Dental Traumatology

Dental Traumatology 2008; 24: e11-e15; doi: 10.1111/j.1600-9657.2008.00578.x

Management of horizontal root-fractured teeth: report of three cases

CASE REPORT

Vânia Portela Dietzel Westphalen, Maria Helena de Sousa, Ulisses Xavier da Silva Neto, Luiz Fernando Fariniuk, Everdan Carneiro

Department of Endodontics, Pontifícia Universidade Católica do Paraná (PUCPR), Curitiba, PR, Brazil

Correspondence to: Prof. Everdan Carneiro, Mestrado em Odontologia, Rua Imaculada Conceição, 1155 Prado Velho, Curitiba, PR, CEP: 80215-901, Brazil Tel.: +55 41 3271 1637 Fax: +55 41 3271 1405 e-mail: everdan.carneiro@pucpr.br

Accepted 8 November, 2006

Horizontal root fractures are characterized by rupture of hard structures of the root, affecting dentin and cementum, separating the tooth into an apical segment, which usually is not displaced, and a coronal segment, which is often displaced (1, 2).

This type of trauma frequently occurs at the maxillary anterior region, affecting the incisors and especially teeth with incompletely formed roots. Root fractures may be located at the coronal, medium or apical portions. Medium fractures are the most common, and cervical fractures are rare (3).

The diagnosis of root fractures may be reached by the information obtained in clinical and radiographic examinations. At the first moment, it is possible to observe a normal or extruded crown. Sensitivity to palpation and/ or percussion allow(s) the identification of tooth presenting trauma, but not necessarily fracture. When it is located at the cervical third there is remarkable mobility, at the medium third there is increased mobility, and at the apical third it is nearly normal (1).

Radiographic examination is fundamental, as it allows the confirmation of the hypotheses suggested by clinical examination and also the establishment of the location and information on the number of fractures, either simple, multiple or comminutive. The radiographic image depends on the angle of fracture and X-ray incidence, and a combination of these two factors may enhance identification or hide the fracture (2).

The treatment of fractures is characterized by immediate and mediate procedures. Immediate procedures involve care with the gingival tissues, which are commonly dilacerated, repositioning and retention. The

Abstract – Horizontal root fractures frequently occur at the maxillary anterior region and sometimes may be healed without endodontic treatment. Diagnosis of horizontal root fractures is mainly reached by the information obtained in clinical and radiographic examinations. The report of three cases presents horizontal root-fractured teeth, at different thirds, which were healed satisfactory with and without endodontic treatment, rigid splint and carefully monitored.

period of retention pulp tissue status depends on the position of the root fracture (2).

The repair depends on the location of the fracture, displacement of the coronal fragment, reduction in fracture and retention. Root fractures at the apical third are more difficult to immobilize and have a higher probability of pulp contamination (4, 5).

When the fracture is immediately reduced, there may be a root repair by union of the fragments with the formation of mineralized tissue. If the fracture is not immediately repositioned and there is no contamination of the pulp tissue, there may be a repair by interposition of bone or fibrous tissue between the fragments, which may be regarded as healing. The type of repair, either with dental bone or with fibrous tissue, depends on the pulp status, especially at the coronal portion, as it occurs only in the presence of vital pulp tissue.

When the aggression to the pulp is greater, there is an increased possibility for pulp necrosis, affecting the repair and healing. After diagnosis of pulp tissue alteration, endodontic treatment should be performed at the coronal portion, as the apical portion remains vital in most cases. In cases of complete pulp necrosis, endodontic treatment should be performed in the two fragments. If the fragments are separated and misaligned, the apical fragment should be removed.

Immediate diagnosis of the pulp status is complex and thus should not be precipitated. Some signs that usually indicate necrosis, such as shade alterations and sensitivity, may indicate reversible alterations in these cases, which would not require endodontic treatment. Observation of root resorption, which often originates at the level of fracture, seems to be an important step in the repair process, and not an indication of the need of endodontic treatment. These resorptions are often temporary and are interrupted at 1 year after the trauma.

Besides pulp necrosis, another common sequel is root canal closure by fast dentin deposition. According to Poi et al. (3), 75% of cases of horizontal root fracture present root canal calcification, thereby narrowing the pulp space.

This study describes three case reports of root fracture in teeth with incompletely and completely formed roots, at different thirds, treated at the Dental Clinic of Pontifical Catholic University of Paraná.

Case reports

Case 1

A patient aged 7 years, of female gender, attended the clinic of dentoalveolar trauma of PUCPR, reporting a history of dentoalveolar trauma to the anterior teeth 7 days before and an accomplishment of semirigid splint in the emergency care.

Clinical examination revealed that the right and left maxillary central incisors presented mobility, sensitivity to percussion, normal shade and negative sensitivity test. Radiographic examination demonstrated incompletely formed roots and horizontal root fractures at the middle thirds of both teeth (Fig. 1).

The semirigid splint was replaced by a rigid splint performed with 0.7-mm stainless steel wire, fixated with light-cured composite resin from canine to canine and kept for 3 months, to stabilize the teeth.

Pulp sensitivity tests were performed every 3 months. After 3 years of clinical and radiographic follow up, there were root formation, repair of fractures and root canal calcification (Fig. 2).



Fig. 1. Radiographic image suggesting incompletely formed roots with horizontal fractures at the middle thirds.



Fig. 2. Radiographic image at 3 years follow up.

Case 2

A patient aged 17 years, of male gender, attended the Dental Clinic of PUCPR, reporting dentoalveolar trauma to the anterior teeth 23 days before.

Clinical examination revealed coronal fracture of the right and left maxillary central incisors, semirigid splint and remarkable mobility of the left maxillary central incisor. Radiographic examination demonstrated multiple horizontal root fracture at the middle and cervical third of the left maxillary central incisor (Fig. 3).

Semirigid splint was replaced by a rigid splint. After 2 weeks, there was pulp necrosis of the right maxillary central and lateral incisors. However, during the accomplishment of biomechanical preparation in the right maxillary central incisor, there was pulp bleeding. A more detailed analysis revealed the presence of root fracture at the apical third. Thus, endodontic treatment was performed up to the level of fracture.

The right maxillary lateral incisor was submitted to conventional endodontic treatment. After 90 days, the left maxillary central incisor presented a positive sensitivity test and its mobility was regarded as normal; thus, the splint was removed.

Pulp sensitivity tests were performed every 3 months. The right maxillary central incisor presented positive pulp sensitivity until the last clinical and radiographic follow up, at 3 years after the trauma (Fig. 4), suggesting healing of root fracture.

Case 3

A female patient, aged 23 years, was presented with root fractures on the right maxillary lateral incisor (cervical third), right maxillary central incisor (medium third) and left maxillary central incisor (middle third). The patient was wearing rigid splint for 6 months (Figs 5 and 6).



Fig. 3. Radiographic image suggesting multiple horizontal root fracture at the middle and cervical third of the left maxillary central incisor.



Fig. 5. Radiographic image suggesting root fractures on the right maxillary lateral incisor (cervical third), right maxillary central incisor (medium third) and rigid splint.



Fig. 4. Radiographic image at 3 years follow up.



Fig. 6. Radiographic image suggesting root fractures on the left maxillary central incisor (middle third) and rigid splint.



Fig. 7. Radiographic image at 3 years follow up.

All teeth were positive to the pulp sensitivity test. Rigid splint was removed at 8 months after the first session. After 3 years of clinical and radiographic follow up, all teeth presented positive pulp sensitivity, suggesting a repair of root fractures (Fig. 7).

Discussion

Root fractures of permanent teeth, which account for 0.5-7% of traumatic lesions, are rare in teeth with incompletely formed roots, because of resilience of the alveolar bone (1, 6–8), whose impact at this stage would cause tooth avulsion. Horizontal root fractures at the cervical third in teeth with incompletely formed roots are frequently complicated, and there are not many treatment options (9).

The treatment of choice for teeth with incompletely formed roots and pulp necrosis is apexification; however, the remaining walls are thin and may not support the masticatory force or another trauma, leading to tooth loss (10).

Teeth with root fracture and incompletely formed roots have great potential to keep pulp vitality when compared to teeth with incompletely formed roots (8). Andreasen et al. (11) stated that 3% of cases of root fracture presented pulp necrosis in teeth with incompletely formed roots and 27% in teeth with completely formed apices. Caliskan and Pehlivan (6) evaluated 56 teeth with root fracture and observed that 57% were located at the medium third of the root, whereas 34% were located at the apical third.

The fracture may remain unnoticed in the radiographic examination performed immediately after the trauma; with time, there is separation of the fragments and the diagnosis becomes easier (5, 12). Thus, the vertical angle should be varied to enhance visualization (2).

In case 2, the fracture could only be detected during shaping because of the occurrence of root canal bleeding,

revealing the need for a more accurate radiographic analysis. Immediate treatment of horizontal root fractures comprises reduction, rigid splints and occlusal adjustment. The period of permanence of retention depends on the location of the fracture (2, 6).

In the present cases, the splintings were kept for 90 days in cases 1 and 2 and 14 months in case 3. When the root fracture is located at the cervical third, the rigid splint should be kept for a longer period, from 6 months to 1 year; 3 months if it is located at the middle third; and some cases with fracture at the apical third do not require retention (2).

In case 2, even though the fracture was located at the cervical third, the splint was kept for only 3 months, as after this time there was stabilization of the fracture. In case 3, 14 months were required for stabilization.

Fracture repair or healing depends on two conditions: damage to the pulp and bacterial invasion. If there is no bacterial contamination and the fragments are united or close, there may be a repair, which consists of the formation of a dentin callus between the two fragments (1, 12).

If there was rupture of the pulp, revascularization of the coronal region should occur before fracture healing. The exact nature of this process remains unknown. However, it is suspected that two events may occur: invasion of cells from the apical pulp or from the periodontal ligament. Depending on the source of cells penetrating into the affected area, fracture healing will occur through union with a hard tissue or interposition of connective tissue (from the periodontal ligament), respectively (12).

Healing is complicated in the presence of contamination, as there is accumulation of granulomatous tissue between the root fragments as a reaction against pulp infection (1, 12).

In case 1, even though the pulp sensitivity tests were negative, follow up was performed until there was any clinical and/or radiographic sign indicating pulp necrosis. During follow up, there were root formation and root canal calcification, suggesting that the latter contributed to the negative pulp response. The negative pulp response immediately after trauma does not necessarily indicate pulp necrosis, as there may be normal vitality after some time (13).

Öztan and Sonat (14) suggested that immediate endodontic intervention should be avoided, mentioning that clinical and radiographic follow up could be the treatment chosen, provided there are no clinical and radiographic signs of pathological alterations and there is pulp vitality.

When there is pulp necrosis (in case 2, right maxillary central incisor), it should be detected and treated as early as possible, as the necrotic pulp releases toxins into the fracture area, and thus may impair the pulp present at the apical fragment (15). In some cases, the apical fragment of root fracture may not be affected by pulp necrosis.

Pulp necrosis often affects only the coronal fragment, whereas the pulp at the apical fragment may remain vital (16). After the completion of endodontic treatment, teeth should be followed up clinically and radiographically at every 3 months for a period of 1 year, and yearly for 5 years thereafter (15).

The long-term success should be identified by the absence of clinical and radiographic signs indicating pathological alterations. If these signs were observed in the follow up, further clinical procedures will be required (12).

References

- Andreasen JO, Andreasen FM. Texto e atlas colorido de traumatismo dental. Porto Alegre: Artmed Editora; 2001. 770 p.
 Soares IJ, Goldberg F. Endodontia: técnica e fundamentos.
- Porto Alegre: Artes Médicas Sul; 2001. 376 p. 3. Poi WR, Manfrin TM, Holland R, Sonoda CK. Repair
- characteristics of horizontal root fracture: a case report. Dent Traumatol 2002;18:98–102.
- Herweijer JA, Torabinejad M, Bakland LK. Healing of horizontal root fractures. J Endod 1992;18:188–92.
- Zachrisson BU, Jacobsen I. Long-term prognosis of 66 permanent anterior teeth with root fracture. Scand J Dent Res 1975;83:345–54.
- Caliskan MK, Pehlivan Y. Prognosis of root-fractures permanent incisors. Endod Dent Traumatol 1996;12:129–36.
- Pereira AJA, Araújo CYT, Almeida CCN, Souza C. Conseqüência do diagnóstico equivocado no prognóstico das fraturas radiculares. Rev Assoc Paul Cir Dent 1997;51:579–82.

- Feely L, Mackie IC, MacFarlane T. An investigation of rootfractured permanent incisor teeth in children. Dent Traumatol 2003;19:52–4.
- Johnson BR, Jensen MR. Treatment of a horizontal root fracture by vital root submergence. Endod Dent Traumatol 1997;13:248–50.
- 10. Raffer M. Apexification: a review. Dent Traumatol 2005;21: 1–8.
- Andreasen JO, Andreasen FM, Mejare I, Cvek M. Healing of 400 intra-alveolar root fractures. 1. Effect of pre-injury and injury factors such as sex, age, stage of root development type, location of fracture and severity of dislocation. Dent Traumatol 2004;20:192–202.
- Andreasen FM. Pulpal healing after luxation injuries and root fracture in the permanent dentition. Endod Dent Traumatol 1989;5:111–31.
- Jacobsen I, Zachrisson BU. Repair characteristics of root fractures in permanent anterior teeth. Scand J Dent Res 1975;83:355–64.
- Öztan MD, Sonat B. Repair of untreated horizontal root fractures: two case reports. Dent Traumatol 2001;17:240–3.
- Mello LL. Traumatismo alvéolo-dentário etiologia, diagnóstico e tratamento. São Paulo: Editora Artes Médicas; 1998. 287 p.
- Jacobsen I, Kerekes K. Diagnosis and treatment of pulp necrosis in permanent teeth with root fractures. Scand J Dent Res 1980;88:370–6.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.