



Resolved Tooth Discolouration Following Root Fracture Employing a Conservative Approach: A Case Report

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ABSTRACT

Dental trauma is one of the most common childhood incidents that leads to the damage or loss of deciduous and permanent teeth. One of the most challenging types of dental trauma is horizontal root fracture (HRF). In this case report, a central maxillary incisor with horizontal root fracture had been treated by the conservative approach of splinting the tooth and follow-up. In the initial evaluation, the tooth had a normal appearance and did not respond to either the cold test or electric pulp tester. After 4 weeks, the tooth was sensitive to the cold test; however, showed discolouration. After 4 months, discolouration disappeared and the tooth had a positive response to pulp sensibility tests. The tooth remained asymptomatic with a positive response to pulp sensitivity tests up to 15 months following the treatment.

Keywords: Discolouration, Horizontal Root Fracture; Pulp Vitality; Trauma

Introduction

Traumatic dental injuries are most commonly observed in young patients [1] and, usually, the anterior teeth are the most affected ones [2-6]. Previous studies have reported that the prevalence of traumatic dental injuries range from 16 to 40 percent in permanent teeth amongst 6-12 year-old children [4, 7].

Compared with other dental injuries, the incidence of horizontal root fractures are relatively low (0.5-7%). They are frequently seen in the middle third of the root [1, 3, 8-13]. These fractures are more likely to occur in fully erupted permanent maxillary central incisors with completely formed root [9, 10, 14, 15]. The consequences can be complex because of combined damage to the pulp, dentine, cementum, bone, and periodontium [10, 11, 15-17].

Root fractures are diagnosed through clinical and radiographic examinations. Clinical examination includes evaluation of mobility, presence or absence of tenderness and pain

on soft tissues palpation, percussion testing and pulp sensibility testing. The tooth is often mobile, however, the degree of mobility is frequently determined by the fracture location. Root fracture diagnosis can be established through radiographic examination but must be performed with care; 2 or 3 radiographs, from various vertical angles, may be necessary. The possibility of observing the fracture line on radiographs is greatly reduced if the x-ray beam does not pass directly through it [8, 11, 15].

Treatment usually consists of the repositioning of the coronal segment and its stabilization in the correct position. In addition, the tooth should be monitored for pulpal vitality during the splinting phase [12, 14]. Despite advances made in the endodontic management of traumatic dental injuries, controversies, regarding the optimum treatment plan for root fractured teeth, exist [7, 17, 18].

The treatment outcome of root fractured teeth may be influenced by numerous factors, such as displacement of the coronal fragment, root formation stage, fracture location, time

period between trauma and treatment. Although the treatment outcome of root fractured teeth is favorable in 60 to 80 percent of cases, complications _such as pulpal necrosis, radicular resorption, and pulpal canal obliteration_ are observed [13, 15, 17].

In this case report, an example of horizontal root fracture and lateral luxation on a maxillary incisor is presented in which only a conservative approach of splinting to adjacent teeth was performed. The tooth regained response to cold stimulus and electrical pulp testing (EPT). It also showed resolving discoloration up to 15 months following the treatment.

Case Report

An 11-year-old female patient, who had experienced facial trauma due to falling off the bike two days earlier, was referred to the Endodontic Department, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran. The patient claimed to have no systemic diseases and had no other history of facial trauma. Moreover, there were no inflammation, no soft tissue injuries, or asymmetry in the extra-oral examination.

Clinical evaluation of the patient demonstrated that the maxillary right central incisor (tooth number 8) had a lateral luxation with grade III mobility (Figures 1A and 1B). The cold test (Roeko Endo Frost; Roeko, Hangenav, Germany) and EPT (Parkell Electronics Division, Farmingdale, NY, USA) showed no response in tooth number 8 but positive response for all the other mandibular and maxillary teeth (Table 1). Tooth number 8 was also sensitive to percussion and palpation.

In the periapical radiography of tooth number 8 with different vertical angulations, a horizontal root fracture in the apical third of the root was observed (Figures 1C). In addition, there were no signs of alveolar bone fracture.

Tooth number 8 was repositioned under local anesthesia [buccal infiltration of 2% lidocaine with 1:80000 epinephrine (Persocaine; DaruPakhsh, Tehran, Iran)] using gentle digital manipulation. Then it was splinted to the adjacent teeth with a 0.5mm orthodontic wire and composite resin bonded to the labial surfaces of the maxillary teeth (Figures 1D to 1F). Tooth number 8 was evaluated for traumatic occlusion in the centric, lateral, and protrusive lower jaw movements. A 4-week splinting

period was scheduled for the patient based on the “International Association of Dental Traumatology” (IADT) guidelines for the management of traumatic dental injuries [19].

At the end of the 4-week period, and after removing the splint, the tooth showed a positive response to the cold test and was asymptomatic. Therefore, and despite the fact that there was a sign of tooth discoloration (Table 1, Figure 2A to 2C), it was decided to continue the follow-up with no other treatment intervention.

At the 2-month follow-up, the discoloration of tooth number 8 had slightly resolved. Moreover, the tooth responded normally to the electrical and thermal tests. The tooth discoloration had resolved completely 4 months after the trauma (Figures 2D to F).

After 15 months of follow-up (clinical and radiographic examinations), there were no signs and/or symptoms in the previously fractured tooth. There was no mobility and no pain caused by percussion or palpation. Furthermore, soft tissue examination showed no signs of swelling and there were no signs of sinus tract (Figures 2G to 2I).

Discussion

One of the most prevalent causes of tooth loss is trauma, especially in children and young adults. Despite the advances made in endodontics, management of traumatic dental injuries is still a controversial issue in many circumstances such as horizontal root fractures [17, 18].

The assessment of pulp vitality and evaluation of the necessity for root canal treatment are amongst the most important prerequisites in treating traumatized teeth [20]. The most common methods for assessing the pulpal status of a tooth are thermal testing and EPT [18, 21]. Nevertheless, a completely reliable technique has not been developed for the determination of dental pulp status.

Moreover, all available methods are indirect methods for pulpal status determination. These methods examine the responsiveness of nerve fibers in the dental pulp. Thus, it is difficult to differentiate permanent pulp necrosis from transient pulp infarction or coagulation necrosis at its early stages [18, 21].

Table 1. Diagnostic tests for tooth number 8

	Before treatment	4 weeks	2 months	4 months	10 months	15 months
Cold test	-	+	+	+	+	+
Electrical pulp testing (EPT)	-	-	+	+	+	+
Percussion	++	-	-	-	-	-
Mobility	3	0	0	0	0	0



Figure 1. A-D) Preoperative photographs and periapical radiographs; E-F) Immediate postoperative photographs, and periapical radiographs after splinting

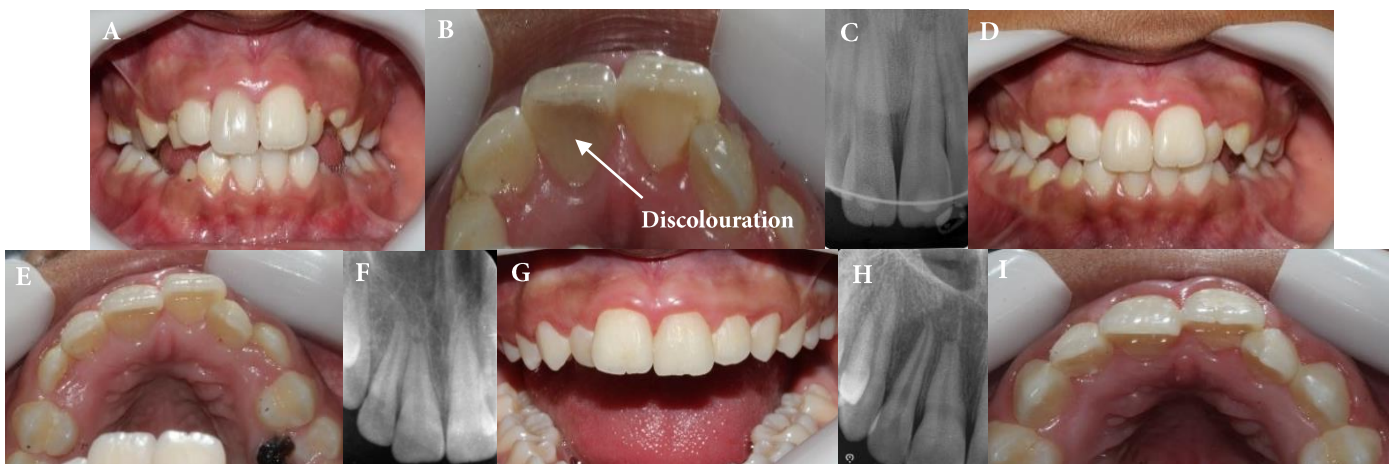


Figure 2. Follow-up photographs and periapical radiographs, A-C) 1-month follow-up; D-F) 4-month follow-up; G-I) 15-month follow-up

False-positive and false-negative results are often obtained in pulp sensibility tests; especially in young adults with immature or traumatized teeth [21]. According to IADT guidelines for the management of traumatic dental injuries, false-negative results in pulp sensibility tests may occur up to 3 months after trauma [19, 21]. False-negative results may lead to unnecessary endodontic treatments, whereas false-positive results may lead to delayed diagnosis [20].

Initial lack of response to vitality tests does not indicate irreversible damage to the pulp in traumatized teeth. Therefore, root canal treatment should be performed only

when there is evidence for pulp necrosis. Some authors have recommended the use of a “wait and see” strategy, which advocates abandoning endodontic treatments until additional signs of pulp necrosis such as sinus tract, root resorption, abscess, coronal discoloration, or apical periodontitis develop [20, 21]. Therefore, subsequent to the implementation of clinical management, follow-ups are crucial for the clinical assessment of treatment success [13]. The initial impact on pulp may be reversible or create a latent effect on the vitality of pulp some years after the incident [4].

Tooth discolouration may happen after traumatic injuries and can be in a range of pink to grey [19]. Discolourations either occur instantly after the dental trauma or induced progressively. As a result, instant discolouration can be reversible but the progressive ones may need root canal therapy [22]. In this case report, we described a yellowish to grey instant tooth discolouration, following horizontal root fracture that reversed to normal colour after 14 months.

Liao *et al.* [18] have reported a case of maxillary incisor with HRF and pulp infarction which regained vitality. Their study subject was a 24-year-old man, and pulp vascularization was confirmed by “Laser Doppler Flowmetry” (LDF). They reported that in the first weeks, venous stasis and inflammation process led to the tooth discolouration, and later, revitalization occurred. Their study was advantageous due to the use of LDF for the evaluation of oxygenated hemoglobin concentration and oxygen saturation within the pulp [18]. In the present case report, the tooth discolouration resolved after 4 months. This result might support their hypothesis regarding the role of inflammatory process and pulp regeneration in the months following traumatic dental injuries [18].

Ahn *et al.* [21] compared the long-term prognosis of traumatized teeth with contradictory results in conventional pulp testing and LDF. They concluded that the latter method is more reliable in the evaluation of pulpal status [21]. One of the limitations of the present case report is the use of conventional methods for the evaluation of pulp vitality. This limitation can be overcome in future cases by adding LDF to the initial and follow-up evaluation methods of traumatized teeth [21].

Radiographic examinations have some limitations in the detection of root fractures. One limitation is that the possibility of observing the fracture line on the radiographs is greatly reduced if the x-ray beam does not pass directly through it [8, 11, 15]. The advent of cone-beam computed tomography (CBCT) has made possible the accurate diagnosis of HRF (its presence or absence) as well as the determination of the exact location, extent, and direction of the fracture line [8, 11, 23]. However, and due to high radiation dose of CBCT, at first, taking radiographic images with different vertical angulations have been recommended by “The American Association of Endodontists” (AAE) and IADT. Orhan *et al.* [8] reported the results of CBCT regarding a spontaneously healed root fracture in a 36-year-old subject [8]. Root fracture healing occurs in 80% of subjects with no treatment other than splinting, and the outcome of the other 20% is necrosis. One of the most important factors in this process is the position of the fracture. Fractures which led to the communication of oral cavity with pulpal tissue

resulted in contamination and pulp necrosis in most cases [8].

Healing following root fractures, based on the type of lesion and anatomical and functional characteristics, have been described by four sequelae: healing with calcified tissue, interproximal connective tissue, interproximal bone and connective tissue, and interproximal inflammatory tissue without healing. The way in which these lesions heal initially depends on the health of the pulp, dentine, cementum, and alveolar bone, and the degree of dislocation of the fragments [3, 15]. If the pulp becomes necrotic and infected, the coronal portion will require root canal treatment [15].

One of the major factors, affecting the prognosis of traumatic teeth, is the age of the patient and the chance of vascularization. Teeth with open apices have a higher chance of regaining vitality in comparison to closed apex teeth. Thus, it is recommended that, considering the age of patients and apical status of traumatized teeth, different modalities -ranging from root canal treatments to splinting and observation- should be provided for the patient [7, 24, 25]. In the current case report, the latter treatment modality was chosen.

Conclusion

In this case report, after 15 months of clinical and radiographic follow-ups, there were no signs and/or symptoms associated with the previously fractured tooth. The tooth was not discolored and the occlusion was normal. There was no mobility and no pain during percussion or palpation. Moreover, soft tissue examination showed no signs of scarring or sinus tract.

Conflict of Interest: ‘None declared’.

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