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Abstract

External inflammatory root resorption (EIRR) is one of the major complications seen after replantation of avulsed teeth. EIRR can occur rapidly in young teeth with open apices. The routine treatment plan consists of long term application of calcium hydroxide (CH). However, this treatment modality has many disadvantages such as increase of the brittleness of root dentin and risk of cervical root fractures in immature teeth. On the other hand, mineral trioxide aggregate (MTA) produces CH during its hydration and therefore has the benefits of CH such as increase of the root surface pH. However, it has been shown that this material does not increase the brittleness of root dentine as CH does. Here we report a case of successful treatment of a complicated case of inflammatory EIRR in a maxillary right central incisor with mineral trioxide aggregate (MTA) without prior application of calcium hydroxide (CH).

Keywords: Avulsion; External Inflammatory Root Resorption; Immature Tooth; Mineral Trioxide Aggregate; Open Apex

Introduction

One of the major complications seen when encountering teeth with a history of avulsion is external inflammatory root resorption (EIRR) which occurs in 50% to 76% of cases [4,15,20]. This kind of root resorption can adversely affect the prognosis and treatment outcome of the tooth and if not controlled, can result in rapid tooth loss [3,11,19]. If the avulsed tooth encounters excessive dry time before replantation, the periodontal ligament cells will be damaged and a severe inflammatory response will initiate after replantation over a diffuse area of the root surface [12]. If the pulpal tissue undergoes necrosis and becomes contaminated with bacteria, this inflammatory response can be intensified [23]. Clinically teeth undergoing EIRR are usually asymptomatic in the early stages and can only be diagnosed by radiographic imaging. However, as the resorption progresses, symptoms may occur. EIRR can occur rapidly in young teeth with open apices. This is due to the existence of wide dentinal tubules which allow irritants to move freely to the external surface of the root [23]. Therefore, if diagnosed late, the tooth structure may be compromised and the prognosis of the tooth will be poor.

When encountering a tooth with EIRR, the treatment plan consists of long term calcium hydroxide (CH) therapy [1,10]. CH has a strong antibacterial effect and also increases the pH of the dentine, therefore inhibits the activity of the acid hydrolases of osteoclasts in the periodontal tissue and activates alkaline phosphatase [21]. By using this treatment modality healing may occur irrespective of the extent of resorption and the amount of root substance lost [7].


Despite of all the benefits of this treatment, the long-term use of CH has some disadvantages. For instance, it increases the brittleness of the root dentin and the risk of cervical root fractures especially in immature teeth [5,24]. This treatment modality also requires repeated clinical sessions and high cooperation from patients. Furthermore, due to the necrotizing effects of CH on PDL cells, formation of a normal attachment apparatus may be prevented and replacement resorption may be caused [16]. Therefore, some consider the application of CH in cases with damaged cementum to be a contraindication [16].

Mineral trioxide aggregate (MTA) is a water based cement which releases calcium hydroxide as a byproduct of its hydration process [8,9]. Andreasen., et al. [6] have shown that the fracture resistance of teeth obturated with MTA was higher than those treated with short term CH prior to MTA obturation and also higher than those treated with long term CH.

The following case report discusses the successful management of EIRR by obturating the root canal with MTA without prior application of CH in a tooth with a history of avulsion in a young female patient.

Case Report

An 8-year-old female patient presented with a history of traumatic injury to the anterior maxillary portion, crown fracture of the left maxillary central incisor and avulsion and replantation of the right maxillary central incisor two months ago was referred to us at the department of Endodontics of the School of Dentistry of Tehran University of Medical Sciences (Figure 1). The patient’s medical history was noncontributory. The patient's legal guardians reported that the extra-oral dry time of the avulsed tooth was about 30 minutes and then the tooth was immersed in milk for 2-3 hours. Afterwards the tooth was replanted by a general practitioner. Following replantation, the four anterior teeth were stabilized by a rigid wire and composite resin. After 2 months, the splint was removed and the patient was referred to us. At this time, our clinical examinations showed that the right maxillary central incisor had grade 1 mobility (less than 1 mm) and was tender to percussion and palpation while the other anterior teeth were normal regarding these matters. The results of periodontal probing of all anterior teeth were within normal limits (< 3 mm) except for the left maxillary central incisor which had a 5 mm probing depth in the mesial side.

Cold test with Endo-Frost cold spray (Roeko; Coltene Whaledent, Langenau, Germany) elicited no response on the right maxillary central incisor, whereas other anterior teeth responded to cold without lingering. In radiographic examinations (Figure 2), the right maxillary central incisor showed extensive external root resorption with a periapical radiolucency while the other anterior teeth had open apices without any periapical rarefaction.

The concluding diagnosis for the right maxillary central incisor was symptomatic apical periodontitis with external inflammatory root resorption. Considering the extent and severity of the resorption and the possibility of perforation existence due to the resorption, we decided to obturate the root canal space of the right maxillary central incisor with MTA to arrest the inflammatory root resorption. After completely explaining the possible risks of the treatment to the patient's legal guardians, an informed consent was acquired.

Local anesthesia was obtained by infiltration of 2% lidocaine and 1:80,000 epinephrine (Darupaksh, Tehran, Iran). Access cavity was prepared and the tooth was isolated with a rubber dam. We used an electronic apex locator (Root ZX; J. Morita, Tokyo, Japan) to indicate whether the EIRR perforated the root canal system and also to determine the working length. The device confirmed the presence of perforation in the root canal system. Cleaning and shaping was mainly done chemically due to the severity of EIRR. To prevent a hypochlorite accident, we used 2% chlorhexidine (Consepsis, Ultradent, South Jordan, UT) for irrigation. To increase the effect of the irrigant we agitated a file in the root canal after the irrigant was delivered inside it. Afterwards, the root canal was rinsed with normal saline and then it was obturated with tooth colored ProRoot MTA (Dentsply Tulsa Dental, Tulsa, OK). A moist cotton pellet was put inside the access cavity. Then the tooth was coronally sealed with temporary filling material (Zonalin, Kemdent, ADP, Swindon, UK). Radiographic images were taken to observe the quality of the placed MTA (Figure 3). Considering the fact that systemic antibiotics were not prescribed for the patient by the previous clinician, we prescribed systemic amoxicillin [2].

In the second session, 7 days later, the temporary filling material was removed and the setting of the MTA was checked. MTA was completely set. Then the tooth was coronally sealed (Zonalin, Kemdent, ADP, Swindon, UK) again. In this session, the tooth was asymptomatic during clinical examination. The patient was referred for permanent restorative procedures.

After 2 months, in the first follow up session, the tooth was clinically asymptomatic and was within the normal limits regarding probing, percussion, mobility and palpation. The tooth had a good composite restoration with no visible leakage. In the second follow up session, 7 months later, the tooth was clinically asymptomatic and in radiographic examination healing of the bone rarefaction was observed (Figure 4). Furthermore, the resorptive process had stopped and lamina dura formation had occurred in the resorptive areas.

**Figure 4:** 7 month follow up radiographic images.

**Discussion**

This case report describes the successful treatment of a complicated case of EIRR occurring during 2 months after replantation of an avulsed permanent tooth. Considering the fact that the other central maxillary incisor of the patient also had an open apex and the patient was 8 years old we can conclude that the avulsed central maxillary incisor had an open apex when avulsed. Unfortunately, the patient’s dental record regarding the replantation session were incomplete and it is unknown what protocol was used during tooth replantation. According to the patient’s statement the tooth was kept dry for 30 min and afterward was stored in milk for 2-3h prior to replantation. According to the 2012 guidelines of the International Association of Dental Traumatology for management of avulsed permanent teeth [2], in the case of teeth with open apices, topical administration of minocycline or doxycycline is advised. In this case, we are not aware of the administration of this protocol. It has also been advised to stabilize the tooth for 2 weeks with a flexible splint [2]. In this case, a rigid splint was used for 2 months. Moreover, according to the patient’s statement systemic antibiotics were not prescribed after replantation. All these factors may contribute to EIRR [12,23].

The treatment objective of replantation in permanent avulsed teeth with open apices is to give the tooth a chance for revascularization [2]. It should be considered that young permanent teeth have wide dentinal tubules which allow irritants to move freely to the external surface of the root [23]; therefore, if revascularization does not occur and the pulpal tissue gets infected, EIRR may occur rapidly as seen in this case. Hence, careful monitoring and follow up accompanied by high compliance of the patient is necessary to obtain successful outcome.

The conventional and routine treatment protocol for a progressive EIRR consists of chemomechanical preparation of the root canal system including a short-term dressing of creamy paste of CH for disinfection of the root canal space. The process is followed by a long-

term dressing of densely packed CH to provide an alkaline pH inside the dentinal tubules to kill the bacteria and neutralize the endotoxins, which are potent inflammatory stimulators [11].

Although this treatment protocol has a high success rate [22], the long-term use of CH has some disadvantages. Because the treatment includes repeated clinical sessions to replace the CH, it demands high cooperation and motivation from the patient. In addition, long-term presence of CH in the root canal space can increase the brittleness of the root dentin and the risk of cervical root fractures especially in immature teeth [5]. Furthermore, some studies have shown even the application of CH for a short-term period can significantly reduced the strength of dentin [17,18]. On the other hand, during the hydration process of MTA, calcium silicate hydrate gel and CH is produced [8]. The presence of CH makes this cement highly alkaline (pH = 12.5) [8]. Subsequently the presence of this cement in the root canal makes the pH of the root surface highly alkaline and even significantly more alkaline than when CH is applied in the root canal [14]. Although CH is produced during the hydration of MTA, studies have shown that the fracture resistance of tooth dentine is higher when MTA is applied compared to when CH has been administered [13]. An explanation could be that MTA induces the expression of TIMP-2 in the dentin matrix, which prevents the degradation of the organic matrix caused by MMP-2 and MMP-14, thereby possibly preventing the destruction of the collagen matrix [13].

Considering the aforementioned facts, we decided to use MTA instead of short and long term CH application. As seen in the follow up evaluations this method had a successful outcome; therefore, we suggest more studies regarding whether MTA can replace CH in the treatment of EIRR or not.

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The authors deny any conflict of interest.

Bibliography


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