Horizontal Fractures - A Silent Finding: A Case Series

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Incisors are common teeth to suffer dental trauma, with root fracture occurring in <3% of injuries. Horizontal root fractures occur mainly in the middle third of root mostly affect upper central incisors. Nevertheless, apical and coronal 3rd fracture is also sometimes reported. The fracture may go undiagnosed for many years until the patient reports with discolored, mobile tooth which on radiograph reveals a break in continuity of the root. This paper reports the management of three horizontal root fractures (delayed and immediate) in upper incisors; two treated with mineral trioxide aggregate and calamus (Dentsply) for warm vertical obturation and one with fiber post.

Keywords: Central incisors, Fiber post, Horizontal root fracture, Mineral trioxide aggregate

INTRODUCTION

Traumatic injuries of teeth are the main cause of emergency treatment in dental practice.1,2 Horizontal root fractures are more frequently observed in the maxillary anterior region and young male patients.1,4 The most common type of root fracture is in the middle third, followed by an apical and coronal third.3,5 It was reported that 31% of the patients with root fractures were identified during routine dental radiographic examinations.3,6 Proper clinical and radiographic examination is required for correct diagnosis, and the treatment plan is decided depending on the type of fracture and extent of the fracture line. Immediate treatment in horizontal root fractures includes repositioning of the coronal segment, splinting, and delayed management by endodontic treatment of coronal fragment with or without splinting.9 The frequency of root fractures in permanent teeth is 0.5-7% and 2-4% in deciduous teeth.10 The prognosis of such cases depends on the patient’s age, stage of root growth, mobility of the coronal fragment and diastasis of the fragments. Horizontal or transverse root fractures can be sub-classified on the basis of:

- Location of fracture line (cervical, middle, and apical)
- Extent of fracture (partial and total)
- Number of fracture lines (simple, multiple, and comminuted)
- The position of the coronal fragment (displaced and not displaced).

Depending on the position of the fracture line, transverse root fractures can also be classified into three zones11 as follows:

- Zone 1: Extends from the occlusal/incisal edge to the alveolar bone crest
- Zone 2: Extends from the alveolar bone crest to 5 mm below
- Zone 3: Extends from 5 mm below the alveolar bone crest to the apex of the root.

These zones are analogs to crown fracture, cervical root fracture, and middle/apical root fracture, respectively.

The histological reactions at the fracture line are categorized into four types:12

- Interposition of calcified tissue
- Interposition of connective tissue
- Interposition of bone and connective tissue
- Interposition of granulation tissue.

Etiology

Horizontal root fractures are observed in anterior teeth with direct trauma. Maxillary central incisors are most vulnerable to injury, sustaining nearly 80% of all dental injuries, followed by the maxillary lateral and the
mandibular incisors. In posterior teeth, it usually occurs as a result of indirect trauma. In addition, they may occur by Parafunctional habits, traumatic occlusion, extensive tooth decay, and iatrogenic causes.

History
The diagnosis begins by recording the demographics of the patient and taking a brief history of the traumatic event:
- Time and place of the event
- Reason for the injury
- Previous dental injuries
- Spontaneous pain or sensitivity
- Other associated symptoms following an injury (unconsciousness, drowsiness, vomiting, or headache).

Clinical Examination
The diagnosis of apical root fractures is determined by clinical and radiographic examination. A routine follow-up is required to monitor the pulpal status continuously. Recently, the use of pulse oximeter was recommended to evaluate the pulpal status of a recently traumatized tooth. It has better sensitivity and specificity than electrical and thermal tests and gives a constant positive vitality reading with time in cases of recently traumatized teeth.

Radiographic Examination
The fracture line is oriented obliquely in the apical third and middle third of the root and more horizontally oriented in the cervical third. In addition to the conventional periapical radiograph, two additional periapical radiographs (one with a positive angulation of 15° to the fracture line and the second with a negative angulation of 15° to the fracture line) are advised. Other suggested protocols to visualize the fracture line accurately are: Processing radiographs at 45°, 90° and 110°. A steep occlusal exposure along with two conventional periapical bisecting-angle exposures were taken. In addition to the views listed above, occlusal radiographs may be required to disclose fractures in the apical third of the root, although cervical-third root fractures are better visualized with periapical radiographs. Since the introduction of cone-beam computed tomography, examination of root fractures in three dimensions is possible.

CASE REPORT

Case Report 1
Delayed management: This case represents 18 months follow-up of a 23-year-old female who had sustained trauma to her upper left central incisor 8 years back with a horizontal root fracture at the junction of middle and apical third of root. Tooth showed Grade 2 mobility and black discoloration with mild tenderness on percussion (Figure 1). Clinical examination, pulp sensitivity test with electronic pulp tester, and pulse oximeter were done, which showed that tooth was non-vital. Delayed non-surgical management was carried out with 4 weeks splinting (Figure 2) root canal treatment of coronal segment and orthograde restoration of root canal with mineral trioxide aggregate (MTA) followed by obturation with calamus (warm vertical compaction) and composite restoration. Later on smile designing was done with all ceramic crowns and veneers in upper anterior six teeth (Figures 3 and 4). MTA allowed healing and prevent the occurrence of clinical symptoms. Mobility was reduced to Grade 1 within 3 months followed by no mobility after 6 months. 1 and a half year follow-up shows no mobility.

Case Report 2
Immediate management: This case represents 16 months follow-up of a 27-year-old male patient who presented with a history of trauma 2 days back with complaint of pain in upper front tooth region (Figures 5 and 6). Radiograph shows horizontal root fracture at junction of middle and apical one third of root, along with Grade 2 mobility with severe tenderness to palpation and percussion and thermal tests. Non-surgical management was done with 8 weeks splinting (Figure 7), root canal treatment of coronal segment and orthograde restoration of root canal with MTA (Figure 8), and composite restoration. Later on smile designing was done with all ceramic crowns and veneers in upper anterior six teeth (Figures 9 and 10). The mobility was reduced to grade zero in 2 months and 2 years follow-up shows no mobility and periapical changes.

Case Report 3
Delayed management: This case represents a 12 months follow-up of a 20-years-old female who had sustained trauma to her upper left central incisor 1 year back with a horizontal root fracture at the junction of middle and apical third of root (Figure 10). Tooth showed Grade 1 mobility, no discoloration and mild tenderness on percussion. Clinical examination, pulp sensitivity test with electronic pulp tester were done, which showed that tooth was non-vital. The radiograph showed a presence of periapical radiolucency and reinforcing the root with fiber post 2 mm beyond the fracture line using Paracore (Figure 11). No mobility was seen after 1 month, 1-year follow-up shows no mobility, color changes or any periapical changes.

DISCUSSION
Root fractures heal differently depending on the degree of separation of the fragments, the severity of injury, and
the ability of the pulp to heal. If the dental pulp is necrotic, repair does not occur without root canal treatment. Frontal forces effect compression zones labially and lingually/palatally and divide the root into coronal fragment and apical fragment. Root fractured teeth often possess a vital apical fragment, even when the coronal fragment is necrotic. For this reason, only the coronal fragment should been endodontically treated. In the study by Cvek et al. (2004), overfilled root canal filling material between the fragments did not lead to healing or lead to interposition of granulation tissue. In a retrospective study by Andrea Wolner-Hanssen and Thomas Von Arx, endodontically adequately treated teeth with root fractures have a good prognosis. Root resorptions were seldom observed, and the most frequent tissue reaction at the fracture line was interposition of connective tissue. Pulpal necrosis and lack of healing at the fracture line were the most common complications. Andreasen et al. (2007) observed that 60% of the teeth with root fractures exhibited external root resorption. Several experimental studies have shown that
external root resorption after trauma occurs less frequently when ledermix paste is applied as the first filler in the canal (Thong et al., 2001, Bryson et al., 2002, Wong and Sae-lin 2002). The steroid component of ledermix (triamcinolone) suppresses the initial inflammatory reaction, and the antibiotic component (dimethyl-chlortetracycline) inhibits the osteoclast-induced root resorption. International Association of Dental Traumatology (Flores et al., 2007) guidelines recommend endodontic treatment only after pulpal necrosis, not as a prophylactic intervention. It has long been accepted that the treatment for horizontal root fractured teeth involve repositioning and rigid splinting. Additional dental treatment of root fractures may also include endodontic therapy and restorative treatment if necessary.\textsuperscript{16}

Root canal therapy is not recommended on the tooth with horizontal root fracture. In the apical third, because research has demonstrated that the pulp will remain vital in most cases with high percentage of successful healing without receiving endodontic treatments.\textsuperscript{17} A minimum observation period of 1-year is recommended for damaged teeth with no apparent complications.\textsuperscript{18} Repositioning the displaced tooth fragment enhances pulp and hard tissue healing. Type and duration of splinting had no significant difference in healing.\textsuperscript{19} Horizontal root fractures situated on the middle or apical third of the root present better prognosis in comparison with vertical fractures and teeth with vertical root fractures and poor prognosis are classified as a genuine indication for autogenous tooth transplantation.\textsuperscript{20}
When the pulp tissue vitality is preserved, the odontoblasts and the cells from the cementum are usually responsible for the healing process. Deposition of calcified tissue occurs, with the possibility of a connection of the root pieces. The ratio of healing by odontoblasts or cementoblasts appears to be dependent on the injuries each tissue has been subjected to and whether or not revascularization of the pulp takes place. The possibility of spontaneous healing after a root fracture in teeth that maintain pulp vitality is clinically significant, and may occur in approximately 70-80% of intra-alveolar root fracture cases. However, if the pulp injury is severe, healing does not occur and granulation tissue separates the fractured segments, obviously without the hard tissue healing.21,22

Newer materials are being investigated to create an artificial barrier at fracture site. Calcium hydroxide (CH) is the most widely accepted material earlier, because it limits bacterial infection and establishes a suitable environment for the induction of calcified tissue.23 The most important problem with the typical calcified barrier formed with CH is the duration of the therapy, which is from 3 to 21 months.24 Furthermore, prolonged exposure of dentine to CH has a weakening effect on the dentine due to its proteolytic capacity. Another major drawback is it requires prolonged patient-motivation. With the MTA technique, a one-step obturation could be performed at the fracture site. The MTA mixture creates an artificial stop to the filling material and prevents weakening of dentine. It is suitable for closing the communication between the root canal and surrounding periodontal tissues. MTA was chosen to fill the fragile fractured root with a material with a fast-setting time and excellent biological and physical properties.25,26 In this case, the MTA mixture was placed to prevent the extrusion of the material. It allowed healing and prevented the occurrence of any clinical symptoms. This study’s results are similar to those reported in other studies in which MTA appeared to show good sealing ability, a high degree of biocompatibility, and a reasonable setting time.26

**SUMMARY AND CONCLUSION**

Patient’s age at the time of injury is considered one of the most important factors in pulpal healing after root fracture. In the apical third root fractures, it is recommended to leave the apical fragment untreated unless pathological, in which case it may be surgically removed. Endodontic treatment of both the fragments is not recommended. Long-term follow-up of patients with injuries is important because pathological changes can occur several years following injury. So far, for the patients described in this paper, MTA appears to have been a valid option for horizontal root fractures, with the added advantage of speed of completion of therapy and reduced mobility. These were followed by smile designing.

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**REFERENCES**

22. Falomo OO. Spontaneous repair following root fracture.

Garg and Khurana: Horizontal Root Fracture

