Monoblock Obturation Technique for Non-Vital Immature Permanent Maxillary Incisors Using Mineral Trioxide Aggregate: Results from Case Series

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ABSTRACT
Ten patients presented with non-vital immature teeth for root canal treatment. In all these cases the pre-operative clinical examination revealed apical periodontitis with a buccal sinus tract of endodontic origin. These cases were treated by a mineral trioxide aggregate (MTA) monoblock obturation technique. Follow-up evaluations were performed at 1 – 2 years after treatment. Eight out of 10 cases were associated with periradicular healing at follow-up evaluation. Mineral trioxide aggregate Monoblock obturation technique appears to be a valid material to obtain periradicular healing in teeth with open apices and necrotic pulps.

Key Words: Mineral trioxide aggregate. Necrotic pulp. Monoblock obturation.

INTRODUCTION
It has been observed that about 20 – 30% of 12 years old children have suffered some form of dental injuries.1 When teeth with incomplete root formation suffer pulp necrosis, the formation of dentine stops, and root development ceases. Consequently, the canal remains large, with thin and fragile walls, and the apex remains open. These features make instrumentation of the canal difficult and hinder the formation of an adequate apical stop.

There are different treatment options such as apexification technique using calcium hydroxide, one-visit MTA apical plug apexification, retrograde filling, revascularization to induce the root closure if the patient is in growing age.

Calcium hydroxide pastes have become the material of choice in these cases to induce apexification.2 However, the apexification procedure may take many months and require multiple visits, making patient compliance a problem. It may also further weaken the teeth and possibility of increased tooth fracture after the use of calcium hydroxide for extended periods.3

For these reasons one visit apexification has been suggested.2 Mineral trioxide aggregate (MTA) has been proposed as a material suitable for one visit apexification.4 However, there is a little published information about its use in cases of immature teeth with open apices in humans. Previous reports of MTA in root-end closure are primarily case reports only.4,5

The monoblock obturation technique or filling of the entire root canal system with MTA is the logical progression in the evolutionary application of this material for non-vital immature teeth. The monoblocks created in the root canal spaces are classified as primary, secondary or tertiary type.6 According to this classification, mineral trioxide aggregate monoblock obturation represents a contemporary version of the primary monoblock.

Mineral trioxide aggregate (MTA) might have a profound advantage when used as canal obturation material because of its superior physiochemical and bioactive properties MTA provides an effective seal against dentin.7 MTA obturation in teeth with immature apices can induce apexogenesis by stimulating the mesenchymal stem cells from the apical papilla to promote complete root maturation in the presence of periapical pathosis and abscesses.8 Recent data have demonstrated that root canal treated teeth obturated with MTA exhibit higher fracture resistance than their untreated counterparts.9 Previously only few case reports of MTA monoblock obturation technique in non-vital immature permanent teeth have been documented.10,11

The aim of this report was to present the short-term follow-up results in ten consecutively treated permanent maxillary incisors that presented with non-vital pulps, open root apices and, were treated by mineral trioxide aggregate (MTA) monoblock obturation technique.

METHODOLOGY
This report include ten permanent maxillary incisors in 10 subjects aged between 13 and 32 years who
presented with non-vital immature permanent teeth for root canal treatment at the Department of Endodontics of the College of Dentistry of the Ziauddin University, Karachi, Pakistan, from January 2010 to January 2012. The inclusion criteria were patients presenting with incomplete development of the involved tooth without any root fracture or internal or external resorption of the tooth.

Clinical and radiographic examination were performed and clinical diagnosis were made (Table I). Ethical approval was sought and granted. Informed consent was obtained from all the subjects.

The teeth were isolated with a rubber dam. A conventional access cavity was prepared and the canal was then gently cleaned with manual instruments and 5% NaOCl irrigation (Clorox, Pakistan). The working length was measured radiographically with a K-file and recorded for reference (Table I).

The canals were dried with sterile paper points and filled with calcium hydroxide (Ultracalx Ultradent, USA) placed using intracanal capillary tips (Ultradent Inc.), and the access cavity was sealed with cavit (3M ESPE, Asia). After one week, the calcium hydroxide was removed by rinsing with alternating solutions of NaOCl 5% and EDTA 17% (META). A final rinse with sterile water was performed. Once the canal was dry at the working length, with no exudates, the full canal was filled with MTA (Dentsply Tulsa).

Mineral trioxide aggregate were mixed, as recommended by the manufacturer, and filled the whole canal using hand Lawaty technique. The armentarium used for MTA placement and adaptation were containing amalgam gun and locally modified hand and finger pluggers, K-file with flat end (Figure 1).

MTA was mixed in a dappen dish and transferred to the pulp basin with amalgam gun. An apex locator was then attached to a K-file, 1 size smaller than the MAF. The K-file was moved circumferentially along the canal glide path with an apical pumping motion by using the coronal portion of the canal as a funnel, which allows the MTA to flow from the access cavity reservoir to the canal terminus. The apex locator was removed as the depth of the canal glide path was reduced, and the apical MTA plug was formed. The MTA can, thereafter, be circumferentially funneled and pumped. A sterile sponge pellet moistened with sterile water was placed over the canal orifice and the access cavity was sealed temporarily. Correct placement of MTA was confirmed radiographically. At the next appointment, the access cavity was sealed and the teeth were restored with dentine and enamel-bonded composite.

Cases were reviewed radiographically using the paralleling technique at the first visit, and at the 12 and 24 months follow-up appointments. Clinically, treatment was considered successful when symptoms such as pain, swelling, buccal sinus tract, or tenderness to apical and gingival palpation or percussion were absent.

Healing was classified according to the radiographic appearance against the following criteria: (i) complete healing: complete regeneration of the periodontal ligament space; (ii) partial complete healing: substantial reduction (more than 75%) in the diameter of periapical lesion; (iii) incomplete healing: substantial reduction (more than 50%) in the diameter of the periapical lesion; and (iv) unsatisfactory healing: no reduction or an increase in the diameter of the periapical lesion.

RESULTS

At the 12-month clinical examination, all teeth were free from symptoms, buccal sinus tracts, and swelling. Radiographic examination revealed incomplete resolution of the periapical lesion in all cases (Figure 2C and 3C).
At the 24-month follow-up, 8 teeth displayed partial complete healing (Figure 2D and 3D). In two teeth (patient no. 4 and 6), although the clinical symptoms disappeared and the tooth was in adequate clinical function, the radiographic follow-up revealed incomplete healing with substantial reduction (more than 50%) in the size of the periapical lesion (Figure 4B and 4D).

**DISCUSSION**

In general, the outcomes in this case series are nearly similar to previously reported cases of successful MTA monoblock obturation technique in teeth with necrotic pulps and open apices.\(^{10,11}\) The previous reports confirm that MTA can be considered as an effective material to support regeneration of apical tissues in immature necrotic teeth. The treated teeth were asymptomatic, and radiographic follow-ups showed healing of periapical tissues and new hard tissue formation in the apical area of the affected teeth. For the present study, a 2-year follow-up evaluation revealed partial complete healing in 8 out of 10 cases. In all these cases, the pre-operative clinical examination revealed apical periodontitis with a buccal sinus tract of endodontic origin.

At the 2-year follow-up examination, 2 cases (patient no. 4 and 6) displayed incomplete healing. For these patients, the pre-operative radiolucency was extensive, and involved teeth presented with wide-open apex. These two teeth with incomplete healing at the 2-year radiographic follow-up also revealed substantial reduction (more than 50%) in the size of the periapical lesion. It can be assumed that the very large pre-operative apical lesion and wide-open apex would need a longer period of time to heal.

It was also observed that all treated teeth obturated with MTA were not fractured at the 2-year follow-up examination and this outcome is similar to recent research on immature tooth models that were obturated with MTA and indicated that MTA showed higher fracture resistance than untreated controls.\(^9\)

The canal obturation with MTA requires the same preparation and irrigation normally executed for gutta-percha placement. The placement of the MTA can be accomplished using different methods. MTA can be placed by using ultrasonic energy or hand condensation technique with or without the help of microscopic vision. In the present study, the MTA were placed by a standardized hand condensation Lawaty technique.

Based on our observations, the non-surgical management of teeth with necrotic pulps and incomplete apex formation with MTA monoblock obturation was successful. In two out of 10 cases, the radiographic healing was incomplete, a finding which may have been influenced by the initial severity of the lesion and the architecture of the root-end or both these factors contributing together for incomplete healing.

**CONCLUSION**

Orthograde MTA monoblock obturation placed by hand condensation technique resulted in a successful outcome for a period of 2-year. Mineral trioxide aggregate monoblock obturation technique appears to be a valid material to obtain periradicular healing in teeth with open apices and necrotic pulps.

**REFERENCES**


