Case Report

Flexible Wire Composite Splinting for Root Fracture of Immature Permanent Incisors: A Case Report

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Abstract: *Root fracture injuries affect up to 7% of permanent teeth, and injury in teeth with immature root formation is even rarer. The purpose of this paper was to report the case of a 7-year-old girl who experienced pain in her permanent maxillary central incisors following a fall from a bicycle. A radiographic examination revealed immature maxillary central incisors with mid-root oblique and horizontal root fractures. Splinting was performed, and the child was observed under a regular follow-up regime. After 18 months, clinical examination showed normal tooth color and position, with a positive response to the pulp test. This case report also aims to provide an insight into the splinting duration and various splinting techniques and how this can affect the prognosis. (Pediatr Dent 2011;33:63-6) Received April 23, 2008 / Last Revision October 19, 2008 / Revision Accepted December 7, 2008*

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The horizontal root fracture injuries of permanent teeth affect up to 7% of all dental trauma.[1,2] Although this type of injury is rarely seen in teeth with immature root formation, the prognosis is generally good, depending on the fracture's site.[3,4] Falls are the leading reported cause of root fracture injuries (46%), and most involve 1 tooth (71%). Permanent maxillary central incisors are the teeth most often affected (95%). The most common type of root fracture was in the middle third of the root (57%), followed by the apical third (34%). Approximately 59% of untreated or splinted teeth maintain their vitality.[5] Dental splints are used for fixing a single traumatized tooth or multiple traumatized teeth or for reimplantation of a tooth to prevent further damage to the pulp and periodontal structure during the healing period.[6,7]

The purpose of this case report was to provide insight into the splinting duration and various splinting techniques and how this can affect the prognosis. This report presents a case of root fracture in immature permanent maxillary incisors using the flexible wire-composite splint and 24 months follow-up.

Case description

A 7-year-old girl presented to the pediatric dental clinic, Wardha, India. with profuse bleeding from the maxillary anterior region of the mouth, swelling of the upper lip, and no facial or head injury, following a fall from a bicycle approximately 15 minutes earlier. The child was alert, oriented, and cooperative with no signs of neurological impairment. The medical history reported by the parents was noncontributory.

Intraoral examination revealed that the patient was in the mixed dentition stage with 2 permanent maxillary central incisors. Both the maxillary central incisors and the permanent right lateral incisors were traumatized along with an injury to the labial frenum (Figure 1). The maxillary central incisors presented with mobility on palpation and were sensitive to touch, and sulcular bleeding was evident. A radiographic examination revealed that the

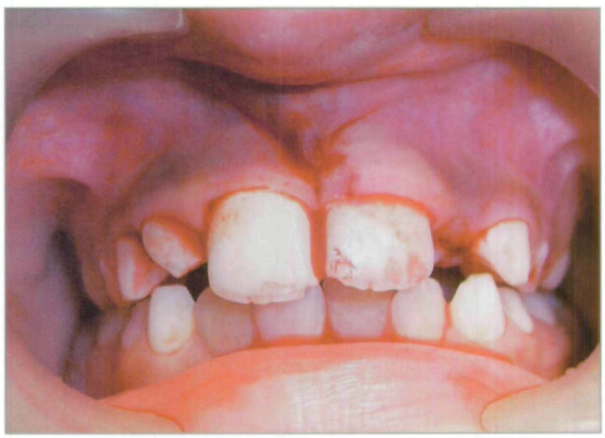

Figure 1. Permanent maxillary incisors loosened by a traumatic blow, with sulcular bleeding.

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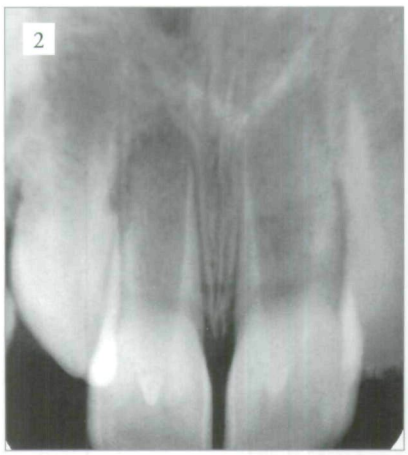
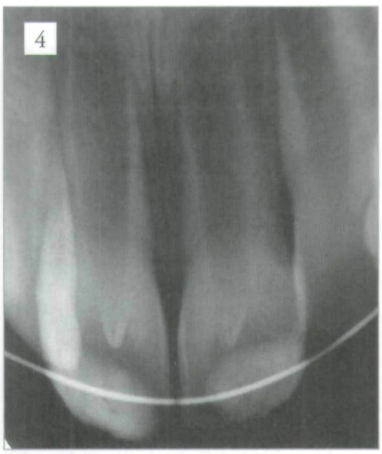
immature maxillary central incisors had oblique root fractures inclined apically from the mesial to distal side at the root's cervical third. There was also a fracture at the right central incisor's middle third, along with the displacement of fractured segments of both central incisors (Figure 2).

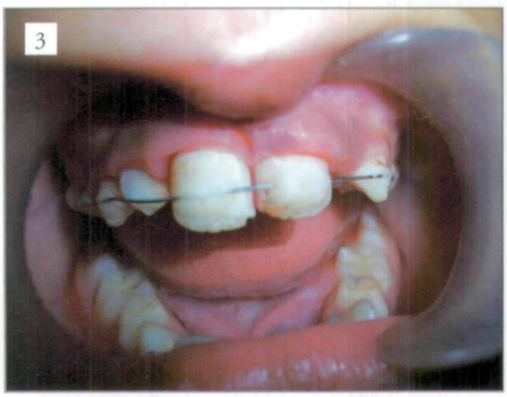
Treatment. Repositioning of the incisors with a 0.3-mm, soft, round, stainless steel, flexible arch wire bonded with light cure resin was performed immediately after cleaning the injured area (Figure 3). Once the splinting was performed, the patient was reassured and an intraoral periapical radiograph was taken to verify the tooth repositioning (Figure 4). The patient was instructed not to exert any functional loading. Antibiotic therapy (Tab Clamox, amoxicillin 250 mg, clavulanic acid 125 mg three times a day), a soft diet, antiplaque mouth rinse (chlorhexidine 0.12%), and an anti-inflammatory agent (Tab Meftal P, mefenemic acid 100 mg four times a day) were prescribed. The latter was given to relieve pain and reduce inflammation for faster healing. The antibiotic was given as a therapeutic measure to prevent any infection, because the fall was on the roadside with a laceration and contamination of wounds in the maxillary anterior region, which increases the chance of infection spreading due to its high vascular supply.

One week after fixation, tenderness of the permanent maxillary central incisors persisted, but the soft tissue swelling had subsided. By the third month, there was no pain or tenderness to percussion and no mobility was observed on clinical examination. Good apposition of fracture lines was evident on radiograph (Figure 5). The splint was then removed, and the electric pulp test was performed using Digitest (Parkell Electronics Division, Farmingdale, NY).

After 12 months of fixation, the diastema closure was evident as a part of physiologic tooth development made possible by the use of flexible splinting. Further root formation was noted on the radiograph (Figure 6). Clinical examination at 18 months revealed no adverse signs or symptoms in the permanent maxillary central incisors. Their continuous root development was apparent on radiographs (Figure 7), with complete root development evident after 24 months (Figure 8).







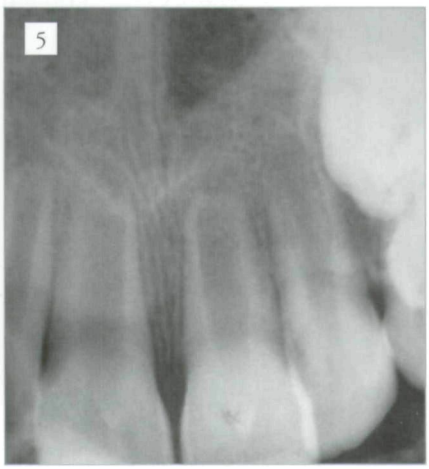


Figure 2. Intraoral periapical radiograph showing immature permanent maxillary central incisors with midroot oblique and horizontal root fractures on them.

Figure 3. Radiograph taken immediately after stabilization with a flexible acid etch wire composite splint.

Figure 4. Intraoral periapical radiograph taken immediately after splinting.

Figure 5. Intraoral periapical radiograph taken 3 months after stabilization, with apposition of fracture lines.

Figure 6. Intraoral periapical radiograph taken 12 months after stabilization.

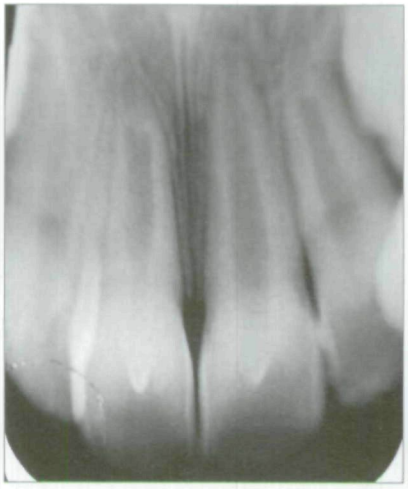


Figure 7. Intraoral periapical radiograph taken 18 months following treatment.

Figure 8. Intraoral periapical radiograph taken 24 months following treatment.

Discussion

In root fracture cases, tooth repositioning is required along with local anesthetic injections. The prognosis of dental trauma with root fracture depends on the extent of dislocation, root development, and time elapsed between injury and reporting to the dental clinic.[1,8] A tooth with a root fracture without displacement has a higher likelihood of maintaining its vitality than a displaced tooth. In the present case, the roots were immature with wide root canals and open apices of the roots that favored pulp survival.[9] A good healing outcome has been reported in 27 (79%) teeth where root development was incomplete. Poor healing was reported in 7 (21%) teeth with complete root development out of 34 root fractured teeth in 33 8- to 15-year olds.[4]

The soft, round, 0.3-mm stainless steel wire offers stability, and its slight flexibility provides some physiologic mobility to the splinted teeth within the alveolar socket and developing occlusion. It also makes splint retention time less critical. Some practitioners use wire-composite splints, flexible nylon fishing line bonded with filled resin, acid-etch resin splints, bracket splints, and titanium trauma splints.[10]

Using rigid splinting, the outcome for treated root fractures in permanent maxillary incisors in a study examining pulp vitality, root tissue union, and survival showed that hard root tissue union is significantly affected by pulp necrosis and luxation of the coronal fragment. Survival was poorest, however, for root fractures within the root's gingival third.[11] Splinting with rigid fixation had no significant effect on pulp vitality and type of root tissue union.[11]

In the present case, healing of the dentin and cementum was noted. Some observers believe that the reparative dentin deposition and the subsequent reduction of the pulp space has a close relation with the dental pulp revascularization or reinnervation.[2] The present case reaffirms the likelihood of hard tissue healing and maintenance of pulp vitality in injured immature teeth.[2,4] The flexible splint also provided the physiologic mobility of the teeth, which is required in cases of the developing dentition. The midline diastema closure was evident after the 12-month follow-up (Figure 6). The treatment outcome supports the newly evolving protocol that root fractures are most successfully treated using a flexible splint.[14]

Splinting duration. To treat root fracture, rigid fixation for at least 2 to 3 months is recommended.[13] One study reported 5 months of splinting in a 7-year-old child with root fracture in the permanent incisors. Another study reported 31 months of splinting in an 11-year, 10-month-old boy with a fracture in the root's middle third. It was also indicated that the healing process by calcification might be possible with the use of long-term splinting, and the pulp remained vital.[13,14]

Various splinting techniques. Orthodontic ligature wire bonded into a place by a self-etching adhesive bonding system and the compomer material has been used for splinting traumatized teeth. It was found that this facilitates both the resin bonding and its removal.[15]

A retrospective study on a sample of 208 teeth with intra-alveolar root fracture found no significant effect on duration and types of fracture healing.[16] Use of a suture, bonded resin splint, and resin-bonded metal plate have also been reported for splinting fractured teeth.[7,17]

Our patient received a flexible wire-resin splint for 3 months, which was suggested by Andreasen et al for root fractures.[5]

Von Arx et al had compared 4 dental trauma splints: (1) a wire-composite splint (**WCS**); (2) a button-bracket splint (**BS**); (3) a resin splint (**RS**); and (4) a titanium

trauma splint (**TTS**), a new device specifically developed for splinting traumatized teeth. All splints were bonded. Tooth mobility with horizontal and vertical Periotest values (**PTVs**) were assessed before and after splint application and splint removal. The chairtime needed for splint application was significantly shorter for TTS. After applying the splint, horizontal PTVs were significantly lower in the central incisors for a BS vs a TTS, and for a RS compared to a TTS and a WCS. A reduction of lateral tooth mobility (which is also known as splint effect), expressed by the difference between horizontal pre- and postoperative PTVs was significantly greater in RS compared to TTS and WCS for central as well as for lateral incisors. Changes in vertical tooth mobility, however, were not significant across the splinting techniques. Periodontal parameters remained unchanged, reflecting the study subjects' excellent oral hygiene. The chairtime needed to apply a TTS was significantly shorter. All tested splints appeared to maintain physiologic vertical and horizontal tooth mobility. The latter, however, was critically reduced in RS splints.[18]

This case study demonstrates that dental traumas can be successfully resolved with minimal use of invasive techniques, low cost, and little distress to the patient, thanks to the use of tooth-colored resins. The prognosis is generally good when treatment is performed as soon as possible following an injury. The use of the flexible splint in this case allowed physiologic mobility, thereby favoring proper healing. The present case illustrates the favorable results using this management technique exhibiting hard tissue healing and maintenance of pulp vitality.

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