

Avulsed Immature Permanent Central Incisors Obturated With Mineral Trioxide Aggregate: A Case Report

Ahmed Al-Kahtani¹

¹Associate Professor and Consultant, Chairman, Department of Restorative Dental Sciences, College of Dentistry, King Saud University, P.O. Box 60169, Riyadh 11545, Riyadh, Kingdom of Saudi Arabia. Email: endodontic@hotmail.com.

ABSTRACT

The endodontic management of immature permanent incisors in young children can be challenging. This case reported an avulsed immature maxillary central incisors that underwent complete endodontic obturation using mineral trioxide aggregate. A 10-year-old male who suffered a fall injury avulsed both his central incisors. The revascularization process was not possible due to patient compliance and geographic reasons. Mineral trioxide aggregate was utilized as a novel endodontic treatment. After one year post-injury, the teeth remained symptom-free, the clinical and radiographic follow-up showed evidence of healthy periodontium.

Key Words: MTA, Obturation, Avulsed Incisors.

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Address for Correspondence: Dr. Ahmed Al-Kahtani. Associate Professor and Consultant, Chairman, Department of Restorative Dental Sciences, College of Dentistry, King Saud University, P.O. Box 60169, Riyadh 11545, Riyadh, Kingdom of Saudi Arabia. e-mail: endodontic@hotmail.com.

Background

When the dental pulp of an immature permanent tooth before complete root development is injured from either dental trauma or infection, it normally poses a clinical challenge.¹ Providing endodontic treatment is difficult when dentin formation and tooth maturation ceases.¹ The endodontic management of dental trauma is always complicated by the fact that most of the patients are young and require urgent need for immediate care and the need long-term follow-up treatment. Dental avulsion is the complete displacement of a tooth from the surrounding alveolar socket due to injuries and they are particularly complicated to manage in patients with immature teeth. When a

tooth is avulsed, it is important to minimize the damage on the cellular structure of the tooth and bone blood supply, periodontal ligament cells and prevent infection of the pulp tissue. The emergency intervention after avulsion injury is based on the quick return of the displaced tooth to its respective socket, splint the tooth to non-knocked-out adjacent teeth with normal alveolar process and bone support, antimicrobial therapy for prevention of infection and possible treatment at decisive times during the healing phase.²⁻³

An avulsed permanent teeth should be replanted immediately and stabilized for 7- to 14-day period and must record the assessment of the pulp status.⁴⁻⁸ External inflammatory root resorption is

the most devastating early complication of tooth avulsion. The necrotic pulpal tissue exacerbates this resorptive procedure. To prevent root destruction, the American Association of Endodontists and the International Association of Dental Traumatology recommends prophylactic pulpectomy after avulsion of mature teeth with closed apices. An open apex complicates root canal treatment because they have thin dentinal walls which are prone to fracture thereby requiring alternative approach to the management of traumatized avulsed immature teeth. If the teeth are replanted after a short extraoral period subsequent to avulsive injury of the immature

teeth, pulpal revascularization may occur.⁹⁻¹⁰ Prior to complete root development, teeth receiving pulpectomy remain immature. It causes difficulties in the restoration of the coronal anatomy, completion of endodontic therapy, and long-term periodontal stability of the tooth. This is the reason why, pulpectomy is not recommended until there is evidence of clinical or radiographic signs of tooth pathology (i.e., inflammatory root resorption, necrosis, pain or swelling). Pulp necrosis of immature avulsed teeth leaves the root apex open and root canal procedure should normally be initiated but is not feasible, due to the inadequacy of the apical stop. Traditionally, treatment for immature teeth involves creating a

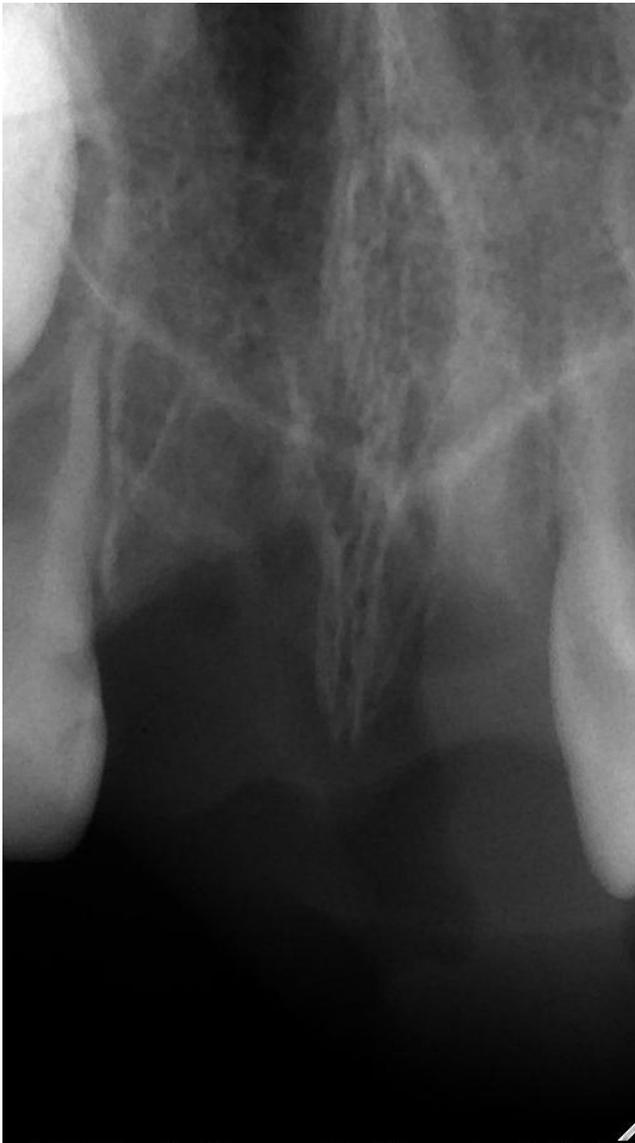


Fig. 1: Post traumatic periapical x-ray.



Fig. 2: Teeth 11 and 21 after replantation.

calcified barrier using Calcium Hydroxide [Ca(OH) 2] to promote formation of a hard apical barrier at the open apex through the process of apexification.¹¹ This technique has a number of disadvantages including prolonged treatment time, multiple treatment visits, does not increase the thickness of the immature dentinal walls and variable outcomes. Long-term dressing with calcium hydroxide on the treated teeth is more likely to suffer a cervical root fracture during, or following root canal treatment. Mineral trioxide aggregate (ProRoot MTA, tooth-colored formula, Dentsply, Tulsa, OK, USA) has been recommended as pulp capping material that provides a hard tissue barrier in one treatment session, can set even in a moist environment and has a high sealing ability.⁴

MTA should be considered as an alternative to the traditional calcium hydroxide apexification technique when used as a root-end closure in immature apices. The purpose of this paper was to report the use of mineral trioxide aggregate as alternative to CaOH apexification for complete endodontic obturation.

Case Report

A healthy 10-year-old male presented to the Emergency clinic of the College of Dentistry, King Saud University, Riyadh, Saudi Arabia. The patient was injured from a fall after leaving the swimming pool. The patient was accompanied by his parents who came to the clinics 45 minutes after the injury with teeth number 11 and 21 totally avulsed and stored in milk. The consent of the patient was obtained prior to the participation in this case study.

No craniofacial anomalies or neurologic disorders were detected on the clinical examination. There were no fractures of the maxillofacial complex as well. A stable, reproducible occlusion was present. The parents reported that the both central incisors had been avulsed intact at the time of the injury.



Fig. 3: Teeth 11 and 21 with splint on.

A periapical radiograph of the maxillary central incisors was taken and displayed immature incisors with open apices and very big canal spaces. After local anesthesia was administered, both central incisors were repositioned properly and an orthodontic wire splint was stabilized by composite resin (Figs. 1, 2 and 3).

Amoxicillin syrup and a 0.12% chlorhexidine gluconate mouthrinse were prescribed. A follow-up visit was scheduled for the patient at the endodontic clinics for splint removal and further evaluation. The patient was re-evaluated clinically and radiographically at 14 days post-injury.

After two weeks, both central incisors were stable with good gingival healing and physiologic



Fig. 4: At 14 days post-traumatic injury.



Fig. 5: Teeth 11 and 21 with calcium hydroxide.

mobility. The vitality testing were inconclusive as both did not respond to EPT and thermal testing. The periapical film displayed a start of external root resorption apically (Fig. 4).

Due to lack of patient compliance and due to geographical reason, the usual procedure for revascularization was not a preference and necessitated pulp extirpation. The apexification process was carried out under local anesthesia using calcium hydroxide powder (Henry Schein Inc, Melville, NY). Calcium hydroxide was used to stop the external resorption. It was introduced to the root canal space using a 25-mm lentulo spiral (Dentsply Maillefer, Johnson City, Tennessee,

USA) in a slow-speed handpiece (Fig. 5). The paste was condensed from the blunderbuss root apex to the tooth's cemento-enamel junction. A dry cotton pellet was placed in the coronal pulp chamber, and the endodontic access was closed with glass ionomer cement following the manufacturer's instructions. The child was reappointed for further evaluation in 1 month.

At 46 days post-injury, the patient returned asymptomatic. Clinical examination continued to reveal normal color, mobility, and response to palpation and percussion. Radiographic evaluation (Fig. 6) revealed no further external resorption and big canal space for both central incisors. The family



Fig. 6: At 46 days post-traumatic injury.

was notified of the radiographic signs of periodontal healing, and a mutual decision was made to continue with the apexification process. With the family's consent, the patient was appointed for treatment and obturation of the teeth using mineral trioxide aggregate. A week later, a local anesthetic was administered and rubber dam isolation was obtained. The temporary restorations on the lingual surfaces were removed and access was gained to the canal. The existing calcium hydroxide paste was removed with K-files (SybronEndo, Glendale, Calif) and multiple rinses of sodium hypochlorite. The canals were instrumented to a size 100 K-file at a working length of 22.5 mm of both teeth. The canals were dried and obturated with A. The MTA was mixed

with sterile water following the manufacturer's instructions. The MTA was placed in the canal with a large amalgam carrier and condensed with Buchanan pluggers. A stopper was placed on the plunger at 22.5 mm. Condensation was checked radiographically and the canal was filled slightly below the cemento-enamel junction.

A wet cotton pellet was placed in the pulp chamber



Fig. 7: Teeth 11 and 21 with MTA obturation and composite resin.

overlying the condensed MTA and Cavit G (3MESPE, Norristown, Pa) was placed in the access opening to close the tooth. The patient was rebooked for final filling a week later. The patient came back a week later for final filling of composite resin (Fig. 7).

Three, 6-, 12-month (Figs. 8 a,b,c) clinical and radiographic re-evaluations of the MTA obturation

extra challenge for clinicians due to the fact that these teeth are potential for many complications



Fig. 8: Radiograph at (a) 3 months recall, (b) 6 months recall, and (c) 1 year recall.

were completed by the endodontist. The patient had been advised to avoid further dental trauma and the investigator was informed later that he remained symptom free.

In this case report, the patient and family remained highly motivated and compliant with the treatment recommendations and follow-up regimen set forth by the authors. Routine evaluation will continue with this patient to ensure that long-term sequelae such as replacement resorption, cervical root fracture, or infection are managed appropriately. The authors were satisfied with the patient's clinical outcome thus far, as the restorative process proved to be atraumatic while allowing for full maintenance of oral function and esthetics.

Discussion

Treatment of traumatized teeth always carries

added to the nature of patients as most of them are young which make the treatment more difficult. Treatment modalities for such teeth depend on many factors including the maturity of teeth, nature of trauma, extra-oral dry time and many others.

Mineral trioxide aggregate (MTA) has gained clinical popularity and has been investigated as a material to seal those that link the root canal system to its surrounding tissues where migration is significantly reduced.² MTA is made up of a powder consisting mainly of lime, silica, and bismuth oxides that transforms into a gel at pH 12.5 to a rigid mass when exposed to moisture and allowed to set for approximately for 4 hours.¹²

MTA is used successfully at the end of tooth roots to create an artificial barrier in order to compress the process of treatment into one or two visits.¹ It has been successfully used to repair horizontal root

fractures, root resorption, internal resorption, furcation perforations and apexification and/or apexogenesis.¹³

MTA has given excellent clinical results when used as an apical plug in root-fractured teeth.¹⁴⁻¹⁶ Its main clinical advantage is reducing the time of overall treatment and calcium hydroxide dressing, as an immediate artificial barrier is created.¹¹ MTA is a biocompatible material that has a superior sealing capabilities through enhanced marginal adaption¹⁷ and an evidence of antibacterial activity. MTA apexification observational studies have demonstrated equivalent healing results to calcium hydroxide apexification.¹¹ However, although the open apex might become "closed", this does not promote the continued development of the immature root, which has thin dentinal walls that render it prone to fracture. Post-endodontic restorations may have great significance in preventing root fracture in these thin-walled immature anterior teeth.¹¹ In vitro studies demonstrate that composite resin restorations following endodontic treatment with extension of the composite resin into the root canal can substantially enhance the strength of MTA-filled immature teeth.¹⁸

Drawbacks of MTA include the potential for tooth discolouration, presence of toxic elements in the material composition, long setting time, high material cost and the absence of a known solvent to aid its removal.¹⁹

Replanting of immature teeth in children is intended to allow possible revascularization of the tooth pulp.²⁰ After soaking in doxycycline, the revascularization rate doubled.²¹ The goal is to stimulate apexification and prevent the inflammatory response.²² MTA is likewise used to obturate immature avulsed incisors with open apices.²³

Replanting the avulsed teeth with open apices after more than 60 minutes will result to a poor long-term prognosis; necrosis of the periodontal

ligament will take place and healing will be difficult, and occurrence of ankylosis, root resorption and inflammatory resorption. This is the reason why other investigators deemed it appropriate that such teeth should not be replanted.^{6,20}

Avulsed primary teeth should not be replanted to prevent further injury to the developing successor.⁶⁻⁷ In contradiction to avulsed permanent teeth which should be replanted as soon as possible and stabilized for 7-14 days.⁵⁻⁸ There is no evidence to disprove that the current course of action and plan would result to a successful periodontal healing after replantation nor will it have an effect on the duration of the splint.²⁴ If within 5 minutes, the tooth cannot be replanted, it should be stored in a medium that will retain vitality of the periodontal ligament fibers.^{7,25} The greatest priority in this case is long-term maintenance of a no pathologic root, despite cervical root fracture or replacement resorption.

For this case report, the investigator believes that after one year, the chance of infection is negligible. When treating traumatic injuries, practitioners must take into account the social psychological, emotional and financial capabilities of the patients and their relatives when making treatment recommendations. Extraction of the avulsed teeth should always remain an option and the practitioner must consider the patient's esthetic, functional, and future restorative needs.

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