Dental Traumatology

Dental Traumatology 2010; **26**: 501–504; doi: 10.1111/j.1600-9657.2010.00932.x

Management of trauma-induced inflammatory root resorption using mineral trioxide aggregate obturation: two-year follow up

CASE REPORT

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Accepted 12 August, 2010

Abstract – Inflammatory root resorption is a serious complication of dental trauma, which leads to progressive loss of the root structure. This report describes the treatment a previously traumatized young maxillary lateral incisor, severely affected by inflammatory root resorption. An 11-year-old boy presented with pain and mobility in his maxillary incisors which experienced fall trauma 2 years earlier. Radiographic examination revealed incomplete root development of the right central incisor, associated with advanced inflammatory root resorption and a periapical lesion. Following removal of a prior long-term calcium hydroxide dressing, the root canal was submitted to a 2-week irrigation regimen involving 1.25% sodium hypochlorite and 2% chlorhexidine gluconate. Thereafter, the entire root was filled with mineral trioxide aggregate. The radiographic follow up at 6 months showed arrest of root resorption and initiation of periapical healing in the absence of clinical symptoms and mobility. This was followed by advanced osseous regeneration and re-establishment of the periodontal space at 12 and 24 months. From the present case, it can be concluded that mineral trioxide aggregate obturation can be a viable option that can improve the healing outcomes in cases of severe inflammatory root resorption in young permanent teeth.

Root resorption is an important complication of traumatic dental injuries including intrusion, avulsion and luxations (1–3). Normally, an intact tooth is resistant to resorption, even if inflammation is present (1). However, when an injury damages the protective layer of precementum, inflammation of the pulp or periodontium will induce root resorption (1, 4). Consequently, the extent of trauma to the periodontium depends on the type and severity of the dentoalveolar injury, which can be related to different types of resorptions. When the surface area of damaged root surface is small and the inflammatory stimulus is absent or transient, the root will heal uneventfully with reparative cementum and periodontal ligament (1, 5). Conversely, if a large area is affected [i.e., >20% of the root surface (6)], the conditions for healing will be unfavorable, leading to ankylosis and progressive osseous replacement (1, 5). When infection of the root canal space is superimposed on trauma-induced resorption, the destructive process will be accentuated, leading to rapid loss of the tooth structure. This process is termed as infection-related root resorption or inflammatory root resorption (3, 5, 7), and may manifest as internal, external or combined internal-external lesions (4). Besides traumatic injuries, apical periodontitis (8), expanding tumors and tumors and cyts (9), or heavy orthodontic forces (10) may also initiate inflammatory root resorption.

Most cases of inflammatory root resorption remain asymptomatic until the resorption reaches an advanced stage (2, 5, 11), and if the inflammatory stimulus is persistent, the pathologic process will continue until no root structure remains (1, 5). Therefore, once detected, endodontic treatment should be promptly initiated so as to remove the inflammatory stimulus and prevent further loss of radicular tissue (1, 2, 5). In advanced stages, endodontic intervention may even require prior repair of resorption defects (e.g., lacunae, perforations) with a suitable biomaterial (11, 12).

The popularity of mineral trioxide aggregate (MTA) as an endodontic repair biomaterial can be attributed to many factors including its good sealing properties, excellent marginal adaptation and ability to set in the presence of moisture and blood (13, 14). In addition to numerous laboratory and animal studies, the biocompatibility and hard tissue inductive effect of MTA have been confirmed in humans (15, 16). MTA can create an environment conducive to periodontal healing, allowing new cement growth on its surface (17). These favorable properties render MTA a suitable material for the management of tissue damage caused by inflammatory root resorption (18).

This case report presents the clinical and radiographic findings of a previously traumatized, young maxillary lateral incisor, severely affected by inflammatory root

resorption, and the 24-month prognosis of treatment with MTA.

Case report

A healthy, 11-year-old boy was referred to the pediatric dentistry clinic for the esthetic and endodontic management of his upper front teeth, which had been traumatized 2 years ago. According to the parents, the maxillary incisor crowns were fractured in a fall accident after which the child was referred to a local dentist who placed splints and prescribed antibiotics. One month after removal of splints, the patient returned with pain and swelling on the maxillary right incisor, and the dentist initiated root canal therapy. Reportedly, the child was extremely apprehensive during the administration of local anesthetics and refused to attend further recalls. Since then, symptoms of pain had occurred frequently, but could not be treated.

Clinical examination of the teeth showed uncomplicated crown fractures of the maxillary central incisors, which both exhibited moderate mobility and tenderness to percussion. There was a buccal sinus tract between the apical levels of the left central and lateral incisors. On radiographic examination, the right central incisor presented with immature root development, as evidenced by short, extremely thin root walls and a wide-open apex (Fig. 1a). The uneven radiolucent regions within the canal and the external borders of the root were highly suggestive of a severe resorptive process. The radiopaque intracanal mass which extended into a periapical lesion was regarded as a calcium hydroxide dressing placed by the local dentist (Fig. 1a). The left central and lateral incisors were non-responsive to electronic pulp testing and thermal tests. Based on clinical and radiographic findings, a treatment plan involving intracanal placement of MTA for the management of root resorption and root canal therapy of the left central and lateral incisors was explained to the patient and his parents. Upon approval, the treatment was initiated at the same appointment.

Following anesthesia and placement of rubber dam, the endodontic access restoration of the right central incisor was removed and the remnants of the calcium hydroxide dressing were gently debrided with #90 Hedströem files and copious 1.25% sodium hypochlorite (NaOCl) irrigation. During the procedure, slight drainage of pus and necrotic pulp tissue was observed. The severity of resorption was evident on a confirmatory radiograph of calcium hydroxide removal (Fig. 1b). As the root canals had been exposed to calcium hydroxide for more than 1.5 years, a new calcium hydroxide dressing was not placed to eliminate further risk of root fracture. A final irrigation was made with copious sterile saline and 2% chlorhexidine gluconate, after which the root canals were dried and a temporary coronal seal was established. Endodontic therapy of the left central and lateral incisors was initiated at the same appointment by removing necrotic pulps and placement of interim calcium hydroxide for the management of the sinus tract. The patient was recalled twice for implementation of the same irrigation regimen, which led to cessation of pus drainage from the right central incisor within 2 weeks. During the same period, the sinus tract disappeared and the left incisors were free of symptoms.

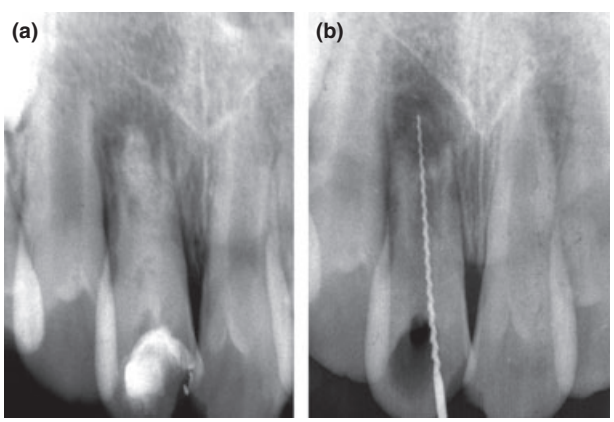

Fig. 1. (a) Radiographic view of the lateral incisor at first visit; (b) The extent of inflammatory root resorption as viewed radiographically.

When the patient returned, the temporary restoration was removed and the root canal received a final irrigation with sterile saline. Following drying with sterile paper points, MTA (White Pro-Root MTA; Dentsply-Maillefer, Ballaigues, Switzerland) was prepared according to the manufacturer's instructions, and a small portion of the material was deposited 1 mm below the apical level using a ProRoot MTA delivery gun (Dentsply-Meillefer). Then, MTA was gently condensed with an endodontic plugger to the working length. The procedure was repeated several times until the root canal was filled with MTA approximately 1 mm below the gingival level (Fig. 2a). A wet cotton pellet was placed on the MTA and the cavity was sealed temporarily with glass ionomer cement. At the same appointment, the calcium hydroxide was removed from the left central and lateral incisors, and the root canal obturation was accomplished with gutta-percha and AH plus sealer (Dentsply-Maillefer). After an uneventful waiting period of 1 week, the access cavities and crown fractures were restored with hybrid resin composite (TPH Spectrum DENTSPLY/DeTrey, Konstanz, Germany), bonded with and etch-and-rinse adhesive (Prime& Bond NT, DENTSPLY/DeTrey).

The radiographic follow up at 6 months demonstrated stability of the resorption site, along with initiation of periapical healing in the absence of clinical symptoms and mobility (Fig. 2b). This was followed by advanced regeneration of the periapical tissue and re-establishment of the periodontal space at 12 and 24 months (Fig. 2c,d, respectively).

Discussion

In the present case, obturation of the entire root canal with MTA was based on a number of reasons. First, an apical MTA plug of at least 4 mm thickness was required to provide optimum apical seal (19). Second, a cervical barrier thickness of approximately 4 mm was necessary to prevent coronal leakage (20). As the total length of the

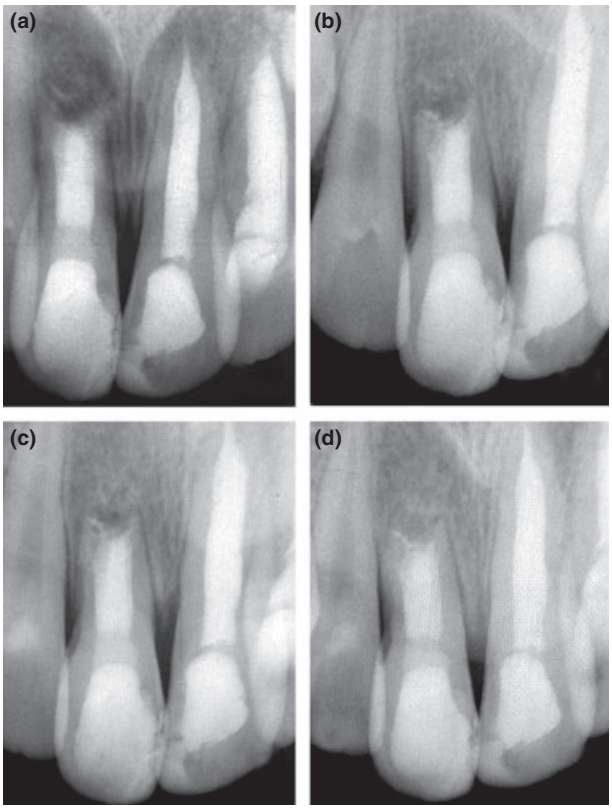

Fig. 2. (a) Mineral trioxide aggregate (MTA) obturation of the root canal; (b) Radiographic follow-up at 6 months demonstrating stability of the resorption and periapical healing; (c) Advanced regeneration of periradicular tissues and re-establishment of the periodontal space at 12 months; (d) 24-month radiographic view, demonstrating complete healing. Periodontal ligament space can be traced along the entire root.

apical and coronal plugs conformed to that of the root canal, no additional space was left for placement of another obturation material (e.g., gutta-percha and sealer). Finally, the in absence of cone-beam computerized tomography scans, the possibility of other resorptive lesions could not be discarded (11), leading to tentative sealing of the root canal with a biocompatible material. It has been shown that MTA obturation can also cause release of calcium ions through dentinal tubules into resorption defects, which may favor the repair potential of the surrounding tissues (21). Moreover, MTA preferentially induces alkaline phosphatase expression and activity in periodontal ligament fibroblasts (22).

The hard tissue inductive effect of MTA has been confirmed in humans, especially when used as root-end barriers in teeth with immature apices (15, 23) and root perforations (17). At the cellular level, this favorable biologic effect is generated by several factors including the induction of bone morphogenetic protein-2 (BMP-2) and transforming growth factor beta-1 (TGF ß-1) (22), stimulation of osteocalcin and subsequent bone growth (24, 25), and stimulation of interleukin production, which leads to overgrowth of cementum (26).

Treatment of dentoalveolar injuries may be neglected or lately referred by parents, due to the child's inability to cope with treatment (27). As with the present case, this may not only cause interruption of the healing process but may also jeopardize the integrity of periradicular tissues, and the root itself. In the present case, the crown-root ratio could not be recovered to an ideal level, as the root development had already been interrupted and the inflammatory resorptive process had caused considerable damage to the remaining root structure. Nevertheless, the treatment outcome was considered successful, because the resorption was arrested and remained stable over the 24-month follow-up period. Furthermore, a continued regeneration of the periapical tissues and the periodontal space was evident in the absence of clinical symptoms. The patient and parents were also pleased with the treatment outcome, as a permanent tooth with otherwise hopeless prognosis was maintained. In light of clinical and radiographic findings, it can be concluded that MTA obturation can be a viable option that can improve the healing outcomes in cases of severe inflammatory root resorption in young permanent teeth.

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