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Root Fracture of an Immature Permanent Tooth with Open Apex: A Case Report

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Abstract: Of the teeth facing with root fractures seen in early permanent dentition, maxillary central incisors are the most common and middle third of the root is the most-affected-part. Although in most of the healed-cases, there was partial or complete obliteration of the pulp space; with proper therapy vitality could be kept in the apical part of the root and a successful-apical closure could be achieved in young permanent teeth having open-apex. A case report of the treatment of a young permanent maxillary-incisor having an open apex with root fractures is presented. The fracture line was treated with Calcium Hydroxide (CaOH) root endodontically filled till fracture line, during first 8 months. Clinically, the teeth became firm and the radiographic results after 4 years showed healing and hard tissue filling in the space at the fracture line and a successful apical closure. As a result, adequate observation period, vitality and/or radiographic control, complains of pain or discomfort of the tooth are the major factors which is guide for the performing successful endodontic therapy along the all root-length.

Key words: Root fracture, young permanent teeth, apical closure, endodontic treatment, calcium hydroxide

INTRODUCTION

Trauma to the maxillary anterior teeth is a frequent occurrence in children and adolescents. Root fractures couldn't be successfully treated by reattachment of the fractured portions every time (Chik and Shy, 2007).

Dental trauma can lead to a wide range of injuries, including crown fractures and intra-alveolar root fractures (Saad, 1991). Although crown fractures may be uncomplicated, root fracture is a combined injury of pulp, dentin, cementum and periodontal ligament and is a relatively uncommon type of dental trauma (Çaliskan and Türkün, 1995). The fracture site may vary from coronal, middle or apical third.

Although the location of the root fracture and the status of the dental pulp determine the type of treatment; the main goal of the treatment is to enhance the vital-healing process. However, in some cases, coronal part of the root-part has intentionally become necrotic. And subsequently, endodontic treatment could be indispensable. Despite coronal or total pulp necrosis, calcification of the pulp space, internal or external resorption and loss of marginal bone are common clinical complications of

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root fractures; the maintenance of vitality of apical part of the root is essential due to the presence of open-apex having a probability of apical cystic-formation, formerly (Andreasen *et al*., 1989; Birch and Rock, 1986; Çaliskan and Turkun, 1996; Brambilla and Cavalle, 2007).

This case report illustrates the optimal treatment of a horizontal root fractures in the middle third on which the coronal segment was necrotic and an open-apex was also present due to incomplete-root-formation.

CASE REPORT

An 8-year-old girl was referred to the Department of Pedodontics at Dicle University School of Dentistry for treatment of a traumatic injury to the teeth of the maxillary anterior region of the mouth. The dental history revealed that the patient had suffered traumatic injury (collusion) to her permanent central incisors a few days ago. The patient complained of pain in his maxillary central incisors and slight sensitivity to apical palpation and percussion. The clinical examination revealed crown fracture and slight mobility in the maxillary left side, but not in right side central incisors (Fig. 1). The radiographic examination showed horizontal root fracture in the middle-third of the maxillary left side central incisor (Fig. 2). Although any periodontal pathosis at the fracture lines was evident; there was an extensive pulpal exposure due to crown fracture. So, a decision was made to start endodontic therapy on coronal fragment but not for apical fragment due to the probability of apical closure if the vitality is continuing.

In the initial treatment, the fixation of the teeth was not needed due to slight mobility of the involved teeth. At the same visit, a local anesthetic was administered and the tooth was isolated with cotton-rolls. The pulp of the coronal fragments was necrotic and was removed to the fracture line. A number 80 H-type file (H-Files Svenska Dentorama AB, SE-171 48 Sweden) was used at the fracture lines and the root canals were irrigated with 5.0% hydrogen peroxide and 0.2% chlorhexidine digluconate solution (DrogSan, Ankara-Turkey). A working length was established by subtracting 1 mm of the fracture lines of the tooth. Following biomechanical preparation, the canals were re-irrigated with the solutions mentioned above and were dried with absorbent paper points. A calcium hydroxide preperat (Vision, Germany) mixing with anesthetic solution was inserted in the root canal (Fig. 3). At the subsequent visit 2 weeks later, the teeth were asymptomatic. After 4 weeks and thereafter at 2-month intervals, the calcium hydroxide was reinserted until a calcific barrier was formed at the fracture line. Hard tissue formation was detected at the fracture line of the root canal in the 8th month of the medical treatment (Fig. 4). In the meantime, it was clearly understood from the same radiography that the root end of apical segment was becoming narrower because of hard-tissue formation. At this appointment, the coronal fragment was obturated with gutta-percha (DiaDent, Korea) and sealer (Sealapex, Kerr/Sybron, USA), using the lateral condensation technique (Fig. 5).

Fig. 1: Clinical appearance of the traumatized maxillary left-central incisor and its neighboring teeth

Fig. 2: Radiographic appearance of the traumatized maxillary left-central incisor with horizontal root fracture and open-apex

Fig. 3: Radiographic appearance of the traumatized maxillary left-central incisor immediately after the initiation of endodontic therapy

Fig. 4: Radiographic appearance of the forming of calcific barrier at the fracture line after 8 month of the therapy

Fig. 5: Ended of endodontic treatment for coronal root-segment

Fig. 6: Conservative treatment of crown fracture using dentine-pin and light-cured composite resin

Fig. 7: Radiographic appearance of the fractured tooth after 4 years

After 1 week, the crown was restored with the acid-etch composite resin technique using microhybrite light-cure composite resin (3M Valux Plush. 3M Dental Products, USA) to provide aesthetic and function (Fig. 6).

After 4 years, clinical examination of the maxillary left central incisor revealed that it was asymptomatic; there was no mobility, no pain to percussion or palpation. Radiographic examination showed that fracture line was completely filled by hard-tissue-formation and a successful apical closure was achieved (Fig. 7).

DISCUSSION

Numerous forms of injury can occur as a result of dental trauma. The prognosis of these injuries varies. In general, many factors play an important role in influencing the outcome and pattern of repair (Saad, 1991; Andreasen and Hansen, 1967; Brambilla and Cavalle, 2007). Apart from the crown fractures, root fractures involve cementum, dentin and pulp tissue. Successful union of root fragments is aided by vital pulp tissue and a healthy periodontium. With most root fracture maintaining vitality of the pulp, the main goal of treatment is to enhance this healing process. The clinician should try to reunite the fractured segments by calcific callus formation because the tooth will be stronger than one without the union of broken parts.

Extraction may not be the ouly alternative for the root fractures. Even for fractures under the alveolar margin, alternative multidisciplinary approaches can be used to restore and allow the tooth to survive (Demiralp *et al*., 2007).

The prognosis of root fractures depends on the extent of the fracture line, the pulp tissue situation, occlusion, dislocation of fragments and the general health of the patient. From the scientific literatures, the sequelae to root fractures may be divided into four categories: i)healing with cementogenic or calcified tissue, ii) healing with interproximal dense counective tissue, iii) healing with interproximal bone and counective tissue, iv) interproximal inflammatory tissue without healing (Andreasen *et al*., 1989; Andreasen and Hansen, 1967; Mata *et al*., 1985; Michanowicz *et al*., 1971; Kothari *et al*., 1994).

The healing of horizontal root fractures seems to involve hard tissue deposition in and around the fracture site and calcification in the pulp spaces both in the apical and the coronal segments. Repair appears to depend on an intact periodontal ligament, from which the hard tissue forming cells originate (Andreasen and Hansen, 1967; Herwejier *et al*., 1992). If the fragments are more separated, the fracture spaces fill with cellular mineralized hard tissue or bone surrounded by connective tissue [Type-3] (Herwejier *et al*., 1992). Contrary, if the fragments are narrower, the fracture line can be healed with cementogenic and/or calcific tissue as seen in our case [Type-1 or 2].

Despite keeping of vitality in both coronal and apical fragments is essential; of the cases with horizontal root fractures, 43.7% have had pulp necrosis (Al-Nazhan *et al*., 1995). When the coronal pulp becomes necrotic and there is no radiographic or clinical evidence that the apical segment is irreversibly inflamed or necrotic, the treatment of the coronal segment ouly is indicated. The apical segment will probably remain vital. Therefore, in most cases of unhealing root fractures only the coronal segment is treated (Hovland, 1992).

In initial treatment, an apexification procedure of the segment should be performed before obturation of the root canal (Çaliskan and Turkun, 1996). This technique involves the repeated placement of calcium hydroxide over a period of 6-24 months until a calcific barrier is formed at the fracture line (Cvek, 1974). The use of calcium hydroxide in teeth with horizontal root fractures was first recommended by Cvek (1974). He proposed that the canal at the level of the fracture line is comparable to the apical foramen of an immature tooth. Thus, he assumed that the repair would be similar to the apexification procedure employed for the tooth with an open apex (Mata *et al*., 1985). Similarly, in a study by Jin *et al*. (1996) an experimental-root-fracture-model in dog teeth revealed that the early reaction of the wound healing was infiltration of inflammatory cells particularly at the coronal part of the fracture, whereas less inflammation but more abundant collagen fibers were seen at the apical part of the fracture (15 and 30 days). At day 180 (6th month) bone tissue healing was observed. Same authors also suggested that in the fractured-root, the regeneration of blood vessels is important in the wound-healing process and the revascularization is synchronized with the fracture wound healing. In parallel with these evidence and suggestions, in our case, a conspicuous hard tissue formation has been observed between the coronal and apical segments following the repeated placement

of calcium hydroxide during 2 to 8 months period. When compared to similar cases presented in literature, the time needing to close fracture-line is considerably short. Probably, the vitality of apical segment can facilitate the hard tissue deposition at the fracture-line. Moreover, proximity of fragmants can also responsible for this fast-healing.

The relationship between healing complications and preinjury and injury factors could generally be explained by better healing possibilities in teeth with immature root formation. A possible explanation for that could be the softer bone surrounding the tooth, whereby trauma to the periodontium might be diminished (Andreasen *et al*., 2006).

Interestingly, apart from the root-fractures reported just now, our case represents an open apex to be close to eliminating the risk of apical pathosis in the following years. Of course, keeping the vitality of apical root segment has led to natural closure of apical-foremen, indicating the continuing cementoblastic activity.

In the case presented here, it was clearly understand from the case presented here that not ouly a proper endodontic and/or conservative treatment, but also adequate observation period were necessary to diagnose pathological changes to be occurred following years. After an adequate observation period, if vitality and/or radiographic control reveals non-vital pulp tissue, or if the patient complains of pain or discomfort of the tooth, then endodontic therapy can be performed along the all root-length.

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