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Treatment of horizontal root-fractured maxillary incisors – a case report

CASE REPORT

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Abstract – Traumatic dental injuries often occur to the teeth and their supporting tissues and they are the main reasons for emergency visit to a dental clinic. Management of a fracture depends on its position and the extent of root involvement. Horizontal root fractures are not seen frequently and the treatment consists of reduction and long-term rigid fixation of the coronal segment. The present case demonstrates the successful management of two horizontally fractured maxillary central incisors with a follow-up period of 9 months.

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Traumatic dental injuries of teeth are among the main causes of emergency treatment in dentistry. Incisors are most frequently involved teeth and the largest proportion of injuries in permanent dentition occurs in the form of crown fractures. Luxation injuries are seen less frequently and root fractures are among the least seen dental injuries (1, 2). Horizontal root fractures in permanent dentition have been reported to occur in 0.2–7% of all traumatic injuries of teeth (1, 3–7). Horizontal root fractures are more likely to be observed in permanent dentition with teeth that have closed apices (8). Although seen quite few, horizontal root fractures at the level of periodontal attachment have a poor prognosis and management is often complex because of combined damage to the pulp, dentin, cementum, and tooth supporting tissues (9).

Diagnosis of root fractures is accomplished by clinical and radiographic examination. Clinical examination includes the evaluation of mobility, the presence or absence of tenderness and pain to palpation of the soft tissues, percussion of the teeth and pulp testing. Radiographic examination must be performed carefully. Multiple angled X-rays must be taken as root fractures can be overlooked because of the beam angulation (10).

The management of a fracture depends on its position and the extent of root involvement. According to Andreasen (1, 3), the location of the root fracture does not effect pulp survival and long-term rigid fixation of the coronal segment is the first choice of treatment. Avoidance of any occlusal contact of the involved tooth should also be managed (9, 11). Further dental treatment may involve endodontic therapy, intra-radicular splinting and associated restorative treatments (12).

The following case report describes the treatment of two maxillary central incisors with horizontal root fractures that remained vital in both coronal and pulpal segments.

Case report

As a result of a traffic accident, a 19-year-old Caucasian female presented with root fractures of both of the maxillary central incisors with complete root formation. The patient referred to the clinic 2 days after the accident. On clinical examination, both of the central incisors were displaced lingually, with slight extrusion of the right maxillary incisor (Fig. 1). During centric occlusion, both central incisors came into traumatic contact with mandibular incisors. The incisor teeth were slightly mobile and the attached gingival was tender to palpation. Radiographic examination revealed root fractures in both maxillary incisors (Fig. 2). The fracture line of the right incisor was at the middle of the root and the fracture line of the left incisor was at the coronal two third portion of the root. Both incisors did not respond to electrical pulp testing.

The treatment plan comprised reduction, repositioning and rigid splinting the coronal fragments. For this purpose, 0.018×0.025 edgewise brackets were bonded to the labial surfaces of both right and left central and lateral incisors. Under local anesthesia, the central incisors were positioned to slightly forward position to protect the traumatized incisors from contacting the lower teeth. The splinting was made with 0.016 inch stainless steel wire that was given first and second order bends to retain the forward positioning of the incisors during splinting (Fig. 3). The patient was instructed to

Fig. 1. Initial intraoral view.

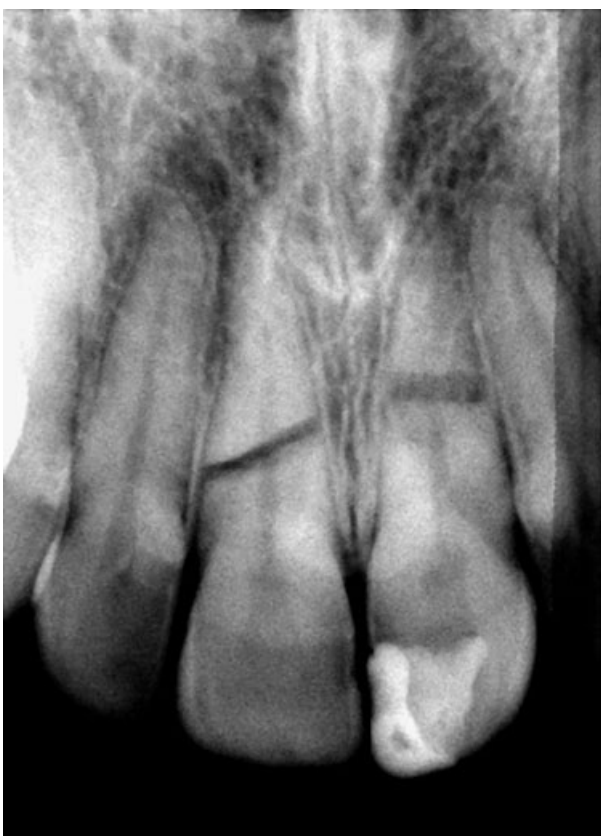

Fig. 2. Initial radiographic view.

Fig. 3. Ortodontic brackets and 0.016 inch stainless steel wire for splinting.

Fig. 4. Intraoral view at day 20. Note the color change in tooth # 21.

maintain good oral hygiene. No medication was prescribed.

The splint was retained for 14 weeks. During the first month, the prognosis was checked every 10 days with radiographic and clinical examinations. A slight color change was observed in the left central incisor at day 20 after the splinting (Fig. 4). However, as there was no sign of any pulpal infection at the radiograph, it was decided to wait until the next appointment for any endodontic intervention (Fig. 5). The patient returned after 8 weeks and the color of the left central incisor had returned to normal. The patient was recalled 2 weeks later, but she showed 4 weeks later. At the 5th visit, it was observed

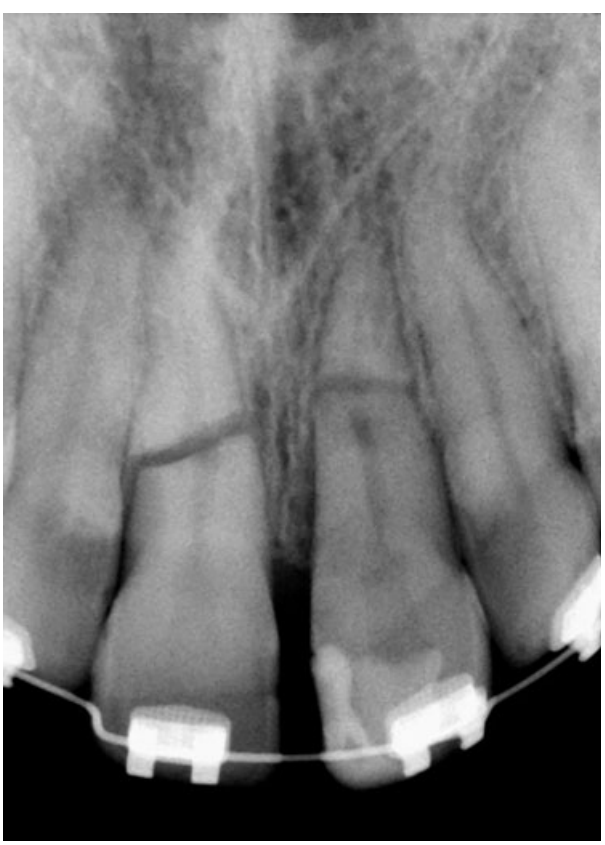

Fig. 5. Periapical view at day 20.

Fig. 6. Intraoral appearance after removal of brackets at 14th week.

Fig. 8. Clinical appearance after a 9-month follow-up.

Fig. 7. Periapical view after removal of the splints.

Fig. 9. Radiographic appearance after a 9-month follow-up.

that the diastema that had occurred because of forward positioning of the coronal fragments had closed spontaneously. At the end of 14 weeks, the brackets and the archwires were removed and the patient was scheduled for follow-up visits at 3-month intervals (Fig. 6, 7).

Nine months after the splint removal, the patient reported no discomfort with her tooth (Fig. 8). Clinically, the mobility of both of the incisors was within normal limits. No pain was observed in horizontal and vertical percussion tests. The electrical test responses of both of the incisors were at grade 4. The control check was made to laterals and it was at grade 2. In the radiographic examination, there was no sign of pathology (Fig. 9).

Discussion

A variety of traumatic conditions like falling, blows on the face can cause traumatic dental injuries. Automobile accidents may also cause dental traumas, causing in an approximate rate of 20–60% injury to the facial region (13). Maxillary centrals are most vulnerable to injury and avulsions or intrusions are the most common types of injuries. Horizontal root fractures are seen rarely and reported to occur in $< 3\%$ of all dental injuries (13). In the presented case, the traffic accident caused horizontal fractures in both of the maxillary central incisors.

According to Andreasen and Hjørting-Hansen (3), the healing sequalae of root fractures can occur in four different ways:

1. Healing with tissue, giving union across the fracture.
2. Healing with interposition of hard and soft tissue between the fragments.
3. Healing with interposition of only soft tissue.
4. No healing.

The healing of a root fracture is primarily related to the stage of root formation and extent of injury (14). The displacement of the coronal segment and the severity of the trauma are also among the main factors that contribute to the healing process. The ideal outcome of root fractures is repair with hard tissue. This type of healing could be achieved by splinting the tooth as early as possible and if the fracture is fully reduced and fracture edges are held in close apposition during splinting (15). In this case, the patient referred to our clinic 2 days after the accident and the coronal segments were slightly displaced. Therefore, healing with calcified tissue was not expected. Periodontal ligament healing was observed in the present case. In this type of healing, the surfaces of the root fracture are covered by cementum and may undergo some resorption. The segments seem radiographically separated by a narrow radiolucent line, with edges rounded by surface resorption. The pulp may become calcified but usually remains vital and responsive to pulp tests (3). According to Andreasen et al. (16), as distance between the fragments increases, the chance of pulp necrosis also increases. In this study, although the fragments were slightly displaced from each other during splinting to prevent occlusal trauma, pulp vitality remained.

The frequency of pulp necrosis following root fractures is higher in mature teeth than in teeth with open apices (14). In this case, even though slight color change had occurred in the left maxillary incisor 20 days after the trauma, the condition had improved at the next visit. Moreover, 50 weeks after the trauma, there was no sign of pulpal necrosis and both teeth showed positive response to the electrical pulp testing indicating vitality. If the condition had not improved and pulp necrosis had occurred, endodontic treatment should have been carried out. A recent study has shown that root canal filling with mineral trioxide aggregate material (MTA®) after 1 month placement of CH for disinfecting the dentinal tubules and root canal offered improved long-term fracture resistance (17).

In the present case, despite the fact that the patient had not referred to the clinic as soon as possible and the fragments had a slight displacement at the time of first visit, the traumatized teeth showed good prognosis. Also, the absence of the fracture line with the oral environment prevented any bacterial penetration. Repositioning the segments using the steel wire prevented any occlusal trauma that could have negatively affected the survival of the teeth.

Recently, the International Association of Dental Traumatology has developed a consensus statement on diagnosis and treatment of dental traumas (18). According to these guidelines, through clinical and radiographic examinations should be performed, followed by sensibility tests and patient care instructions. For treatment of root fractures, repositioning of the coronal segment as soon as possible and stabilization with a flexible splint for 4 weeks was recommended. Andreasen et al. (16) have found no differences for healing of teeth splinted for 2 months or less and for longer splinting periods. The planned stabilization period for this case was 4–6 weeks; however, the splint was retained in place for a longer time because of mobility.

Various types of splints had been introduced over the years (19). According to Andreasen et al.(20), orthodontic brackets can be used for splinting and are often advantageous in multiple tooth injuries. Mackie & Warren (21) stated that orthodontic splints present the advantage of a removable splint and any teeth included in the splint could be placed in the arch later. In a study that had investigated the healing of 400 root fractures, it was shown that the type of splints appeared to have no association with the healing outcome (16). For the stabilization of the traumatized incisors in the present case, we preferred to use bonded orthodontic wire type of splint because we planned to position the incisors slightly forward to minimize any possible occlusal trauma. Moreover, any diastema that might have occurred could be corrected after the healing period.

Long-term follow-up of patients with traumatic dental injuries is quite important as pathological changes can occur several years following the accident (22). The follow-up period for this case was not quite long; however, if the primary purpose of the treatment of the fractured teeth is to maintain the vitality of the teeth, the present case demonstrated the positive outcome in 50 weeks following the trauma.

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