Treatment of horizontal root fractured central incisors and 30 months follow up: 2 case reports

ABSTRACT

Background Horizontal root fractures are rare in comparison to other types of injuries and according to the literature account for between 0.2%–7% of all traumatic tooth injuries.

Case reports Case 1: A 12-year-old girl was referred to our clinic with a complaint of mobility and tenderness in her permanent upper left central incisor. An electric pulp test showed reduced tooth vitality. Although the initial clinical findings suggested a subluxation injury, radiographic examination revealed a horizontal root fracture in the middle third of the root (Fig. 2). Accordingly, the treatment plan consisted of tooth splinting and close follow-up for any signs of pulp necrosis. A splint was fabricated from 0.3 mm orthodontic wire and composite resin (Grandio, VOCO, Cuxhaven, Germany) and bonded to all incisors in order to immobilise the injured tooth and shielding it from any traumatic forces. The follow-up examination showed healing with hard tissue in the fracture line for both of the cases.

Conclusion Using semi-rigid splints without any further treatment resulted with hard tissue healing in both of the cases and was successful for the treatment of horizontal root fractures.

Keywords Dental trauma; Horizontal root fracture; Mouthguard; Splint.
additional force (Fig. 3). The patient was also instructed to use a chlorhexidine mouth rinse for two weeks, not to use her tooth, and to avoid any pressure or trauma on it. Follow-up visits were arranged for 2 and 4 weeks after treatment. At the 4-week follow-up, the tooth was no longer mobile, and the splint was removed; however, electric pulp test still showed limited response. Follow-up visits continued on a 3-month basis for 18 months and on a 6-month basis for an additional year. At the 9-month follow-up visit, the tooth responded normally to electric pulp test, indicating that it had regained vitality. After 30 months, the tooth continued to show vitality according to electric pulp test and exhibited no clinical or radiographic signs of pathology (Fig. 4). Healing with hard tissue was observable on the control radiograph (Fig. 5).

Case 2

A 12-year-old boy was referred to our clinic with an injury to his upper left central incisor occurred in a collision during a handball game 3 days earlier. Clinical examination showed the tooth to be extruded by 2 mm (Fig. 6), sensitive to percussion and slightly mobile (1st degree). The tooth did not respond to electric pulp test. Radiographic examination revealed a horizontal root fracture in the middle third of the root (Fig. 7).

An attempt to reposition the coronal fragment of the injured tooth was unsuccessful, most likely because of the time interval between injury and application. Since there was no primary contact with the mandibular teeth, the injured incisor was allowed to remain in place. A treatment plan was devised that consisted of tooth immobilisation and close follow-up to control for tooth vitality. In addition, a mouth guard was fabricated to protect the injured tooth from any additional trauma during sports activities.
A splint was fabricated from 0.3 mm orthodontic wire and composite resin (Grandio, VOCO, Cuxhaven, Germany) and bonded to teeth 11, 12, 22 and a left lateral supernumerary tooth (Fig. 8). The patient was instructed to use a chlorhexidine mouth rinse for two weeks and to protect the tooth from any additional forces. In addition, a custom-made mouthguard was prepared using 4 mm Essix clear resin (Raintree Essix, Dentsply, Florida, USA), and the patient was advised to use the mouthguard during training and matches (Fig. 9).

Follow-up visits were arranged for 2 and 4 weeks after treatment. At the 4-week follow-up, the tooth was no longer mobile, and the splint was removed. An electric pulp test showed a limited response, indicating some tooth vitality; therefore, follow-up continued with no further treatment.

Follow-up visits continued on a 3-month basis for 18 months and on a 6-month basis for an additional year. At the 6-month follow-up visit, the tooth responded normally to electric pulp test, indicating that it had regained vitality. After 1 year, the radiographic examination showed hard-tissue healing along the fracture line.

During the course of follow-up, the patient reported sustaining 3 additional orofacial injuries (at 2, 7 and 17 months) during sports activities; however, no tooth injuries were apparent, probably because he was using the mouthguard when the events occurred. After 30 months, the tooth continued to show vitality to the electric pulp test and exhibited no clinical or radiographic signs of pathology (Fig. 10). Healing with hard tissue was observable on the control radiograph (Fig. 11).

Discussion

Root fractures occur most frequently in permanent upper incisors with closed apices in young patients [Jacobsen, 1976; Andreasen et al., 2004c]. Causes include falling, sports activities and traffic accidents.

The reported healing rate for root fractures is between 77%–80% [Cvek et al., 2001; Andreasen et al., 2004c]. In their radiographical and histological study, Andreasen and Hjorting-Hansen described 4 possible healing patterns for root fractures, as follows [Andreasen and Hjorting-Hansen, 1967].

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

Healing with hard tissue is considered the ideal outcome. Factors that may affect healing include; stage of root development, location of the fracture line, dislocation of the coronal fragment, pulp sensitivity and application/type of splint [Cvek et al., 2001; Andreasen et al., 2004c].

There are several case reports of spontaneous healing of root fractures without any treatment that were coincidentally diagnosed during routine control [Chala et al., 2009; Gördüysus et al. 2008]. Other studies that include large groups of intra-alveolar root fractures report that neither the application nor the time of splinting affected healing of root fractures [Cvek et al., 2001; Andreasen et al., 2004b; Cvek et al., 2008]. Furthermore, both Andreasen et al. and Cvek et al. reported that hard-tissue healing was more frequent in teeth that were not splinted [Cvek et al., 2001;
Andreasen et al., 2004b]. In explaining these results, the authors noted that rigid fixation resulted in disturbances of circulation and wound healing. However, it should be noted that the teeth in these studies that were not splinted had no displacement of the coronal fragment and could thus be expected to have higher than average rates of hard-tissue healing. At the same time, it is important to avoid complete immobilisation of teeth when using cap splints or composite resin splints so as not to harm the healing process.

The International Association of Dental Traumatology guidelines [Flores et al., 2007] recommend immediate repositioning and splinting of root-fractured teeth for between 4 weeks and 4 months. In both the cases presented here, the injured teeth were splinted for 4 weeks using orthodontic wire and composite resin to restrict the mobility of the teeth without completely immobilising them. One child (Case 2) was also given a mouthguard, which immobilises the tooth in the same manner as a cap splint; however, the mouthguard did not have a negative effect on healing, most likely because it was used only during sports training and matches for a total of 10 hours per week. Both cases presented here showed hard-tissue healing of fractures, and both teeth were vital at the end of the second year of follow-up. Previous studies have reported that dislocation and repositioning of fragments have a significant effect on the healing process [Andreasen et al., 2004b; Andreasen et al., 2004c; Cvek et al., 2008]. In Case 1, there was no dislocation between the fragments. This may have had a positive effect on hard-tissue healing by providing a shorter healing distance [Andreasen et al., 2004b]. On the other hand, in Case 2, the coronal fragment was displaced 2 mm and could not be repositioned due to the time delay between injury and application. According to previous studies, few teeth with diastases of more than 1 mm have shown hard tissue healing [Cvek et al., 2001; Andreasen et al., 2004c]. In line with this finding, the fragment dislocation in Case 2 may have been expected to have a negative effect on healing. Interestingly, however, radiographic examination showed no differences between Cases 1 and 2 in terms of the time of hard-tissue formation over the fracture line or in tooth vitality. Although coagulum in the fracture line provides a good substrate for bacterial growth [Andreasen et al., 2004b], it is possible that these unexpected results are related to personal healing and immunological characteristics. Moreover, the use of a chlorhexidine mouth rinse and optimal oral hygiene may have prevented bacterial contamination through the gingival pocket and helped to induce healing.

Mouthguards are known to protect soft tissue and teeth by providing a resilient, protective surface that distributes impact forces, and their use during sports activities is recommended by many authors [Nowjack-Raymer and Gift, 1996; Newsome et al., 2001; Sane et al., 1988]. In Case 2, the patient was injured during a handball match in which he was not wearing a mouthguard. As part of his treatment, the patient was given a mouthguard to wear during sports activities. During the 30 months follow-up period, he reported 3 additional sports-related orofacial injuries, and none of these injuries appeared to have had any effect on the healing process of the injured tooth. While the importance of using a mouthguard is unquestionable, this case suggests that a mouthguard may also have a positive effect on the healing process of injured teeth.

**Conclusion**

Using semi-rigid splints without any further treatment resulted with hard tissue healing in both cases and was successful for the treatment of horizontal root fractures in the long term. Also mouthguard usage following treatment did not have a negative effect on healing of the root fracture.

**References**


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