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Maintenance of Pulp Vitality after Horizontal Root Fractures in Three Permanent Mandibular Incisors Following Trauma: One Year Follow-up Case Report

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Case Report
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Abstract

Horizontal root fractures in permanent teeth are uncommon injuries and the reported prevalence in the literature is between 0.5% and 7%. These fractures commonly result from a horizontal impact and are transverse to oblique in direction. Their incidence is more in the middle third of the root than at the apical and cervical thirds. The treatment and prognosis of root fractures depend on many variables, the most important being the length of time between trauma and treatment, degree of dislocation and mobility, site of fracture, fixation period, stage of root development, age of patient, and quality of treatment. The ideal healing type is hard tissue healing. The aim of this case report is to present a case of horizontal root fracture in different locations in three permanent mandibular incisors following trauma in the same patient treated by repositioning and fixation with good healing. After long-term clinical and radiographic follow-up (up to one year), all teeth presented positive response to electrical pulp tests, suggesting a repair of root fractures. Using splint without any further treatment was found to be successful in the presence of suitable conditions for the treatment of horizontal root fractures.

Keywords: Horizontal Root Fracture; Splinting; Conservative Management

Introduction

Root fractures in permanent dentition are uncommon injuries and account for only 0.5–7% of dental traumas [1-3]. Root fracture is defined as "fracture involving dentin, cementum and pulp".1 Horizontal root fracture refers to the presence of a fracture line that is perpendicular to the long axis of the tooth's root [4]. The incidence of horizontal root fracture is most common in the middle third of the root (57%) followed by fracture in the apical third (34%) and very rarely in the coronal third [5]. Maxillary central incisors are more prone to traumatic dental injuries (approximately 68%) probably due to their position in the dental arch, followed by maxillary lateral incisors (27%) and mandibular incisors (5%) [6,7].

Root fracture occurs as a consequence of an impact force on the top of the root and frontal forces affect the

compression zone labially and lingually/palatally, thus dividing the root into coronal and apical fragments. This can traumatize the supporting periodontal tissues eventually leading to displacement of the root fragments [8]. Proper diagnosis of root fracture is made through clinical and radiographic examination, the latter frequently being limited by the position of the fracture. A clinician must check for mobility of the coronal fragment and the vitality of pulp. Radiographically, a radiolucent line is seen separating the apical and coronal fragments [9,10].

The management of horizontal root fracture varies according to the displacement and vitality of the fractured fragments. The amount of dislocation and the degree of mobility of the coronal segment affects the prognosis outcome. Apical third root fractures usually display no mobility and generally do not require any treatment. Root fractures at the cervical third often require extraction when the coronal fragment shows severe mobility. The middle third root fractures offer favourable prognosis. The initial treatment consists of repositioning of the displaced segments, followed by stabilizing of the tooth to allow healing of the surrounding periodontal tissues [1]. The present case report documents conservative approach adopted for three permanent mandibular incisors with horizontal root fractures in the middle and cervical third in a patient following trauma. One year follow-up of the case showed promising results both clinically and radiographically.

Case Report

An 11 year old male patient presented to the Department of Pedodontics & Preventive Dentistry at Post Graduate Institute of Dental Sciences, Rohtak, Haryana, India with the chief complaint of pain and tenderness in lower front teeth region following traumatic injury two days back. No relevant medical history was reported. The extra-oral examination revealed no swelling or gross facial asymmetry. On intra-oral examination, the right permanent mandibular lateral incisor appeared to be displaced occlusally (Figures 1 a & b) with presence of grade two mobility. Both the right permanent mandibular central and lateral incisors were tender on vertical percussion. Radiographic examination revealed presence of horizontal root fracture in the cervical third in right permanent mandibular lateral incisor, and middle third root fractures in both right mandibular central incisor and left lateral incisor teeth (Figure 2).

Figure: 1 (a): Pre-operative frontal view showing 42 out of occlusion. (b) Pre-operative occlusal view.

The fractured root apices were completely formed and no periapical changes were noted. Based on the clinical aspects that showed positive response to pulp sensitivity tests, absence of periapical pathosis and non-discolored crown, non-endodontic conservative management of the fractured teeth was planned and explained to the patient's parents (Figure 2). An informed written consent was obtained. Repositioning of the coronal segment of tooth 42 with finger pressure under local anaesthesia was done. A non-rigid composite-twisted ligature wire splinting was done bonded to the labial surfaces of the mandibular teeth and photo-polymerizable composite resin from canine to canine, which remained for three months (Figure 3). The tooth 42 was relieved from occlusion and positioning of the splint was confirmed radiographically (Figure 4). Follow-up examinations were performed at 15 days, 1 month, 3 months, 6 months, 9 months and 12 months to evaluate pulp vitality and dental mobility, as well as to evaluate the radiographic characteristics. After three months the splint was removed and intra-oral periapical radiograph was taken to assess the healing status (Figures 5-9). At the time of splint removal, the teeth did not show increased mobility. The fractured

mandibular incisors showed positive responses to pulp sensitivity tests.

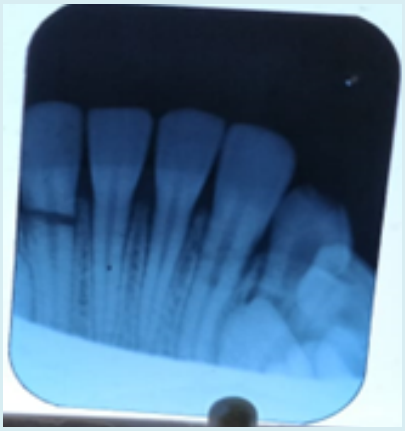

Figure 2: Pre-operative intra-oral periapical radiograph showing horizontal root fracture in the cervical third of 42 and middle third of 41 and 32.

Figure 3: Reduction and semi-rigid splinting was done i.r.t. 42, 41, 31 and 32.

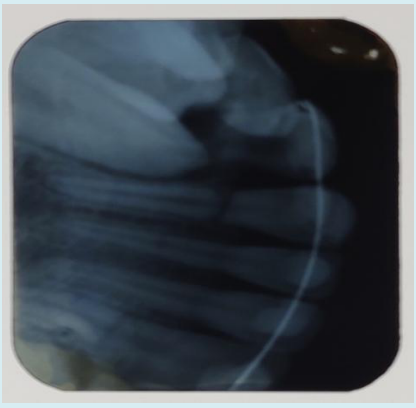

Figure 4: Radiograph was taken to check the position of the splint.

Figure 5: One-month follow-up Radiograph.

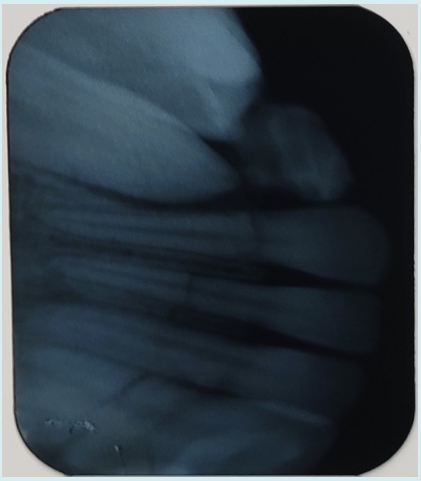

Figure 6: Three-months follow-up Radiograph. The splint was removed.

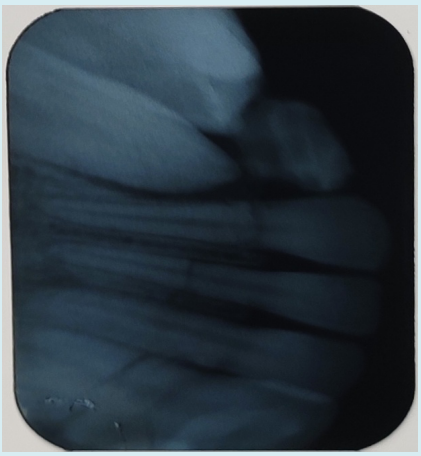

Figure 7: Six-months follow-up Radiograph.

Figure 8: The Teeth were clinically healthy and asymptomatic at six months follow-up.

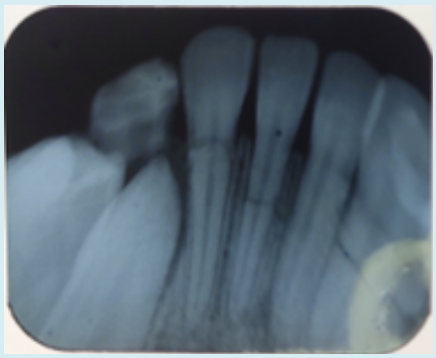

Figure 9: Nine-months follow-up radiograph.

After one year of clinical follow-up, the patient was asymptomatic with no signs and/or symptoms associated with the previously fractured teeth. There was no spontaneous pain, periodontal inflammation or mobility with respect to the traumatized mandibular incisors. Also, there was no tenderness on percussion or pain to palpation of the soft tissues. No tooth discoloration was seen and the teeth responded positively to electrical pulp testing (Figure 10). Radiographic examination showed no periapical or periradicular pathology associated with any of the traumatized teeth (Figure 11).

Figure 10: One year clinical follow-up showed positive response to the electric pulp testing and normal color and physiological mobility i.r.t. 42, 41 and 32.

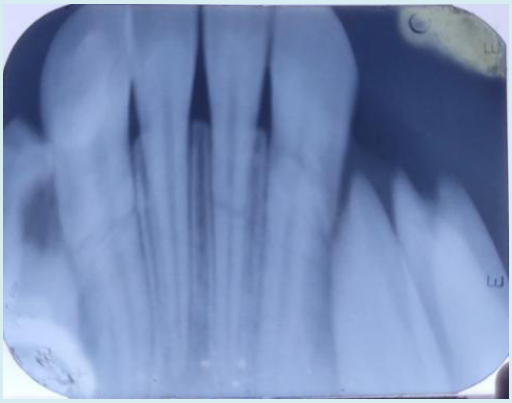

Figure 11: One year follow-up radiograph showing healing of fractured roots of traumatized teeth.

Discussion

Dental traumatic injuries can result in root fracture causing a complex injury to the cementum, dentin, pulp and the periodontal tissues [11]. Such injuries can occur due to road accidents, violence, sport injuries, and so forth. Maintaining "the physiological and functional integrity" is the main goal while treating traumatized teeth. The classification of horizontal root fractures is based on the location of the fracture line (apical third, middle third, or cervical third) radiographically and on the degree of dislocation of the coronal fragment [12]. The distance between the tooth fragments and the level of horizontal root fracture directly influence the treatment outcome.

Pulp vitality is better preserved in teeth that have undergone horizontal fractures than in teeth with dislocations and without root fractures [10]. The rapid reduction and immobilization of the fracture was instrumental in maintaining pulp vitality of the involved teeth. Although the fracture of the right maxillary lateral incisor occurred in the cervical third, maintaining pulp vitality is proof of the absence of contamination of the root canal. The exposure of the fracture to contamination of the gingival sulcus makes it more difficult to stabilize the fragment in the cervical portion and compromises tissue repair in the cervical third [11,12]. Only 30% of fractured teeth in the cervical third present pulp vitality.

Horizontal root fractures that localize in the middle or apical third of the root present better prognosis when compared with cervical third root fractures. The vitality of pulp is better preserved in teeth that have undergone horizontal fractures than in teeth with dislocations and without root fractures [13]. In the present case, rapid reduction and immobilization of the involved teeth was instrumental in

maintaining the pulp vitality. In the cervical third, healing depends on proximity of the fracture to the gingival sulcus and possibility of contamination [14-20]. The exposure of the fracture to contamination of the gingival sulcus makes it more difficult to stabilize the fragment in the cervical portion and compromises tissue repair in the cervical third [21,22]. Only 30% of cervical third root fractures present pulp vitality [23]. In the present case, maintenance of pulp vitality of right mandibular lateral incisor following cervical third root fracture is proof of the absence of contamination of the root canal. Andreasen, et al. [23] evaluated healing process between fragments in case of root fracture and observed no difference for healing of teeth splinted for two months or less and for longer splinting periods. A particular situation could happen to cervical third root fractures when longer time of maintenance of splint could be necessary. However, in the present case tooth 42 had a positive response to pulp sensitivity tests and no mobility was detected during the first three months of follow-up. For this reason, the splint was removed at three months time interval.

The prognosis for middle third root fractures is more favourable, and in about 86% of cases, it is possible to maintain the responsiveness of the affected teeth to pulp sensitivity tests [24]. The diameter of the apical foramen, condition of vascular support, number of cells available and degree of diastasis (separation between fragments) are fundamental to the prognosis [25]. In the present case, both the mandibular incisors with middle third root fractures showed favourable prognosis during the follow-up periods without any mobility or pathological symptoms and responded positively to pulp vitality tests.

The success of treatment and type of healing after horizontal root fracture depend on age, stage of root development, degree of dislocation of coronal fragment and pulp condition. Following initial treatment of the root fracture, the type of healing can be divided into five groups: (1) fracture healing, (2) pulp necrosis, (3) root canal calcification or obliteration, (4) resorption, and (5) fracture non-healing [26]. The ideal outcome for horizontal root fractures is fracture healing with interposition of calcified tissue. For this type of healing, the pulp of the traumatized tooth must be intact and the coronal fragment should not be dislocated. Thus, the pulp remains vital and the mobility of the tooth is within certain physiological limits [27]. In the present case report, the clinical and radiographical examinations showed no obvious displacement of the fragments of involved teeth. Non-endodontic conservative management of the traumatized teeth was done with the aim of maintaining the pulp vitality. After long-term clinical and radiographic follow-up up to one year, all teeth presented positive response to the electrical pulp test, suggesting a repair of root fractures. Furthermore, the traumatized teeth showed normal color and mobility, and no pain was observed on horizontal and vertical percussion tests. The patients reported no discomfort with his teeth.

Conclusion

The present case report highlights successful conservative management of horizontal root fractures in cervical and middle third of permanent mandibular incisors following trauma. Thus it can be concluded that after careful monitoring of all the clinical parameters involved especially mobility, diastasis and pulp status, non-endodontic conservative management of horizontal root fractures in the presence of suitable conditions can help in spontaneous healing and maintaining the vitality of pulp.

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