CASE REPORT

Induction of Apical Barrier Formation In An Immature Central Incisor: A Case Report

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Abstract

Immature permanent teeth with necrotic pulp present a clinical challenge due to the absence of a natural apical constriction, which complicates effective root canal obturation. Apexification is a widely accepted technique to induce the formation of a calcified apical barrier, allowing for adequate sealing of the root canal system. This case report presents the management of a non-vital, immature maxillary central incisor in a 9 year old patient following dental trauma. Clinical and radiographic examinations confirmed pulp necrosis with an open apex in relation to 21. An apical barrier was created using Mineral Trioxide Aggregate (MTA), and after 24 hrs obturation was done in relation to 21. The treatment was completed with a post-endodontic restoration with GIC and composite build up was done to restore the esthetics and function of the tooth. This case highlights the importance of timely diagnosis and staged endodontic intervention in managing traumatized immature teeth, demonstrating favourable outcomes in terms of healing and restoration.

Keywords: Apexification; Pulp necrosis; Open apex; Mineral trioxide aggregate; esthetics

INTRODUCTION

Traumatic dental injuries to immature permanent teeth often result in pulp necrosis and incomplete root development, presenting a significant endodontic challenge. In such cases, apexification is a process aimed at inducing the formation of a calcified apical barrier which is a critical treatment modality to allow for effective root canal obturation and long-term tooth preservation. Traditionally, calcium hydroxide has been employed for apexification; however, its limitations include prolonged treatment duration, multiple clinical visits, and an increased risk of root fracture due to the extended exposure time required for apical closure.[1,2]

Several studies done in this regard have shown that apexification can form a hard tissue apical barrier, but the teeth might be more prone to cervical fracture due to thin dentin walls at the cementoenamel junction (CEJ). An alternative to calcium hydroxide would be silicate-based materials like mineral trioxide aggregate (MTA), Biodentine, etc., and these materials are found to be biocompatible, which could simulate biomineralization, thereby offering a superior seal and better bond strength.[3]

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Mineral trioxide aggregate (MTA) has emerged as a superior alternative due to its excellent biocompatibility, bioactivity, and ability to induce hard tissue formation at the root apex. MTA apexification can often be completed in a single visit, significantly reducing patient compliance issues and treatment duration while providing predictable outcomes.[4,5] Its sealing ability and antibacterial properties further enhance the prognosis of non-vital immature teeth.[6]

This report presents the clinical management of a traumatized immature permanent maxillary central incisor in a young patient using MTA for apexification. Following dental trauma that led to pulp necrosis and halted root development, MTA was used to induce a reliable apical barrier. The procedure not only facilitated successful obturation but also ensured structural integrity and continued functionality of the tooth, highlighting the clinical advantages of MTA in managing such complex cases.

CASE REPORT

A 9-year-old female patient presented to the Department of Pediatric Dentistry at Kothiwal Dental College and Research Centre, complaining of mild pain and discomfort in her upper front tooth for the past six months. She had a history of trauma to the same tooth three years ago. Her medical history was noncontributory, and extraoral findings were unremarkable. Clinical examination revealed complicated crown fracture with mild discoloration in the upper left central incisor (21). (Fig. 1).

Fig.1: Pre-operative intraoral photograph of 11 and 21

Both teeth were not tender on percussion. On thermal pulp sensibility test and electric pulp test 21 was unresponsive whereas 11 was sensitive to both the test. On radiographic examination 21 showed an open apex with associated periapical lesion (Fig.2).

Fig.2: Pre-operative radiograph of the patient.

Based on the clinical history and radiographic findings, a provisional diagnosis, that is, irreversible pulpitis and Ellis class IV fracture w.r.t 21 and Ellis class II fracture w.r.t 11 was made. After discussing various treatment options with the patient, a decision was made to proceed with the MTA (BioStructure, SafeEndo, India) apexification.

Access cavity preparation and working length determination was done with #20 kfile (Mani, Prime Dental Product Pvt. Ltd., India) (Fig.3).

Fig.3: Working length determination

The canal was then meticulously cleaned mechanically using intracanal instruments. Copious irrigation with 2.5% sodium hypochlorite (NaOCl) (Bharat Chemical, India) was done 3 mm above the working length using a 30 G double-side vented needle. After that, the canal was dried with sterile paper points. Triple antibiotic paste with calcium hydroxide was (containing, minocycline, ciprofloxacin, and metronidazole) was placed in the root canal for 3 weeks so that periapical region can heal.

On recall after 21 days, the patient was asymptomatic and radiograph also showed the signs of periapical healing. Triple antibiotic paste (TAP) was mechanically removed and rinsed out of the root canal using copious irrigation with 2.5% NaOcl , followed by 17% ethylenediaminetetraacetic acid (EDTA) for the removal of the smear layer. After drying the root canal, MTA was introduced and placed in the apical third of the root canal and 3mm apical plug was made (Fig:4).

Fig.4: Apical plug formed with MTA

After which access cavity was sealed with moist cotton and temporary restoration and after 24 hrs visit. Obturation was done using gutta percha and bioceramic sealer and the post endodontic restoration with GIC restoration was also completed on the same visit. (Fig.5)

Fig.5: Apical plug formed with MTA

On follow-up recall after 7 days, the tooth was asymptomatic so, composite restoration was done w.r.t 21. (Fig.6)

Fig.6: Composite restoration i.r.t 21

DISCUSSION

Dental trauma is frequently observed in children aged 6 to 9 years, with one of the most severe outcomes being pulp necrosis. The likelihood of pulp necrosis varies depending on the type of injury—ranging from approximately 1% to 6% in crown fractures, and reaching nearly 100% in cases of tooth intrusion. When necrosis occurs in an immature permanent

tooth, it halts root development and prevents apical closure. In such situations, a procedure known as apexification is required to stimulate the formation of a calcified barrier at the root apex, allowing for proper root canal obturation.[2]

Traditionally, calcium hydroxide has been the material of choice for this procedure, owing to its ability to induce hard tissue formation at the apex. However, prolonged treatment durations, multiple visits, and an increased risk of root fracture are significant drawbacks of calcium hydroxide-based apexification.[7]

Mineral Trioxide Aggregate (MTA) has emerged as a superior alternative to calcium hydroxide due to its bioactive properties, excellent sealing ability, and ability to set in the presence of moisture.[8] MTA facilitates the formation of a more predictable and faster apical barrier, significantly reducing the treatment time and improving patient compliance—especially in pediatric patients who may struggle with long-term follow-ups.[9]

In a comparative clinical study, El-Meligy and Avery reported a significantly higher success rate and faster apical barrier formation with MTA compared to calcium hydroxide.[10] Similarly, Damle et al. observed that teeth treated with MTA showed faster apical closure and superior radiographic healing outcomes.[11] These findings align with a systematic review and meta-analysis conducted by Bonte et al., which concluded that MTA is more effective in achieving apexification in less time, with fewer complications.[12]

Another advantage of MTA is its ability to improve the fracture resistance of immature roots. In vitro studies have demonstrated that MTA-treated teeth possess higher resistance to vertical fracture compared to those treated with calcium hydroxide.[13] This characteristic is crucial, as immature teeth are particularly susceptible to structural failure due to thin dentinal walls.

Furthermore, MTA promotes better healing outcomes, as shown in a long-term study by Torabinejad and Chivian, who reported successful outcomes in cases involving root perforations and necrotic immature teeth treated with MTA.[14] The material's biocompatibility and its potential to support cementogenesis and osteogenesis further strengthen its indication in apexification procedures.[15]

CONCLUSION

The treatment approach facilitated apical barrier formation, resolution of periapical pathology, and functional and esthetic rehabilitation of the affected tooth. Early intervention, accurate diagnosis, and adherence to a staged treatment protocol are essential for favorable outcomes in managing traumatic injuries in young permanent teeth.

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