Dental Traumatology

Dental Traumatology 2008; **24**: 565–568; doi: 10.1111/j.1600-9657.2008.00577.x

Mineral trioxide aggregate as an alternative treatment for intruded permanent teeth with root resorption and incomplete apex formation

CASE REPORT

Thais Marchini Oliveira, Vivien Thiemy Sakai, Thiago Cruvinel Silva, Carlos Ferreira Santos, Ruy Cesar Camargo Abdo, Maria Aparecida Andrade Moreira Machado

Bauru School of Dentistry, University of São Paulo, Bauru, Brazil

Correspondence to: Dr. Carlos Ferreira Santos, PhD, Al. Octávio Pinheiro Brisolla, 9-75 17012-901 Bauru/SP, Brazil
Tel.: 55 14 32358276
Fax: 55 14 32234679
e-mail: cebola@usp.br

Accepted 8 November, 2006

Abstract – A case of extensive crown fracture associated with intrusion of the permanent maxillary central incisors in an 8-year-old boy is reported. The treatment of both injured teeth included attempts of apexification and arrest of root resorption with calcium hydroxide. After 8 months of the trauma, there was no calcified barrier formation in the apex. Mineral trioxide aggregate (MTA) was then used as a filling material. At 15-month follow up, the teeth were asymptomatic and correctly sealed, the external inflammatory root resorption had stopped, and the radiolucent image had disappeared, which meant the initial healing of the periapical lesion. MTA may be considered as an alternative option for the treatment of traumatized and immature permanent teeth.

Traumatic dental injuries are very common in children and adolescents. Root canal treatment of immature permanent teeth with wide-open apices usually takes a long period of time, and the prognosis is always uncertain (1–3). Dentoalveolar trauma during the maturation process of permanent teeth may result in the incomplete root formation and root resorption (4, 5).

As a result of the rare occurrence of intrusion in permanent teeth (up to 1.9% of the cases) (6), there is a paucity of reports documenting the epidemiological information, clinical radiographic appearance and knowledge about the treatment of these injuries (6–8). The traumatic intrusion of immature permanent teeth produces severe damage to the dental structure, periodontium and pulpal tissues. Periodontal regeneration may occur in intrusions, but healing outcomes usually include root resorption, pulp canal obliteration and necrosis (5).

Conventional therapy to dental injury with incomplete root formation and root resorption includes the use of calcium hydroxide in an attempt to form a hard tissue apical barrier, a process that requires some months (3, 9, 10). Recently, mineral trioxide aggregate (MTA) has been shown to be a potential root-end filling material (11–14). MTA is a mineral powder that consists of hydrophilic particles, whose principal components are tricalcium silicate, tricalcium aluminate, tricalcium oxide and other mineral oxides. It has a pH of 12.5, and sets in the presence of moisture in approximately 4 h (14–18). Studies have shown that MTA is apparently equal or superior to other root-end filling materials with respect to dye and bacterial leakage (15, 17, 19, 20). It presents a good sealing ability (12, 13, 15, 16, 18, 19, 21), biocompatibility (13, 15–17), low cytotoxicity (15, 16, 18), and it also induces odontoblasts to form a hard barrier (15, 16, 22).

The aim of this report was to describe the management of traumatic intrusion of immature permanent maxillary central incisors. Apexification and arrest of root resorption with calcium hydroxide and an alternative filling with MTA are reported and discussed.

Case report

An 8-year-old boy was referred to our institution for management of traumatic intrusion. The patient and mother reported that the permanent maxillary central incisors were traumatized during a bike ride. The clinical examination revealed extensive enamel-dentine crown fractures associated with intrusion caused by axial impact (Fig. 1). Periapical radiographic examination showed the immature open apices and absence of radiolucent lesion in the apical area of the injured teeth (Fig. 2). The grade of mobility was rated as 1–2 in a scale from 0–3 (6). In the clinical tests, both incisors were tender to percussion and did not respond to the vitality

Fig. 1. Initial frontal view of the traumatized teeth revealing almost complete intrusion of the permanent maxillary right central incisor and extensive crown fracture of the permanent maxillary left central incisor in an 8-year-old boy.

Fig. 2. Initial periapical radiograph revealing intrusion of the permanent maxillary right central incisor and incomplete root formation of both maxillary central incisors.

tests. Because of dentin exposure, an initial temporary restoration with glass–ionomer cement was performed. Soft tissue lacerations did not require suture. The re-eruption of both central incisors with immature formation was expected to take place and was verified at subsequent clinical and radiographic controls. The mother and child were instructed how to improve the oral hygiene through correct brushing techniques and the additional use of a 0.12% chlorehexidine solution applied topically with a cotton bud at bed time for 7 days.

Two months later, partial re-eruption of the maxillary right central incisor (Fig. 3), incomplete root formation and external resorption of both teeth were detected

Fig. 3. Partial re-eruption of the permanent maxillary right central incisor and temporary ionomer restoration of the permanent maxillary left central incisor, 2 months after the trauma.

Fig. 4. Two-month follow up periapical radiograph showing incomplete root formation, apical lesion and root resorption of both permanent maxillary central incisors.

(Fig. 4). Attempt of apexification and arrest of root resorption with calcium hydroxide was then started. After isolation of the teeth with a rubber dam, opening of the pulp chambers was conducted with carbide bur, which was followed by irrigation with 1.0% sodium hypochlorite. The root canals were instrumented, dried with paper points and filled with calcium hydroxide. Further follow-up appointments and changes of calcium hydroxide were performed regularly every 30 days. Because of continuous root resorption, this procedure was performed for six consecutives months, when the arrest of root resorption was then observed (Fig. 5).

As no calcified barrier formation in the apices was observed, the use of MTA as a filling material was decided. MTA was mixed with sterile water following the manufacturer's instructions. The condensation and filling of root canals were performed with a small amalgam

Fig. 5. Eight-month follow up periapical radiograph showing absence of calcified barrier in the apices of the permanent maxillary central incisors, 6 months after the beginning of the treatment with calcium hydroxide.

Fig. 6. Clinical aspect 13 months after the trauma showing the permanent maxillary central incisors restored with resin composite.

carrier and with the aid of a lentula bur. The medicament was placed to correct length and was of adequate density. The teeth were temporarily sealed with zinc oxide and eugenol. After 24 h, the patient did not complain of pain or discomfort; therefore the teeth were restored with composite resin. After 15 months of the traumatic intrusion, both teeth did not present mobility, the external inflammatory root resorption had stopped, and the radiolucent image had disappeared, which meant the initial healing of the periapical lesion (Figs 6 and 7).

Discussion

When a tooth is traumatized, the pulp can lose its blood supply. Although revascularization is possible, the canals often become infected (23, 24). An infected pulp of a

Fig. 7. Fifteen-month follow up radiograph showing the arrest of root resorption and incomplete apexification, 7 months after complete filling of root canals of both permanent maxillary central incisors with MTA.

traumatized tooth is particularly dangerous because of the susceptibility to root resorption (5, 21, 25). In immature teeth, this process occurs rapidly because of the wide dentinal tubuli, allowing penetration of bacterial irritants (6, 23, 26).

Intrusion of permanent teeth is a rare dental injury. Furthermore, very few clinical reports have been published to document the prognosis of these injuries and the effect of treatment (6–8). Crown fractures associated with intrusions are some of the most challenging clinical situations. The exposed dentin may facilitate bacterial invasion and subsequent development of pulp necrosis. To prevent such a situation, coverage of exposed dentin is recommended (as shown in Fig. 3). If a radiographic sign of external resorption affecting the root surface is observed, the resorption process could be arrested by endodontic therapy (8–10), as in the case reported here.

Several studies have demonstrated that calcium hydroxide has a high rate of success in cases of traumatized immature permanent teeth (16, 17, 19). On the other hand, one negative aspect of the apexification with calcium hydroxide for extended periods is the possibility of increased root fracture (1, 2, 10, 27). The duration of the treatment, which is usually very long depends on factors such as size of the apical opening, the traumatic displacement of the tooth and the repositioning methods used.

MTA shows good sealing ability, good marginal adaptation, a high degree of biocompatibility and reasonable setting time (14–18). Many studies have reported the potential of its sealing ability for filling of open apices by the intracanal technique (13–16, 28–30). It can be used in the presence of moisture in the root canal. This property is important for teeth with necrotic pulps and inflamed periapical lesions because one of the

problems found in these cases is the presence of exudates at the root apex (14–16, 21). It is worth mentioning that, as in our case, a temporary calcium hydroxide dressing should precede the application of MTA mixture to limit bacterial infection (10, 28).

The prognosis of dental injury is uncertain. We believe that the use of MTA as an alternative option for the treatment of traumatized immature permanent teeth, as documented here seems a valid approach as it may allow longer teeth survival. Aesthetic, functional and psychological conditions of the patients are preserved, thus avoiding constant replacement of prosthetic dental appliances. Although promising, further investigations with long-term follow up are required.

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