MINERAL TRIOXIDE AGGREGATE (MTA) APEXIFICATION IN YOUNG PERMANENT TEETH: TWO CASE REPORTS

ABSTRACT
Treatment of nonvital immature permanent teeth with calcium hydroxide is associated with some difficulties such as weakened tooth fracture, root canal reinfecion and long treatment time. Mineral trioxide aggregate (MTA) apical plug method is an alternative treatment option for open apices, and has gained popularity in the recent times. In this case report, we have attempted to present successful treatment of three maxillary incisors with open apices and periapical lesions with MTA. After preparing the access cavity, the working length was determined. The root canals were irrigated with 2.5% Sodium hypochlorite (NaOCl) and disinfected with calcium hydroxide. MTA was then placed in the apical 4 millimeters of the root canal. The remaining part of the root canal was filled with gutta-percha and the coronal restoration was finished with composite resin.

Keywords: Apexification, immature teeth, mineral trioxide aggregate

INTRODUCTION
Traumatic injuries to young permanent teeth affect 30% of children. These injuries often result in pulpal inflammation or necrosis and subsequent incomplete development of dentinal wall and root apices. In teeth with incomplete root development caused by trauma, caries and other pulpal pathosis, the absence of natural constriction at the end of the root canal presents a challenge and makes control of filling materials difficult. The aim is to seal a sizeable communication between the root canal system and the periradicular tissue and provide a barrier against which obturation material can be compacted. The treatment of choice for necrotic young permanent teeth is apexification. The most commonly advocated medicament is calcium hydroxide. The use of calcium hydroxide was first introduced by Kaiser in 1964 who proposed that this material mixed with camphorated parachlorophenol (CMCP) would induce the formation of a calcified barrier across the apex. Calcium hydroxide can be mixed with a number of different substances (camphorated mono chlorophenol, distilled water, saline, anesthetic solutions, chlorhexidene and cresatin) to induce apical closure. Recently, synthetic apical barriers with a variety of materials have been proposed as alternatives to the traditional apexification treatment
method with calcium hydroxide. Mineral trioxide aggregate (MTA) is the most popular material used these days. MTA has been suggested to create an apical plug at the root end and helps to prevent the extrusion of the filling materials. The material consists of fine hydrophilic particles of tricalcium silicate, silicate oxide and tricalcium oxide. When MTA is mixed with sterile water, it forms a colloidal gel, and its setting time is 3 – 4 hours in the presence of moisture. The following clinical cases describe the use of MTA in apexification of young permanent teeth.

**CASE REPORT I**

A 8 year old boy reported with fractured upper left central incisor. (Figure 1) The medical history was not contributory. No significant family history was revealed. No extra-oral findings were noted. Clinically, we found that there was complicated crown fracture (Ellis class III) in relation to upper left central incisor. The incisor was tender to percussion. No mobility was seen. On electric pulp testing, the upper left central incisor was nonresponsive. On the basis of clinical and radiographical findings, a diagnosis of traumatised young permanent immature teeth was made with respect to upper left central incisor. Endodontic treatment was planned with the use of MTA for apexification. Access opening was prepared under rubber dam isolation and working length was determined. Biomechanical preparation was carried out using 80 size k file with circumferential filing motion. Root canal debridement was done using alternative irrigation with 2.5% NaOCl and saline. Calcium hydroxide was placed in the root canal and patient recalled after 7 days. (Figure 2) At subsequent appointment, canal was irrigated with 2.5% NaOCl and saline. The canal was dried with paper points and MTA placed with pluggers until thickness of 4 mm. A moist cotton pellet was placed in the canal and access cavity was sealed with temporary cement. After 24 hours, root canal was obturated with gutta-percha using lateral condensation technique. (Figure 3) Access cavity was sealed with glass ionomer cement. Fractured crown portion was restored with composite. (Figure 4)

**CASE REPORT II**

A 14 year old girl reported with fractured upper right and left...
The medical history was not contributory. No significant family history was revealed. Extraoral findings were unremarkable. Clinically, we found that there was complicated crown fracture (Ellis class III) in relation to upper right central incisor (11) and upper left central incisor (21). The incisors were slightly tender to percussion. No mobility was seen. On electric pulp testing, the upper right central incisor (11) and upper left central incisor (21) was non responsive. An intraoral periapical radiograph was taken which showed incomplete root formation with wide open apices and periapical abscess in both upper central incisors. Endodontic treatment was planned with the use of MTA for apexification. Access opening was prepared and working length was determined. Biomechanical preparation was carried out. Root canal debridement was done using alternative irrigation with 2.5% NaOCl and saline. Calcium hydroxide was placed in the root canal and patient recalled after 15 days. (Figure 6) At subsequent appointment, canal was irrigated with 2.5% NaOCl and saline. The canal was dried with paper points and MTA placed with pluggers until thickness of 4 mm. (Figure 7) A moist cotton pellet was placed in the canal and access cavity was sealed with temporary cement. After 24 hours, root canal was obturated with gutta-percha using lateral condensation technique. Access cavity was sealed with glass ionomer cement. Fractured crown portion was restored with composite. (Figure 8)

**DISCUSSION**

The goal of apexification is to obtain an apical barrier to prevent the passage of toxins and bacteria into periapical tissues from root canal. In the literature, a variety of materials have been proposed for induction of apical barrier formation. Calcium hydroxide has become the material of choice for apexification; it is bactericidal with an alkaline pH that may be responsible for stimulating apical calcification. Despite its popularity for the apexification procedure, calcium hydroxide therapy has some inherent disadvantages, including variability of treatment time, unpredictability of apical closure, difficulty in patient follow-up and delayed treatment. Therefore, the search continues for procedures and materials that may allow for more natural continued apical closure in teeth with immature apices. The US Food and Drug Administration approved mineral trioxide aggregate (MTA) in 1998 as a therapeutic endodontic material for humans. MTA has been shown to have superior sealing ability to amalgam, zinc oxideeugenol, intermediate restorative material (IRM) and superethoxybenzoicacid. MTA has also been shown to have superior characteristics as a direct pulp capping agent when compared with calcium hydroxide in animals and humans in the root canal, which would result in intracanal bone formation and arrest of root development. MTA as an apexification material represents a primary monoblock. Appetite like interfacial deposits form during the maturation of MTA result in filling the gap induced during material shrinkage phase and improves the frictional resistance of MTA to root canal walls.

MTA has superior biocompatibility and it is less cytotoxic due to its alkaline pH and presence of calcium and phosphate ions in its formulation results in capacity to attract blastic cells and promote favorable environment for cementum deposition. Scaffolding is provided for hard tissue formation by MTA. It stimulates the production of interleukins and cytokines release. Current literature supports its efficacy in promoting the overgrowth of cementum and it may facilitate the regeneration of the periodontal ligament. MTA can be used in teeth with pulp necrosis and inflamed periapical lesions because it may set in moist environments.

In the MTA plug technique, root canals must be disinfected with temporary calcium hydroxide before placing MTA for 2 weeks. This is because performing chemo-mechanical preparation alone is not effective for complete elimination of microorganisms. Hence, we used calcium hydroxide, in this case, in between the appointments in the root canal for disinfection.

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