Case Report

Rehabilitation of a Fractured Tooth with an Open Apex: A Case Report

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ABSTRACT

Thorough knowledge of root canal morphology and its anatomical variations is critical for ensuring consistent and successful endodontic treatment outcomes. One such complex clinical challenge is the non-vital immature tooth with an open apex. The open apex configuration represents a unique anatomical variation showing a marked correlation with historical trauma sustained during active root development, most commonly observed in maxillary central incisors. Anatomical features including thin, fragile dentin walls and the lack of a natural apical constriction result in a complex environment that complicates standard cleaning, shaping, and obturation procedures while increasing the long-term risk of root fracture. This paper reports successful endodontic and prosthetic management of a maxillary anterior tooth with a history of trauma utilizing an Mineral Trioxide Aggregate apical plug and an innovative pink porcelain restoration.

Key words: Apexification, Mineral Trioxide Aggregate, Tooth Injuries, Root Canal Therapy, Gingival Recession

INTRODUCTION

Traumatic dental injuries (TDIs) in children and adolescents represent a significant public health issue, frequently involving the anterior maxillary dentition.[1] A critical complication arises when trauma occurs during the active phase of root development, typically before the closure of the root apex, which concludes approximately three years after eruption. If the trauma causes pulp necrosis or severe vascular disruption, dentin formation stops immediately. This leaves the tooth with an immature root characterized by thin, fragile dentin walls and a wide open apex.[2] Managing a non-vital tooth with an open apex poses considerable endodontic challenges. Standard mechanical instrumentation is difficult because there is no natural apical barrier to confine the instruments during cleaning and shaping.[3]

Historically, apexification using calcium hydroxide was the standard treatment for inducing a hard-tissue apical barrier. However, this method requires multiple visits over a period of 6 to 24 months, increasing the risk of reinfection between appointments.[3] Long-term use of calcium hydroxide can also degrade the organic matrix of dentin, making the root more fragile.[2] To overcome these limitations, single-visit apexification using biocompatible materials such as Mineral Trioxide Aggregate (MTA) has become the preferred approach.[3] MTA acts as an artificial apical plug, providing an immediate seal, excellent biocompatibility, and the ability to promote hard-tissue formation.[4] Following successful apexification, definitive coronal restoration with a full-coverage crown is vital for properly distributing occlusal forces and protecting the structurally compromised tooth from fracture over time.

This case report documents the long-term clinical success of a patient who presented with an open apex secondary to a traumatic fall sustained 14 years earlier during childhood. The tooth was successfully managed with MTA apical plug apexification and restored with a full-coverage prosthetic crown.

CASE REPORT

Initial Presentation and Diagnosis

A 21-year-old male patient presented to the Department of Conservative Dentistry and Endodontics with a chief complaint of a fractured upper front tooth accompanied by aesthetic discoloration since 14 years. The patient's medical history and drug history were non-contributory. Dental history revealed a significant traumatic injury resulting from a fall sustained approximately 14 years ago during childhood, which had left the tooth untreated.

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Clinical examination confirmed a severely discolored, structurally compromised coronal structure of the maxillary right central incisor irt 11 [Figure 1]. The tooth exhibited mobility within normal physiological limits, and gingival recession was noted, with no clinical signs of swelling, tenderness, or an active sinus tract. Standard thermal testing and electrical pulp testing elicited no response, confirming complete pulpal necrosis. Intraoral radiographic examination showed incomplete, arrested root development of irt 11 and an open apex. There were signs of severe periapical radiolucency observed [Figure 2]. Based on the clinical and radiographic findings, a diagnosis of asymptomatic apical periodontitits with an open apex secondary to historical trauma was established, and an apexification procedure using MTA followed by prosthetic rehabilitation was planned.

Fig. 1: Pre-Operative Clinical Image

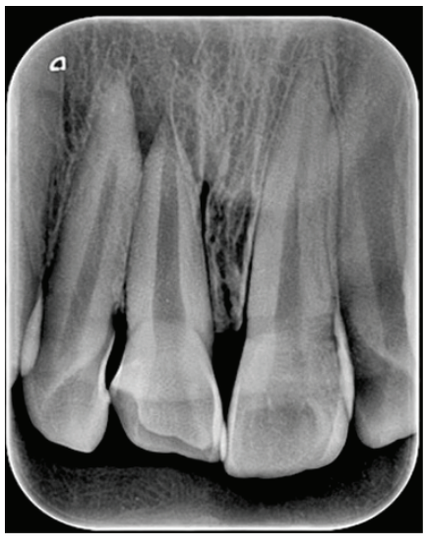

Fig. 2: Pre-Operative IOPAR

Clinical Procedure

The treatment protocol was thoroughly explained to the patient, and informed consent was obtained. The tooth was isolated under a rubber dam, and an endodontic access cavity was prepared irt 11 using a high-speed round bur [Figure 3]. Upon entering the pulp chamber, necrotic tissue debris was gently debrided. Working length was determined carefully using a combination of an electronic apex locator (Root ZX mini, J. Morita, USA) and confirmed radiographically with a hand file positioned 1mm short of the root terminus to avoid mechanical injury to the periapical tissues [Figure 4].

Fig. 3: Clinical Image of Access opening irt 11

Fig. 4: IOPAR showing Working Length irt 11

Minimal mechanical instrumentation of the fragile root canal walls irt 11 was performed using large-diameter hand K-files upto 80 no. K-file preventing thinning or fracturing of the root. Chemical debridement was heavily prioritized; the canal was copiously and gently irrigated with a 2.5% sodium hypochlorite (NaOCl) (Hypochlor Forte, Safe Endo, India) solution using a side-vented needle, followed by a final rinse with normal saline. The canal space was dried completely using sterile paper points. Calcium hydroxide paste ($Ca(OH)_2$) (Calcicur, Safe Endo, India) was placed inside the canal as an intracanal medicament for one week to optimize disinfection.

Fig. 5: IOPAR showing MTA plug barrier irt 11

At the recall appointment one week later, the patient was asymptomatic. The calcium hydroxide paste was removed via continuous irrigation with saline followed by a final irrigation with 2% chlorhexidine (Hexachlor, Safe Endo, India). The canal was dried thoroughly, and a 4-mm thick apical plug of white MTA (MTA Angelus, Angelus, Brazil) was condensed into the apical portion of the root canal of irt 11 using hand pluggers. The proper

adaptation and placement depth of the apical plug were confirmed with an intraoral radiograph [Figure 5]. A moist cotton pellet was placed against the MTA plug, and the access cavity was temporarily sealed with Cavit (Orafil G, Prevest DenPro G, India) to allow the material to set completely.

Obturation and Final Restoration

The patient was recalled after 24 hours to complete the procedure. The temporary restoration and cotton pellet were removed from tooth 11, and the complete setting of the apical MTA barrier was verified clinically with a hand instrument. The remaining portion of the wide root canal space was obturated completely using a thermoplasticized gutta-percha technique and a bioceramic sealer (BioActive RCS, Safe Endo, India) to provide a dense, three-dimensional seal [Figure 6].

Following successful obturation, structural reinforcement of the fragile crown-root complex irt 11 was performed using a dual-cure composite resin (Beautifill, Shofu, Inc, Kyoto Japan) core build-up [Figure 6, 7].

Fig. 6: Post Operative IOPAR irt 11

Fig. 7: Post Operative Clinical Image

The patient reported asymptomatic after 3 months and follow up was done. On radiographic examination, healing of the periapical lesion could be appreciated [Figure 8]. Periodontal surgical management for gingival recession was advised to the patient, however, the patient declined surgical intervention. Therefore, prosthetic rehabilitation was planned and executed as an alternative approach. The tooth was then prepared [Figure 9] structurally for an aesthetic, full-coverage prosthetic crown. A definitive PFM crown incorporated with pink porcelain [Figure 10] was successfully cemented using luting glass ionomer cement (GC Corporation, Fuji I, Fuji Luting, GC Gold Label 1, Japan) irt 11 to distribute occlusal forces evenly, restore natural anterior aesthetics, mask the underlying discoloration alongwith gingival recession, and safeguard the historically traumatized tooth from future cervical fractures. The patient was placed on a long-term periodic recall schedule to monitor periapical healing and functional stability.

Fig 8: IOPAR showing 3 month follow up irt 11

Fig 9: Clinical Image showing Crown prepration irt 11

Fig 10: Clinical Image after Crown Cementation irt 11

DISCUSSION

Traumatic dental injuries (TDIs) involving the anterior maxilla represent a frequent public health concern, particularly during childhood and adolescence.1 When trauma occurs prior to the completion of root development—which typically finishes approximately three years post-eruption—it can result in pulpal necrosis and an immediate cessation of dentin deposition. This leaves the clinician with the formidable task of treating a non-vital tooth presenting with an open apex and thin, fragile root canal walls.[2] Traditional apexification protocols using $Ca(OH)_2$ have historically been standard practice.3 However, this multi-visit methodology requires a prolonged treatment period spanning 6 to 24 months, which significantly increases the risk of inter-appointment reinfection and can structurally weaken the root dentin, making it prone to cervical fractures.[3]

To address these vulnerabilities, single-visit apexification utilizing biocompatible materials like Mineral Trioxide Aggregate (MTA) has emerged as a highly successful alternative.[3] In this case report, a 4-mm MTA apical plug was precisely condensed into the apex of tooth 11 following a one-week intracanal disinfection regimen with calcium hydroxide.[4] The 4-mm thickness has been widely established in endodontic literature as the optimal threshold to effectively resist mechanical displacement and minimize microleakage.[3]

Several case reports have demonstrated the predictable clinical success of Mineral Trioxide Aggregate (MTA) apexification in the management of immature non-vital teeth with open apices. Purra et al. reported successful single-visit apexification using a 4-mm MTA apical plug, emphasizing its excellent sealing ability, biocompatibility, and capacity to promote periapical healing.[4] Similarly, Silva et al. documented favorable clinical and radiographic outcomes following MTA apexification in immature teeth and highlighted the importance of conservative canal preparation to preserve the thin dentinal walls and reduce the risk of cervical root fracture.[5] More recently, Guimarães et al. reported successful management of a traumatized immature permanent tooth using MTA apexification, demonstrating satisfactory periapical healing and long-term clinical stability.[2] The clinical outcome of the present case is consistent with these reports, as significant periapical healing was evident at the three-month follow-up following placement of a 4-mm MTA apical barrier and thermoplasticized gutta-percha obturation.

Following successful endodontic management, restoration of aesthetics presented an additional clinical challenge because of the presence of severe intrinsic discoloration, loss of coronal tooth structure, and localized gingival recession. Unlike the previously reported apexification cases, prosthetic rehabilitation in the present case required simultaneous restoration of both the white and pink aesthetic components. Sonune et al. demonstrated that gingival-coloured porcelain provides a conservative and highly aesthetic alternative for managing gingival defects when surgical correction is either contraindicated or declined by the patient.[7] Similarly, Small et al. reported successful use of pink porcelain for restoring gingival defects associated with compromised anterior aesthetics, emphasizing its ability to recreate harmonious gingival contours and improve smile aesthetics.[10] Jain et al. also highlighted the role of pink porcelain as an effective prosthetic option for masking gingival deficiencies while achieving satisfactory functional and aesthetic outcomes.[8]

Consistent with these reports, the present case utilized a porcelain-fused-to-metal crown incorporating pink porcelain after the patient declined periodontal surgery. This multidisciplinary approach effectively restored aesthetics by masking the underlying discoloration and gingival recession while preserving function, thereby distinguishing the present case from conventional apexification reports that primarily focus on successful endodontic management alone.

CONCLUSION

Managing an immature, non-vital tooth with an open apex requires a staged, multidisciplinary approach. An MTA apical plug offers a highly predictable, biocompatible artificial barrier when paired with conservative mechanical preparation, thorough chemical disinfection, and thermoplasticized obturation. Furthermore, when localized gingival recession and severe discoloration compromise the smile line, a definitive restoration incorporating pink porcelain serves as an excellent, minimally invasive alternative to surgical root coverage, achieving optimal long-term functional and aesthetic outcomes.

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