls remains an enigma for endodontists. Various treatment modalities have been used to manage immature teeth, such as non vital pulp therapy with calcium hydroxide or apexification using Mineral Trioxide Aggregate (MTA), Biodentine, or bioceramic putty. However, these methods fail to address the problem of thin dentinal walls, which often leads to tooth fracture and extraction despite successful initial treatment. Regenerative Endodontic Procedures (REPs) offer the best solution for such cases, with the potential to re-establish the dentin-pulp complex, thereby facilitating apexogenesis and root maturation. The development of second-generation platelet concentrates such as Platelet-Rich Fibrin (PRF) has made the success of REPs more predictable compared to procedures that rely solely on induced intracanal bleeding. A 25-year-old female patient presented with pain and swelling in the upper anterior region, with a history of childhood trauma 17 years earlier and recent incomplete dental treatment. Clinical and radiographic examination revealed tenderness on percussion and a well-defined periapical radiolucency (~10×12 mm) involving teeth #21 and #22. Tooth #21 exhibited an open apex and a necrotic pulp, while tooth #22 had previously undergone root canal treatment. A working diagnosis of periapical pathology secondary to pulpal necrosis was made. A Regenerative Endodontic Procedure (REP) was planned for tooth #21, while tooth #22 was left untreated due to satisfactory restoration and obturation. Following disinfection using 1.5% sodium hypochlorite and placement of an interim calcium hydroxide dressing over three visits, Platelet-Rich Fibrin (PRF) prepared from autologous blood was placed as a scaffold. A collagen plug was positioned over the PRF, followed by a 3 mm layer of MTA, and the tooth was sealed with resin-modified glass ionomer cement. Follow-ups at 3, 6, 12, and 24 months revealed complete resolution of the periapical radiolucency with apical closure of tooth #21. The tooth remained asymptomatic and functional, although no response to pulp vitality tests was observed. Regenerative endodontic treatment can be successfully performed alongside conventional endodontic therapy in managing immature permanent teeth with periapical radiolucency. Two teeth involved in the same lesion can be effectively treated using different treatment modalities, and prior conventional endodontic intervention does not hinder the future success of regenerative endodontics.

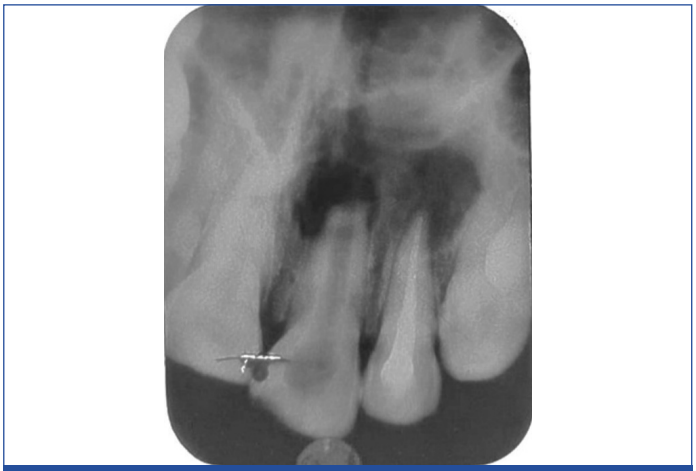
Keywords: Apical periodontitis, Platelet-rich fibrin, Regenerative endodontics, Tooth apex

CASE REPORT

A 25-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of pain and swelling in the upper left anterior region. The patient gave a history of trauma to the maxillary anterior teeth approximately 17 years ago due to a childhood fall. At that time, no dental treatment was sought. However, five months prior to presentation, the patient consulted a local dentist and underwent partial treatment, which was discontinued following a recommendation for extraction. The patient's medical history was non contributory, with no known systemic illnesses or medications.

Clinical examination revealed swelling in the buccal sulcus in relation to teeth #21 and #22. A restoration was present in #22, and an attempted access cavity was noted in #21. Both teeth were tender on percussion. Radiographic evaluation revealed a large periapical radiolucency measuring approximately 10×12 mm, involving #21 and #22. Endodontic treatment had already been completed in #22 [Table/Fig-1]. Tooth #21 exhibited a wide canal with an open apex.

A diagnosis of pulpal necrosis with periapical pathology involving #21 and #22 secondary to trauma was made. The differential diagnosis for the large periapical radiolucency included a periapical granuloma, radicular cyst, and chronic apical abscess. The radiograph showed a well-defined, unilocular radiolucent lesion encompassing the apices of both teeth. The absence of sinus tract formation and purulent discharge ruled out a chronic apical abscess. Although the size and distinct borders of the lesion suggested a radicular cyst, no further investigations such as aspiration or histopathological analysis were performed to confirm this.



[Table/Fig-1]: Preoperative periapical radiograph.

Considering the clinical findings, history of trauma, and non vital status of the involved teeth, a working diagnosis of periapical pathology secondary to pulpal necrosis was established. A conservative endodontic and regenerative treatment approach was planned. After informing the patient of all available treatment options, it was decided to perform regenerative endodontic therapy for tooth #21 to promote apical closure and periapical healing. As there were no signs of leakage in the coronal restoration of #22 and the obturation appeared satisfactory radiographically, retreatment of #22 was not performed. Regenerative treatment of the adjacent immature tooth (#21) was expected to facilitate resolution of the common lesion through periapical healing. Therefore, a conservative, non invasive approach was adopted to avoid unnecessary retreatment.

At the first appointment, local anaesthesia was administered using 2% lignocaine with 1:100,000 epinephrine. After rubber dam isolation, an access cavity was prepared in #21. Working length was determined using an apex locator (Dentsply Propex Pixi) and confirmed with an Intraoral Periapical (IOPA) radiograph. The canal walls were gently cleaned with a #60 K-file, and copious irrigation was performed using 1.5% sodium hypochlorite (20 mL for 5 minutes) delivered with a side-vented needle positioned 1 mm short of the apex. Active irrigation was carried out using an EndoActivator (Dentsply). The canal was then irrigated with normal saline, dried, and an interim dressing of Ultracal (Ultradent, USA) was placed. The access cavity was sealed with Cavit (3M ESPE, Germany), and the patient was recalled after two weeks.

At the second visit, the swelling in the buccal sulcus had reduced in size. After removal of the temporary restoration, the canal was actively irrigated in the same manner, and a fresh intracanal dressing of Ultracal was placed.

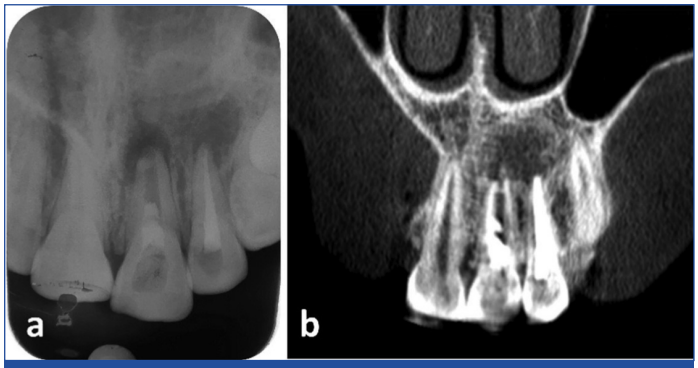
At the third visit, the intraoral swelling had completely subsided, and tooth tenderness had markedly decreased. The canal was irrigated and debrided in the same manner as during the previous two appointments, and Ultracal was placed for the third time. It was decided to perform the regenerative procedure at the next appointment if the clinical condition remained stable.

At the subsequent visit, the tooth was found to be clinically asymptomatic. The tooth was reaccessed, and the calcium hydroxide dressing was flushed out by copious irrigation with normal saline and 20 mL of 17% Ethylenediaminetetraacetic Acid (EDTA) (Desmear, Anabond, India) for five minutes. Final irrigation was performed with normal saline.

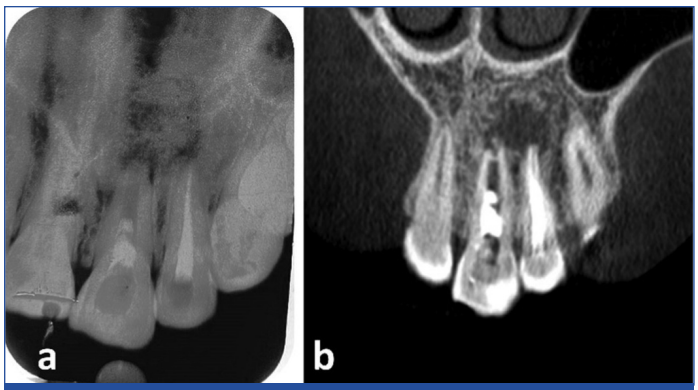
A total of 10 millilitres of blood were drawn from the patient's antecubital vein, transferred to a test tube, and centrifuged at 2110 rpm for 10 minutes. The Platelet-Rich Fibrin (PRF) thus obtained was carefully placed within the canal, followed by the placement of a collagen plug (Collacote; Integra Life Sciences). A 3 mm thickness of Mineral Trioxide Aggregate (MTA) was placed over the collagen plug, and the tooth was restored with Resin-Modified Glass Ionomer Cement (RMGIC) (GC Fuji II LC) [Table/Fig-2]. The patient was recalled for clinical and radiographic evaluation after 3, 6, 12, and 24 months [Table/Fig-3-6].

[Table/Fig-2]: Immediate postoperative periapical radiograph.

[Table/Fig-3]: 3-month postoperative periapical radiograph.



[Table/Fig-4]: 6-month postoperative: a) Periapical radiograph; and b) Cone-beam computed tomographic scan.



[Table/Fig-5]: 12-month postoperative: a) Periapical radiograph; and b) Cone-beam computed tomographic scan.

[Table/Fig-6]: 24-month postoperative: a) Periapical radiograph; and b) Cone-beam computed tomographic scan. The yellow arrow shows complete apical closure in tooth#21)

At all follow-up visits, the tooth remained asymptomatic and functional. Radiographic evaluation at 24 months revealed complete healing of the periapical lesion with apical closure in tooth #21 [Table/Fig-6]. However, the tooth did not respond to pulp sensibility testing or the Electric Pulp Test (EPT).

DISCUSSION

Conventional root canal treatment aims to thoroughly disinfect the root canal system to reduce the microbial load as much as possible, followed by obturation of the canal space and placement of an impervious coronal seal to prevent leakage into the periapical tissues and to entomb any remaining bacteria within the canal. However, in immature permanent teeth, the presence of an open apex and thin dentinal canal walls poses a significant challenge to achieving successful conventional endodontic therapy.

In the past decade, the development of advanced root apex sealing materials such as Mineral Trioxide Aggregate (MTA), Biodentine, and bioceramic putty has made sealing wide apices more predictable. Nonetheless, the problems associated with thin dentinal walls and immature roots still persist [1].

Regenerative Endodontic Procedures (REPs) are biologically based therapies designed to regenerate the cells of the dentin-pulp complex, thereby restoring tooth vitality and the normal physiological functions of the pulp-dentin complex. This leads to continued root-end development and thickening of the root canal walls, reducing the risk of root fracture. Re-establishment of the root vasculature also restores innate immune defense mechanisms, thereby decreasing the likelihood of future endodontic failure [2].

In the present case, the patient had previously undergone conventional endodontic treatment of one tooth following trauma; however, periapical pathology had persisted as the adjacent immature permanent tooth had not been treated. A decision was made to perform a Regenerative Endodontic Procedure (REP) in the immature tooth to provide an opportunity for the tooth to regain vitality and continue apexogenesis.

Active irrigation was performed using 1.5% sodium hypochlorite with a side-vented needle placed 1 mm short of the apex, as regeneration is possible only in a canal that is free of microorganisms [3]. However, using a higher concentration of sodium hypochlorite (5.25%) has been shown to have detrimental effects on Stem Cells from the Apical Papilla (SCAP) and Dental Pulp Stem Cells (DPSC), as well as to cause denaturation of dentin-derived growth factors in a concentration-dependent manner [4].

An interim dressing of calcium hydroxide was placed for four weeks to achieve canal disinfection. The choice of intracanal medicament has long been debated. While triple antibiotic paste was initially used, high concentrations were found to be detrimental to SCAP survival, and complete removal of the paste posed difficulties [5]. Although calcium hydroxide is less potent in antibacterial efficacy, it offers the advantage of lower cytotoxicity, allowing for greater stem cell proliferation and easier removal. Ultracal XS, used in this case, gradually released hydroxyl ions, resulting in a progressive increase in alkalinity and thereby enhancing its antibacterial effect [6].

The use of 17% EDTA as the final irrigant ensures the removal of calcium hydroxide and the smear layer from root canal walls. EDTA also facilitates the migration, attachment, proliferation, and differentiation of stem cells by promoting the release of growth factors. A final rinse with 20 mL of normal saline solution following EDTA irrigation promotes SCAP proliferation without impairing their differentiation [7].

Scaffolds are essential for any regenerative procedure, as they guide and support the migration and proliferation of stem cells. The development of an ideal scaffold remains the “holy grail” of regenerative therapy. Early REP protocols involved inducing apical bleeding up to the level of the cementoenamel junction. However, achieving adequate intracanal bleeding can be challenging, as periapical tissue destruction often leads to insufficient bleeding [8].

Autologous platelet concentrates such as Platelet-Rich Plasma (PRP), Platelet-Rich Fibrin (PRF), and Injectable PRF (I-PRF) have been explored as alternatives to induced bleeding. PRF, a second-generation platelet concentrate, enhances stem cell proliferation, migration, and differentiation. The presence of physiologic thrombin in PRF allows gradual polymerization, making it more favourable for stem cell migration and growth factor entrapment. Furthermore, PRF demonstrates a more sustained release of growth factors (up to 28 days) compared with PRP [9].

Saoud TM et al., [10] reported the regenerative treatment of two anterior teeth that had sustained trauma and exhibited necrotic pulps with significant cyst-like periapical lesions. Although both teeth were fully developed, regenerative therapy resulted in periapical healing, apical closure, and the formation of mineralised tissue within the canal space. Despite limited root wall thickening, the radiographic evidence of healing highlighted the efficacy of REP in managing extensive lesions, similar to the periapical healing observed in our case over 24 months.

Coronal sealing of the canal with Mineral Trioxide Aggregate (MTA) provides a hermetic bacterial seal essential for successful regeneration. MTA also induces the formation of hydroxyapatite crystals, which, when formed at the material-dentin interface, further enhance the integrity of the coronal seal [11]. In the present case, a 3 mm coronal plug of MTA was placed over a Collacote membrane to restrict its apical extent, and the tooth was subsequently restored with RMGIC.

The patient was radiographically evaluated every three months for a period of two years. Progressive periapical healing was observed in both #21 and #22, along with root-end closure of #21. However, pulp sensibility testing continued to yield negative results, likely due to the extensive coronal restoration present in the tooth.

Similar to the present case, Alsofi L documented the effective management of a significant periapical lesion in an immature maxillary central incisor through regenerative endodontic therapy using calcium hydroxide, PRF as a scaffold, and Biodentine for coronal sealing [12]. Their 12-month follow-up demonstrated complete resolution of the lesion and apical closure, underscoring the biological efficacy of PRF and the reliability of bioceramic materials in the conservative management of cyst-like periapical lesions.

Additionally, Van Le H et al., reported two cases of REPs performed on immature permanent premolars exhibiting extensive periapical radiolucencies [13]. Both cases were managed using PRF, calcium hydroxide, and MTA as the apical barrier. Their 24-month follow-up confirmed periapical healing and apical closure. These findings highlight the efficacy of scaffold-supported REPs in managing structurally compromised teeth while minimizing surgical risks.

A conservative approach to managing large periapical cyst-like lesions was also advocated by Narula H et al., who demonstrated that periapical healing could be achieved in immature molars with substantial lesions using calcium hydroxide dressings and MTA obturation, without the need for surgical intervention [14]. Their case supports the concept that effective canal disinfection and bioactive sealing can obviate the necessity for surgical curettage, especially in lesions lacking histopathological confirmation.

Ling D et al., conducted a case series evaluating non surgical root canal therapy in 35 patients with large cyst-like periapical lesions using a modified apical negative pressure irrigation technique [15]. The impressive success rate of 91.4% was attributed to efficient decompression and intracanal disinfection, with younger patients demonstrating more favourable healing outcomes. These results align with the findings of the present case, where a non surgical approach led to complete lesion resolution and apical healing in a young patient.

Regenerative Endodontic Procedures (REPs) have demonstrated significant potential for promoting healing of large periapical lesions, even in cases where previous endodontic treatment has failed. Every tooth should be given an opportunity to regenerate before resorting to surgical endodontics or extraction. Clinicians should have greater confidence in REPs to encourage their widespread clinical adoption rather than limiting their practice to academic settings.

CONCLUSION(S)

The present case highlights the successful application of Regenerative Endodontic Procedure (REP) in treating a non vital immature permanent tooth associated with a large periapical lesion. The combined use of Platelet-Rich Fibrin (PRF) as a scaffold, calcium hydroxide as an intracanal medicament, and Mineral Trioxide Aggregate (MTA) for coronal sealing facilitated periapical healing and apical closure without the need for surgical intervention. Despite the lack of pulp sensibility response, the treated tooth remained asymptomatic and functional over a 24-month follow-up period. The present case underscores the potential of REP as a conservative, biologically based alternative to traditional or surgical endodontic approaches in similar clinical scenarios. Timely diagnosis, meticulous disinfection, and careful case selection are essential for achieving favourable outcomes and broader clinical success of regenerative endodontic therapy.

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PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Conservative Dentistry and Endodontics, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.
2. Associate Professor, Department of Prosthetic Dentistry, Burdwan Dental College and Hospital, Burdwan, West Bengal, India.
3. Assistant Professor, Department of Conservative Dentistry and Endodontics, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.
4. Assistant Professor, Department of Conservative Dentistry and Endodontics, Dr. R. Ahmed Dental College and Hospital, Kolkata, West Bengal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Amrita Ghosh,
Eden Royale, Flat 3B, 1588, Nayabad Avenue, Kolkata-700150, West Bengal, India.
Email: ratrighosh83@gmail.com

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