

Case Series:

Root healing with MTA after horizontal fracture

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Abstract

BACKGROUND: Root fractures in permanent teeth are uncommon injuries and represent complex healing patterns. Fractures occur most often in the middle third of a root and rarely at the apical third. **CASE REPORTS:** Case 1: A 10-year old boy attended the Dept. Paediatric Dentistry Clinic (Istanbul University) after an accident at school 4 hrs earlier. Clinically there was a swollen upper lip, pain on the periapical region of the tooth and horizontal root fractures in the middle third of both roots of teeth 11 and 21 were noted on periapical radiography. Case 2: An 8-year old boy was involved in a bicycle accident 3 months prior to attending. A maxillary splint was present on incisor 11. Clinically an enamel-dentine crown fracture and radiographically a horizontal mid-third root fracture, were seen. Case 3: An 11-year old boy attended after a bicycle accident 1 month before, involving tooth 21. Clinically there was mobility, slight discolouration and radiographically a horizontal mid-third root. **TREATMENT:** In all cases only the coronal segment of roots were treated and MTA was placed as a fracture line plug. **FOLLOW-UP:** At 36 months follow up all teeth were asymptomatic and clinical and radiographic investigation of the teeth revealed excellent healing patterns. **CONCLUSION:** MTA can be considered as a good choice for a definitive root filling material in horizontal tooth root fractures with excellent biological and physical properties.

Introduction:

Root fractures in permanent teeth are less frequent injuries comprising 0.5 to 7 % of all dental trauma cases [Andreasen et al., 2004]. Horizontal root fractures occur mainly in the anterior region of the maxilla, usually owing to a frontal impact, more frequently observed in fully erupted teeth with complete root formation [Andreasen et al 2004; Versiani et al., 2008]. Horizontal fractures occur most frequently in the middle-third of the root and rarely in the apical-third [Caliskan and Pehlivan, 1996; Andreasen et al., 2004; Andreasen et al., 2007]. The prognosis is poorer if the fracture level is in the coronal third [Feiglin, 1995].

Treatment is usually directed at repositioning and stabilizing a tooth (if necessary) in its correct position and monitoring the tooth for an extended period for pulpal vitality [Clark and Eleazer, 2000]. Root fractures represent complex healing

patterns due to concomitant injury to the pulp, periodontal ligament, dentine and cementum [Andreasen et al., 2004].

Mineral Trioxide Aggregate (MTA) is a biocompatible material with numerous interesting clinical applications in endodontics. The material appears to be an improvement over other materials for some endodontic procedures that involve root repair and bone healing [Schwartz et al., 1999; Schmitt et al., 2001; Bramente et al., 2006].

This report records the use of MTA to achieve a barrier on the coronal aspects of the fracture lines in maxillary central incisors with horizontal root fractures. The treatment and long term 3-year follow-up of four treated maxillary central incisors are presented.

Case Reports:

Case 1: A 10-year old boy came to Dept. Paediatric Dentistry Clinic (Istanbul University) after an accidental trauma in school 4 hrs earlier. His medical history was non-contributory. Clinical examination revealed luxation and occlusal displacement of the maxillary central incisors (11, 21). Subsequent to the injury, the patient complained of an inability to bite, a swollen upper lip and pain on palpation in the periapical region of the tooth. A radiographic examination revealed horizontal root fractures in the middle third of both roots of the maxillary central incisors.

Treatment: The extruded teeth were repositioned and immobilised with a wire-composite splint, under a suitable prophylactic antibiotic and anti-inflammatory analgesic coverage for one week. Antiseptic procedures with 0.12% chlorhexidine gluconate were carried out. The positions of the teeth were corrected, immobilized with a wire-composite splint and kept under observation. A soft diet and avoidance of chewing on the maxillary incisors were suggested.

Follow-up: The teeth responded positively to electrical pulp testing and also with cold spray. However, after another 2 months the child had a second trauma to the same region and the teeth did not respond to the vitality tests and were sensitive to percussion (Figure 1a). Endodontic therapy was carried out and after instrumentation and a paste of calcium hydroxide (CaOH) was packed into the canals to the fracture lines. The coronal access was restored with zinc oxide-eu-

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Figure 1. Periapical radiographs of Case 1.

A. Horizontal fractures of 11 and 21 at the 1st visit with splint. **B.** Traumatized teeth treated with MTA 12 months later. **C.** Radiographic appearance of the teeth 36 months later.

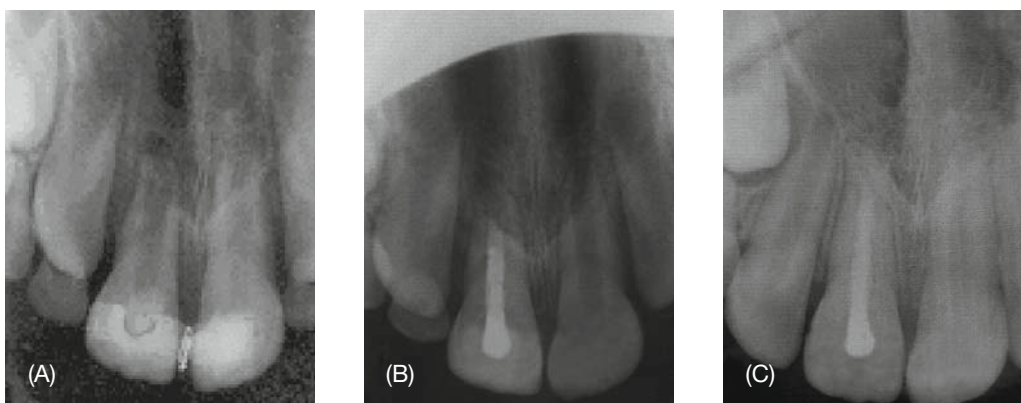


Figure 2. Periapical radiographs of Case 2

A. Traumatized tooth at the 1st visit. **B.** Radiographic view of the treated tooth 12 months later. **C.** Radiographic appearance of the treated tooth 36 months later.



Figure 3. Periapical radiographs of Case 3

A. Traumatized tooth at the 1st visit. **B.** The treated tooth 12 months later. **C.** The treated tooth 36 months later.

genol cement. Immobilization was maintained for 3 months because of extruded teeth, secondary trauma and that the root fractures were near the apical third of the root.

Case 2: An 8-year old boy attended the Paediatric Dental Clinic, following a bicycle accident 3 months before. He was seen the day of the accident by his family dentist and a composite resin-stainless steel wire splint was applied to the traumatised tooth. The patient had an unremarkable medical history. The clinical examination revealed an enamel-dentine crown fracture of maxillary right central incisor. The radiographic examination of the maxillary anterior region revealed a horizontal root fracture at the level of the middle third of the tooth. The tooth was non-responsive to electrical pulp testing and sensitive to percussion (Figure 2a).

Treatment: Endodontic therapy was carried out. The root canal was instrumented and a paste of CaOH was packed into the canal to the fracture lines. The coronal access was restored with zinc oxide-eugenol cement.

Case 3: An 11-year old boy attended as above following a bicycle accident 1 month before. He had also been seen by his family dentist. Clinical examination revealed mobility, slight discolouration and swelling of the gingiva around the maxillary left central incisor and upper lip. A radiographic examination revealed a horizontal root fracture at the level of the middle third of 21 (Figure 3a). The tooth did not respond to the vitality tests. There was a broken composite resin splint when he attended our dental clinic.

Treatment: The immediate treatment consisted of the occlusal relief and immobilization of all the frontal teeth with a wire-composite splint. The fixation period was 1 month for Case 3.

Further endodontic treatment for all 3 cases: Endodontic therapy was carried out in all cases. The root canals were initially instrumented and a paste of CaOH was packed into the canals to the fracture lines. The coronal accesses were restored with zinc oxide-eugenol cement. Two months later, routine extra and intraoral examinations indicated signs of normality; there were no lesions, oedema, or abnormalities. The teeth were reinstrumented, the intracanal dressings were removed and the fracture lines plugged with ProRoot MTA (Dentsply Tulsa Dental). The material was mixed in a 3:1 proportion and taken to the fractured region with a plugger and condensed with a large reversed gutta percha point. Then, the root canals were temporarily filled with a wet cotton pellet inserted into the root canal region. After 72 hours the cotton pellets were taken out and the root canals and the endodontic treatment finished with gutta percha and AH26 (DeTrey Dentsply). The access cavities were restored with Filtek Z250 composite resin (3M-Espe). In the first month, the teeth were observed weekly, and radiographic and clinical examinations were performed. Later, they remained under periodical control every 6 months for 3 years. The patients were comfortable and no periapical pathology had developed (Figures 1B-C, 2B-C, and 3B-C).

Discussion

Root consolidation depends on the pulp and periodontal integrity and odontocementoblasts are responsible for the deposition of hard tissue matrix between the fragments. However, other tissues can be deposited in this interface as fibrosis with bone formation, fibrosis alone or granulation. [Andrade et al., 2008; Fayle, 1999].

It has been reported that, in up to 80% of cases, healing of the horizontal root fractures could take place with or without initial treatment. There are different types of fracture healing depending on some pre- and post-injury factors, such as the stage of root formation, patients' age, tooth mobility, and location of root fracture. After adequate clinical management, it is fundamental that patients be followed up during a certain period of time for clinical treatment success [Andreasen et al., 2007; Gungör et al., 2007; Saroglu and Sonmez, 2008; Versiani et al., 2008].

Although the outcome of a root fracture is generally favourable (60–80% cases), complications such as pulpal necrosis, radicular resorption and pulpal canal obliteration can arise. Spontaneous healing after a root fracture where pulp vitality is maintained is clinically significant, and may occur in approximately 70–80% of intra-alveolar root fracture cases. Healing of root fractures without treatment is presented in many reports, but in the first case presented here with extrusive luxation it had lost its vitality. In fact, it was also reported in the literature that teeth with root fractures have a greater possibility of maintaining a vital dental pulp than luxated teeth without fracture [Gorduysus et al., 2008; Saroglu and Sonmez, 2008].

Pulp necrosis following root fractures occurs in 5–25 % of the affected teeth. The risk is higher in mature teeth and those where significant displacement of a coronal fragment has occurred [Andreasen et al., 2007; Saroglu and Sonmez, 2008]. In reported cases, affected mature teeth maintained pulpal necrosis.

Root fractures occur most frequently in the middle or the apical third of the root with a coronal fragment extruded or luxated. If displacement has occurred the coronal fragment should be repositioned as soon as possible by gentle digital manipulation and the position checked radiographically [Andreasen et al., 2004; Chang et al., 2006; Cobankara and Ungor, 2007; Gungör et al., 2007].

The splinting method used seems to be related to root fracture prognosis as some authors found that cap splints caused an increase in pulpal necrosis, probably due to the additional trauma produced by taking an impression and cementation of this type of splint. The splinting period varied according to the severity of each case. [Andreasen et al., 2007; Versiani et al., 2008]. Root fractures require 4–6 weeks of functional splinting [Andreasen et al., 2007] but individual cases may require longer. Excessive mobility leads to the fracture site becoming filled with granulation tissue [Chang et al., 2006;

Ferrari et al., 2006]. In our cases, splinting for 3 months was used only in Case 1 who had an extrusive luxation and tooth mobility. The fixation period was longer in Case 1 because of secondary trauma and location of fracture lines were near to the apical third of the teeth. If a root fracture is near the cervical area of the tooth stabilization is beneficial for a longer period of time (up to 4 months) [Andreasen et al., 2007]. In the cases presented functional resin-wire splints were used. The splint was broken twice by secondary traumas in the first case.

The angulation of the X-ray in the radiographic detection of a horizontal root fracture is critical. If a horizontal root fracture is suspected it is advisable to take several radiographs at different angles. In our second and third cases, although the patients were seen by their family dentists, they determined that the roots were healthy [Bramente et al., 2006].

Apical root fragments almost always contain viable pulp tissue and invariably sclerose. Rarely they may require surgical removal [Fayle, 1999; Saroglu and Sonmez, 2008]. Following the 36 months follow up of these cases, the apical fragments did not require surgical removal but continued monitoring was required.

In apical and middle-third fractures any endodontic treatment is usually confined to the coronal fragment only. A barrier is achieved at the coronal aspect of a fracture line by preparation of a stop with non-setting CaOH or Mineral Trioxide Aggregate (MTA) and the coronal canal is obturated with guttapercha [Bramente et al., 2006]. MTA may provide an improvement over standard CaOH for immature, non vital, permanent teeth that have been traumatized and which require pulp therapy. Although MTA and CaOH both exhibit similar alkaline pH levels, MTA also shows excellent marginal adaptability and is non-resorbable [Torabinejad and Chivian, 1999].

MTA was chosen in these cases here in order to fill the fragile fractured roots with a material of excellent biological and physical properties [Andreasen et al., 2007; Torabinejad and Chivian, 1999]. In addition, another reason to use MTA as a fracture line plug was to induce regeneration of the periradicular tissue and hard tissue deposition. The radiographic follow-up of these cases at 12, 24, and 36 months revealed repair with bone and connective tissue.

Swartz et al. [1999] used MTA at horizontal root fracture and reported that at a 6 month recall visit, the central incisors were asymptomatic but remained slightly mobile. Bramante et al. [2006] illustrated the potential for repair of a horizontal root fracture after CaOH, sealing with MTA and post reinforcement. They suggested that at 10 months follow-up no pathological signs were observed. In the cases presented here, at 36 months follow-up the central incisors were asymptomatic (Figures 1c, 2c, and 3c).

Conclusion

MTA was used as an apical barrier in horizontally root fractures in three cases. At 36 months follow up, the clinical and radiographic investigation of the teeth revealed asymptomatic and excellent healing patterns. MTA can be considered as a good choice for a definitive root filling material in horizontal fractures with excellent biological and physical properties.

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