ORIGINAL RESEARCH PAPER

Dentistry

KEY WORDS: Apexification, Mineral Trioxide Aggregate, Open Apex, Dental Trauma, Immature Permanent Tooth, Endodontics.

# CLOSING NATURES INCOMPLETE DESIGN WITH MTA APEXIFICATION IN AN IMMATURE TOOTH: A CASE REPORT

**Dr. M K Mrinaalini*** Post Graduate, Dayananda Sagar College of Dental Sciences, WH58+F96, 50 Feet Main Rd, 1st Stage, Kumaraswamy Layout, Bangalore-560078, Karnataka, India. *Corresponding Author

**Dr. Vedavathi B.** MDS, Professor and Head, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, WH58+F96, 50 Feet Main Rd, 1st Stage, Kumaraswamy Layout, Bangalore-560078, Karnataka, India.

**Dr Deepthi M** MDS, Professor and Head, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, WH58+F96, 50 Feet Main Rd, 1st Stage, Kumaraswamy Layout, Bangalore-560078, Karnataka, India.

**Dr Ranjini.** MDS, Professor, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, WH58+F96, 50 Feet Main Rd, 1st Stage, Kumaraswamy Layout, Bangalore-560078, Karnataka, India.

**ABSTRACT**

The management of immature permanent teeth with pulpal necrosis and open apices remains a formidable challenge in endodontic practice owing to the absence of a natural apical constriction, which compromises effective canal debridement, disinfection, and the establishment of a predictable apical seal. Achieving three-dimensional obturation in such cases is inherently complex and demands meticulous clinical management. Mineral Trioxide Aggregate (MTA) has revolutionized apexification procedures by facilitating the creation of an immediate artificial apical barrier. Its exceptional sealing ability, superior biocompatibility, bioactive properties, and capacity to promote hard tissue formation have established MTA as the material of choice for single-visit apexification, offering predictable clinical outcomes while significantly reducing treatment duration and enhancing periapical healing. A healthy adolescent patient presented with a history of trauma to a maxillary central incisor sustained several years earlier. Clinical examination revealed no discolouration but with mild tenderness on percussion, while radiographic examination demonstrated an immature root with a wide-open apex and a periapical radiolucency suggestive of chronic apical periodontitis. Following chemo-mechanical debridement and intracanal disinfection, a 4-mm MTA apical barrier was placed. After confirmation of the apical plug, the remaining canal was obturated using gutta-percha and resin-based sealer, followed by definitive coronal restoration. Hence it is concluded that MTA apexification is a predictable and effective treatment modality for immature permanent teeth with necrotic pulps, allowing immediate formation of an artificial apical barrier and promoting favourable periapical healing.

## INTRODUCTION

Traumatic dental injuries frequently affect young permanent anterior teeth before completion of root development. When pulp necrosis occurs during this stage, root maturation ceases, resulting in thin dentinal walls and a blunderbuss or open apex. [1,2] Such teeth present considerable challenges during endodontic treatment because achieving adequate canal disinfection and obtaining an apical seal are difficult in the absence of a natural apical constriction.[3,4]

Traditionally, apexification was performed using long-term calcium hydroxide dressings, which required multiple appointments over several months.[5] Although effective, prolonged calcium hydroxide therapy has been associated with increased risk of coronal leakage, patient non-compliance, reinfection, and weakening of the root structure, thereby predisposing the tooth to cervical root fractures.[6,7]

The introduction of Mineral Trioxide Aggregate (MTA) has transformed apexification procedures by enabling the creation of an artificial apical barrier within one or two appointments.[8,9] MTA possesses excellent sealing ability, dimensional stability, moisture tolerance, antibacterial properties related to its alkaline pH, and the ability to stimulate cementogenesis and osteogenesis.[10] Numerous clinical studies have reported high success rates with MTA apexification, making it the preferred treatment for immature permanent teeth with pulpal necrosis.

This report describes the successful management of an immature traumatized permanent tooth with an open apex using MTA apexification and highlights the biological rationale and clinical advantages of this treatment approach.

### Case Report

A 25-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of occasional discomfort associated with the maxillary central incisor. The patient had sustained trauma to the anterior teeth approximately 3 years earlier and had not sought treatment at that time.

### Medical History was Non-contributory.

Clinical examination revealed Ellis Class 2 fracture of 11 with mild tenderness on percussion. No mobility or periodontal pocketing was observed. Adjacent teeth responded normally to pulp sensibility testing, whereas the affected tooth showed no response to cold testing or electric pulp testing.

Intraoral periapical radiography demonstrated an incompletely developed root with a wide-open apex and a well-defined periapical radiolucency consistent with chronic apical pathology irt 11

Based on the clinical and radiographic findings, a diagnosis of pulpal necrosis with symptomatic apical periodontitis in an immature permanent tooth was established.

### Treatment Procedure

After obtaining informed consent, 1.8 mL of 2% lignocaine with 1:80,000 epinephrine local anaesthesia was administered and the tooth was isolated under rubber dam. Endodontic access was prepared under magnification (Labomed Prima DNT, Labomed Inc., Los Angeles, CA, USA).

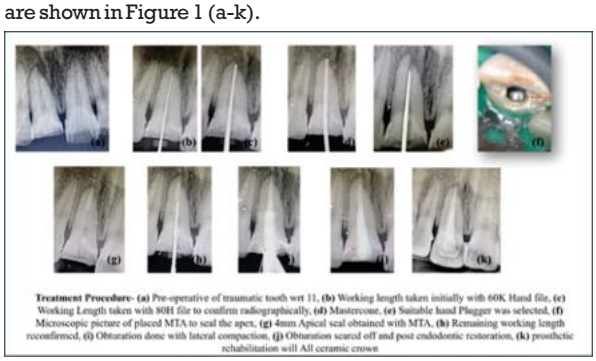
The working length was established with 80K hand file using an electronic apex locator (Woodpex V, Guilin Woodpecker

Medical Instrument Co., Ltd., Guilin, Guangxi, China) and confirmed radiographically. Minimal mechanical instrumentation was performed to preserve the fragile dentinal walls. Copious irrigation was carried out using 3.5% sodium hypochlorite (Hypochlor 3.25%, SafeEndo Dental India Pvt. Ltd., Vadodara, Gujarat, India) followed by saline and 17% EDTA (Smart Prep, SafeEndo Dental India Pvt. Ltd., Vadodara, Gujarat, India) to facilitate canal disinfection while minimizing extrusion through the open apex.

Following drying of the canal with sterile paper points, Mineral Trioxide Aggregate (MTA) BioStructure MTA Putty (0.7 g preloaded syringe; SafeEndo Dental India Pvt. Ltd., Vadodara, Gujarat, India) was inserted into the apical portion of the canal using hand plugger and approximately 4-mm apical plug was condensed gently. A postoperative radiograph confirmed satisfactory placement of the MTA barrier.

A moist cotton pellet was placed over the MTA, and the access cavity was temporarily sealed with Cavit G (SmartTemp, SafeEndo Dental India Pvt. Ltd., Vadodara, Gujarat, India) to allow complete setting of the material.

At the following appointment, the set of the MTA was verified clinically. The remaining canal space was estimated and was obturated with gutta-percha and a resin-based sealer (Sealmax-R resin-based root canal sealer (MAARC Dental, Shiva Products, Mumbai, Maharashtra, India).) using a lateral compaction technique. The access cavity was restored with bonded resin composite to ensure an adequate coronal seal. After one weak the crown preparation was done and all ceramic crown was cemented. All the procedure radiographs are shown in Figure 1 (a-k).



**Treatment Procedure- (a)** Pre-operative of traumatic tooth wrt 11, **(b)** Working length taken initially with 60K Hand file, **(c)** Working Length taken with 80H file to confirm radiographically, **(d)** Mastercone, **(e)** Suitable hand Plugger was selected, **(f)** Microscopic picture of placed MTA to seal the apex, **(g)** 4mm Apical seal obtained with MTA, **(h)** Remaining working length reconfirmed, **(i)** Obturation done with lateral compaction, **(j)** Obturation scared off and post endodontic restoration, **(k)** prosthetic rehabilitation will All ceramic crown

**Figure 1**

## DISCUSSION

Management of immature permanent teeth with pulpal necrosis remains one of the most challenging situations in endodontics because of the absence of an apical constriction, divergent canal walls, and the increased susceptibility of thin dentinal walls to fracture. Historically, calcium hydroxide apexification was considered the gold standard for inducing the formation of a calcific apical barrier. However, its requirement for multiple appointments over several months, dependence on patient compliance, and the potential reduction in fracture resistance of immature roots have limited its long-term clinical desirability. Rafter comprehensively described these biological and clinical limitations, while Huang later proposed that the advent of bioactive materials signaled "the beginning of the end" of conventional calcium hydroxide apexification by providing more predictable alternatives with shorter treatment times.[3,5]

Mineral trioxide aggregate (MTA) has transformed apexification procedures by enabling the creation of an artificial apical barrier in a single or limited number of visits. Its superior biocompatibility, excellent sealing ability, alkaline pH, low solubility, and bioactivity make it particularly suitable for treating teeth with open apices.[2] Following hydration, MTA releases calcium ions that react with tissue phosphates to form hydroxyapatite crystals along the dentin–material interface, improving the seal while promoting cementogenesis and periapical hard tissue formation. Purra et al. highlighted these biological properties as the principal reasons for the high clinical success associated with MTA apexification.[2]

The present case was managed using a single-visit MTA apical barrier following meticulous canal disinfection. This approach is consistent with the prospective study by Simon et al., who demonstrated predictable apical barrier formation and high clinical and radiographic success following one-visit MTA apexification.[7] More recently, Rahaman et al. similarly reported favorable healing outcomes with single-visit MTA apexification, emphasizing reduced treatment duration, improved patient compliance, and earlier definitive restoration. These findings support the current trend toward simplified treatment protocols without compromising biological outcomes.[9]

Systematic evidence further reinforces the predictability of MTA apexification. Guerrero et al., in their systematic review, reported consistently high success rates for MTA apexification, with favorable periapical healing and reduced treatment time compared with calcium hydroxide techniques.[1] Collectively, these findings suggest that MTA apexification achieves clinical success rates exceeding 90%, making it one of the most reliable treatment options for immature necrotic teeth.[1]

Successful apexification depends not only on the placement of an apical barrier but also on effective canal disinfection and preservation of the fragile root structure. Excessive instrumentation may further weaken thin dentinal walls; therefore, conservative mechanical preparation combined with copious irrigation remains the preferred approach. Equally important is the quality of MTA placement. Ghasemi et al. demonstrated that appropriate mixing consistency and controlled placement techniques significantly improve adaptation and reduce void formation within the apical plug, factors that contribute directly to the long-term seal and treatment success.[8] In the present case, careful placement of the MTA plug followed by an adequate coronal seal likely contributed to the favorable healing observed.

Long-term clinical observations continue to validate the effectiveness of MTA apexification. Vijayran et al. reported successful management of traumatized immature permanent teeth using MTA, with complete periapical healing and satisfactory clinical outcomes.[4] Similarly, the recent case report by Miyamoto et al. demonstrated sustained clinical and radiographic success following MTA apexification, reaffirming its predictable performance in contemporary endodontic practice.[6]

Regenerative endodontic procedures (REPs) have recently emerged as biologically based alternatives capable of promoting continued root development, increased dentinal wall thickness, and apical closure. Nevertheless, the success of regenerative therapy depends on several factors, including adequate stem cell survival, minimal canal infection, patient age, and favorable case selection. Consequently, regenerative outcomes remain less predictable in certain clinical situations. Aksoy and Kocak emphasized that while REPs represent the preferred treatment for selected immature teeth, MTA apexification continues to be an evidence-based and highly predictable option when regeneration is contraindicated, technically challenging, or unlikely to succeed.[10]

The successful clinical and radiographic outcome observed in the present case further supports the current body of evidence demonstrating that MTA apexification is a predictable, biologically acceptable, and clinically efficient

treatment modality for immature permanent teeth with pulpal necrosis. Careful canal disinfection, precise placement of a well-adapted MTA apical barrier, and an effective coronal seal remain the key determinants of long-term treatment success.

## CONCLUSION

Mineral Trioxide Aggregate apexification is a predictable and biologically favorable treatment option for immature permanent teeth with necrotic pulps and open apices. The material provides an immediate apical barrier, facilitates three-dimensional obturation, shortens treatment time, and promotes satisfactory periapical healing. Careful case selection, thorough disinfection, and an adequate coronal seal are critical for long-term success.

### Clinical Significance

Single-step MTA apexification provides clinicians with a reliable and efficient treatment option for managing traumatized immature permanent teeth with open apices, reducing treatment duration while achieving excellent biological and clinical outcomes.

## REFERENCES


1. Guerrero F, Mendoza A, Ribas D, Aspiazu K. Apexification: A systematic review. Journal of Conservative Dentistry and Endodontics. 2018 Sep 1;21(5):462-5.[1]
2. Purra AR, Ahangar FA, Chadgal S, Farooq R. Mineral trioxide aggregate apexification: A novel approach. Journal of conservative dentistry and endodontics. 2016 Jul 1;19(4):377-80.[2]
3. Rafter M. Apexification: a review. Dental traumatology. 2005 Feb;21(1):1-8.[3]
4. Vijayran M, Chaudhary S, Manuja N, Kulkarni AU. Mineral trioxide aggregate (MTA) apexification: a novel approach for traumatised young immature permanent teeth. BMJ Case Reports CP. 2013 Jan 10;2013:bcr2012008094.[4]
5. Huang GJ. Apexification: the beginning of its end. International endodontic journal. 2009 Oct;42(10):855-66.[5]
6. Miyamoto Y, Kiho K, Yokokawa D, Hasegawa T, Sakai C, Ehara M, Ochiai T, Kawano S, Nagayama M. A case report of apexification using mineral trioxide aggregate. Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology. 2025 May 1;37(3):562-6.[6]
7. Simon S, Rilliard F, Berdal A, Machtou P. The use of mineral trioxide aggregate in one-visit apexification treatment: A prospective study. Int Endod J 2007;40:186-97.[7]
8. Ghasemi N, Janani M, Razi T, Atharmoghaddam F. Effect of different mixing and placement methods on the quality of MTA apical plug in simulated apexification model. Journal of clinical and experimental dentistry. 2017 Mar 1;9(3):e351.[8]
9. Rahaman SM, Chandarani S, Mukherjee A, Jes TE, Mandal P, Buragohain A. The application of MTA in single-visit apexification treatment: A prospective study. Bioinformation. 2025;21(12):4741-5.[9]
10. Aksoy D, Kocak S. Management Strategies for Teeth with Open Apex: From Apexification to Regenerative Endodontics. Cumhuriyet Dental Journal. 2025 Sep 30;28(3):462-8.[10]