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Horizontal root fracture treated with MTA, a case report with a 10-year follow-up

CASE REPORT

Miguel Roig, José Espona, Montse Mercadé, Fernando Duran-Sindreu

Department of Restorative Dentistry and Endodontics, Universitat Internacional de Catalunya, Sant Cugat del Vallès, Barcelona, Spain

Correspondence to: Fernando Duran-Sindreu, Dentistry Faculty, Universitat Internacional de Catalunya, C/Josep Trueta, s/n. 08195 Sant Cugat del Vallès, Barcelona, Spain
Tel.: +34 504 2000
Fax: +34 504 2031
e-mail: fduranst@hotmail.com

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Abstract – Root fractures occur more frequently in fully erupted permanent teeth with closed apices in which the completely formed root is solidly supported in the bone and periodontium. The consequences can be complex because of combined damage to the pulp, dentine, cementum, bone, and periodontium. Management of horizontal root fractures and lateral luxation depends on several factors, with the result that various clinical modalities have been suggested. This case report describes the treatment and 10-year follow-up of two maxillary central incisors, one with horizontal root fracture and the other with lateral luxation, treated with mineral trioxide aggregate and root canal treatment, respectively.

Introduction

Root fractures, defined as fractures involving dentine, cementum, and pulp, comprise only 0.5–7% of all dental injuries, and the age group between 10–20 years old are the most likely to be affected. Horizontal root fractures are chiefly observed in the maxillary anterior region (1). Almost 75% of them affect maxillary central incisors (2), of male patients as a result of trauma associated with automobile accidents, sports injuries, fights, etc. (3). Root fractures also occur more frequently in fully erupted permanent teeth with closed apices in which the completely formed root is solidly supported in the bone and periodontium (1). The consequences can be complex because of combined damage to the pulp, dentine, cementum, bone, and periodontium.

Diagnosis of horizontal root fracture is based on the information obtained in clinical and radiographic examinations. Root fractures often present clinically as a slightly extruded tooth, often lingually displaced (4). The tooth is often mobile, but the degree of mobility is frequently determined by the fracture location (4). Treatment outcome of fractured teeth may be influenced by several factors, such as degree of dislocation, stage of root formation, location of fracture, time period between trauma and treatment, and type of dental trauma (displacement of the coronal fragment compared with no displacement of the coronal fragment (5).

According to the type of lesion and anatomical and functional characteristics, healing can take place by interposition of calcified tissue, interposition of connective tissue, or interposition of bone tissue. The way in which these lesions heal depends on the health of the pulp, dentine, cementum, and alveolar bone and the degree of dislocation of the fragments (6). If a rupture of the pulp takes place, revascularization of the coronal region should occur before fracture healing. The precise nature of this process remains unknown. However, it is believed that one of two events occurs: invasion of cells from the apical pulp or from periodontal ligament (1). If the pulp becomes necrotic and infected, the coronal portion will require root canal treatment (7). Mineral trioxide aggregate (MTA) found to be effective as a pulp capping, and pulpotomy agent has been shown to promote root-end induction in teeth with immature apices (8–10). There are no previous clinical studies, and few case reports suggesting the use of MTA material in the treatment of teeth with horizontal root fractures (11, 12).

This case report describes the treatment and 10-year follow-up of two central incisors, one with root fracture using MTA and the other with lateral luxation.

Case report

An 18-year-old male sought dental care after having suffered a dental trauma when playing Brazilian Jiu-Jitsu 3 days earlier. The patient explained that he had been attended to by a physician who prescribed NSAIDs and advised him to have a dental check-up when he felt better. The patient reported constant pain and was unable to completely close his mouth because of altered position of the upper front teeth. Clinical examination revealed swelling and erosions in the soft tissues. No signs of alveolar bone fracture were observed. Grade 2 mobility was shown by tooth 2.1. Both 2.1 and 1.1 crowns were slightly dislocated in a palatal direction, with premature occlusal contact between maxillary central incisors and mandibular incisors, preventing

Fig. 1. Intraoral image of the patient at the first visit. Upper front teeth show an altered position, together with swelling and erosions in the soft tissues.

contact of posterior teeth and presented with sensitivity to percussion (Fig. 1). Teeth 2.1 and 1.1 were not sensitive to thermal stimulations.

Two radiographs with different vertical angulations were taken of the upper anterior teeth. They revealed the presence of a horizontal root fracture in the middle third of the root of tooth 2.1 and an enlargement of the periodontal space in tooth 1.1 (Fig. 2). Tooth 1.1 was diagnosed as having lateral luxation and tooth 2.1 having horizontal root fracture.

The decision to proceed with root canal treatment in both teeth 2.1 and 1.1 was postponed. Initial lack of response to cold test in traumatized teeth does not imply an irreversible damage to the pulp. Endodontic treatment should be performed only when there is evidence of pulp necrosis. It is to the patient's advantage to preserve pulp vitality whenever possible. Correct diagnostic techniques and patient selection allow for appropriate selection between endodontic therapy and monitoring pulpal conditions (13).

The initial treatment plan comprised reposition and rigid splinting of teeth 2.1 and 1.1. Under local anesthesia, the teeth were repositioned using gentle digital manipulation. Rigid splinting of teeth 1.2–2.2 was performed with six layers of fibreglass strip (Fibersplint©; Polydentia, Mezzovico, Switzerland) and intended to be maintained for 3 months (Fig. 3). The splint was partially removed after 4 weeks, and a composite was placed between the two upper central incisors (14). Four weeks after the first visit, the patient returns to the office with swelling and pain in teeth 2.1 and 1.1. Tooth 1.1 was instrumented with GT rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) up to GT.12/70 at working length. The instruments were used with a TriAuto ZX handpiece (Morita, Kyoto, Japan), at maximum torque and 300 rpm. The working length was controlled using Triauto ZX. Between each instrument usage, the canal was irrigated with 2 ml of 4% sodium hypochlorite. After completing instrumentation, the canal was irrigated with 2 ml of 10% citric acid, which was left in the canal for 1 min. After drying the canal with paper points, a size 70 Thermafil® obturator (Dentsply Maillefer) was used to fill the root canal, with AH Plus (Dentsply De Trey, Konstanz, Germany) as root canal sealer. As regards tooth 2.1, the coronal fragment of the tooth was instrumented to a size 90 Profile rotary file (Dentsply Maillefer). Special care was taken to keep the file tip within the coronal fragment of the tooth to avoid damaging the pulp of the apical fragment of the root. Working length was established with an apex locator (15, 16). After copious irrigation with 4.0% sodium hypochlorite, the canal was dried with paper points. A 6 mm MTA (ProRoot; Dentsply Maillefer) plug was then placed, similarly to an apexification, leaving the apical fragment untouched. A wet cotton pellet was placed in the canal over the MTA, and the access was sealed with Cavit G (3M ESPE, Seefeld, Germany). Two days later, the coronal portion of the canal was filled with warm gutta-percha (Fig. 4). A composite filling was used to seal the coronal access. Ten

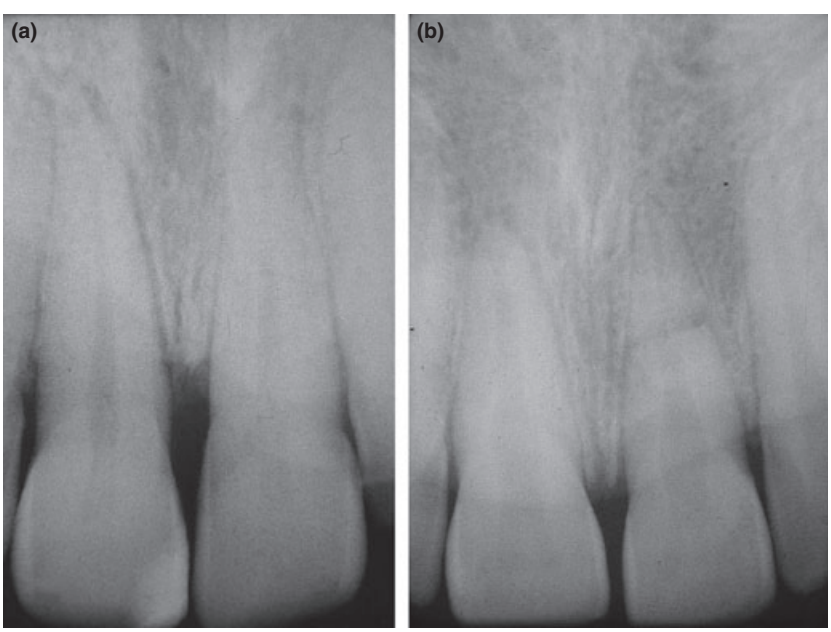

Fig. 2. In an orthoradial intraoral radiograph, an enlargement of the periodontium of teeth 1.1 is shown, no fracture line is shown in teeth 2.1 (a). Moving the cone beam apically, a clear fracture line is shown in teeth 2.1 (b).

Fig. 3. After repositioning the two central incisors, a rigid fiberglass splint was placed.

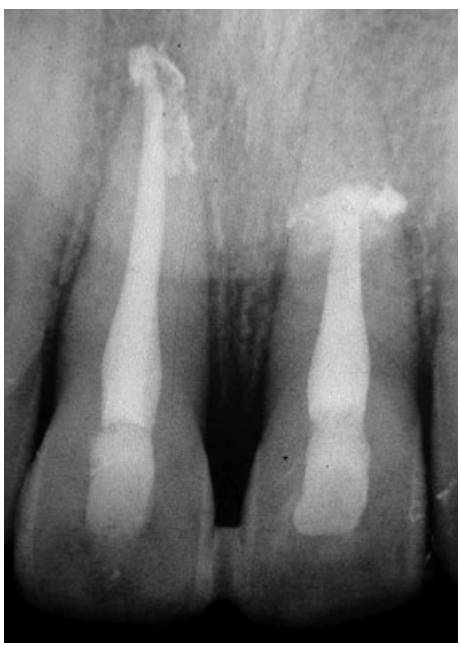

Fig. 4. Once the need for root canal treatment was determined, it was performed on tooth 1.1. In tooth 2.1, the root canal treatment was limited to the portion of the root canal coronal to the fracture line. Working length was established with an apex locator. On the first visit, an MTA plug was placed in tooth 2.1. Seven days later, the rest of the root canal was filled with root canal sealer and gutta-percha.

Fig. 5. Ten year control picture and radiograph. The diastema has been stable since the 2 year control, when the patient asked to have the diastema closure/splinting removed. No signs nor symptoms of apical pathosis have been developed over the 10 years of observation.

years later, the patient reported absence of any painful symptoms and the tooth had normal mobility. Radiographic exploration revealed an unaltered status of the tissues around the teeth, with a repair by interposition of connective tissue. There was no evidence of periodontal ligament breakdown either at the fracture level or periapically (Fig. 5).

Discussion

As the incidence of necrosis in cases of horizontal root fracture is slightly over 20%, it has been suggested that immediate endodontic intervention should be avoided, making clinical and radiographic follow-up the treatment of choice, provided there are no clinical and/or pathological signs (17, 18). The decision for endodontic treatment may be taken after 3 months of follow-up if the tooth still fails to respond to electrometric or thermal pulp testing and if radiographs show radiolucency next to the fracture line (7). When pulp necrosis develops, the apical part of the fractured tooth usually remains vital (1). Hence, root canal treatment is performed only in the coronal fragment. However, it is difficult to seal this fragment because an apical stop is often impossible to achieve (12). Calcium hydroxide has been used to achieve an apical stop. The main drawbacks of this procedure include a need for multiple scheduled visits, susceptibility of treated canals to reinfection, as they are restored with temporary fillings, and susceptibility of treated roots to fracture, in immature teeth, because root resistance reduces after a long-term contact between calcium hydroxide and root dentin (19–21). For these reasons, the use of MTA in teeth with necrotic pulps and open apices has been recommended (6, 12). Studies have observed higher fracture resistance (11, 21), higher clinical and radiographic success at inducing apical closure (21, 22), and absence of signs of clinical and radiographic failure (21, 22), greater amount of hard tissue formation and a lower level of inflammation (23) when MTA-filled root canals are compared with root canals filled with calcium hydroxide. Hence, MTA was selected in the root canal treatment of the present horizontal root fracture, because its use might improve the outcome of the treatment (24).

As the incidence of pulp necrosis in teeth with closed apices after lateral luxation has been shown to be 77% (17), follow-ups in cases of lateral luxation have been recommended, and root canal treatment should only be performed if there were clinical signs of pulp necrosis or radiographic evidence of periapical involvement. Lin

et al. (25) by contrast, proposed root canal treatment in these teeth because of the low probability of revascularization and as a prevention of serious consequences associated with an infected necrotic pulp (25). In this case, even though the pulp sensitivity tests initially were negative, follow-ups were planned to monitor healing, but the presence of signs of inflammation after 4 weeks forced the decision to proceed with the root canal treatment.

This case report shows a good long-term outcome when MTA was used in a root-fractured tooth with coronal pulp necrosis.

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