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Repair of a horizontal mid-root fracture accompanied by labial luxation and partial alveolar fracture: a 21-year follow up

CASE REPORT

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Abstract – The prognosis of injured teeth involving horizontal mid-root fractures is poor and depends heavily on pulpal vitality, periodontal health and the repositioning of the tooth to its original position. Here, we report the case of an upper right central incisor presenting a horizontal mid-root fracture, complicated by impaction of the coronal fragment in the external alveolar bone, which in turn prevented the repositioning of the tooth fragment. As a consequence, it was necessary to raise a full-thickness flap and perform window-osteotomy to free the coronal fragment and reset the fractured fragment. Short-term follow up revealed pulpal vitality of the affected incisor and tissue repair at the level of the line of fracture, without any signs of periapical or periradicular pathology. In this paper, we describe some of the clinical features found upon revising this case 21 years later. The affected tissues are in good health, the root fracture is repaired and the pulp maintains its vitality.

Root fracture is a lesion which affects the pulp, dentin, cementum and periodontal ligament. Horizontal fractures of permanent teeth represent 0.5–7% of all dental injuries (1). The vast majority of these fractures are of the central incisors of young patients. Fractured teeth fragments have been observed to undergo essentially one of two types of repair processes: union of the fragments by means of the formation of hard tissues or union of both fragments by means of the interposition of connective tissues (2). The factors that determine which type of repair takes place appear to depend on the state of health of the affected tissues (3, 4).

Here we present one such case involving the additional complication of displacement of the fractured coronal fragment into the alveolar bone. This circumstance hindered what would otherwise have been a simple procedure to reposition the fractured fragment. Surgical intervention was considered appropriate, involving raising a full-thickness flap to unlock, reposition and stabilize the injured root fragment. Upon examining this patient 21 years later, we found that the fragments were repaired and did not present any signs of periapical or periodontal pathology. Moreover, the tooth continued to respond positively to pulp stimulation with carbon dioxide.

Description of the clinical case

The patient who visited our clinic was 19 years of age and presented injury to an upper right central incisor, with occlusal and lingual displacement of the crown of the tooth. The gingival sulcus showed signs of mild bleeding (Fig. 1a, left). Periapical radiographic exploration revealed a horizontal mid-root fracture (Fig. 1a, right). Examination of pulpal vitality using carbon dioxide revealed that the pulp was still healthy.

During therapeutic intervention, we experienced difficulties in returning the coronal fragment to its original position. A lateral periapical radiograph was thus taken (Fig. 1b, right), revealing displacement of the coronal fragment towards the buccal vestibule and impaction of the same in the external alveolar bone. With a view to repositioning the fractured fragment, a full-thickness flap was raised to access the external alveolar bone. We thus detected a small alveolar fracture (Fig. 1c, left) and decided to eliminate the bone in the region of the line of the root fracture, to free the impacted dental tissues (window osteotomy; Fig. 1c, right). This procedure enabled the simple repositioning of the coronal fragment to its original position (Fig. 1d, right). The clinical photograph shows how at that time (1984), gloves were generally not worn during surgical procedures (Fig. 1d, left).

Finally, the repositioned coronal fragment was splinted by means of distal interposition of composite resin (Fig. 2a). One week later, sutures were removed and one month later, the composite splinting was removed (not shown). Follow up 3 months later did not reveal changes in the hard tissues and vitality tests continued to show positive results.

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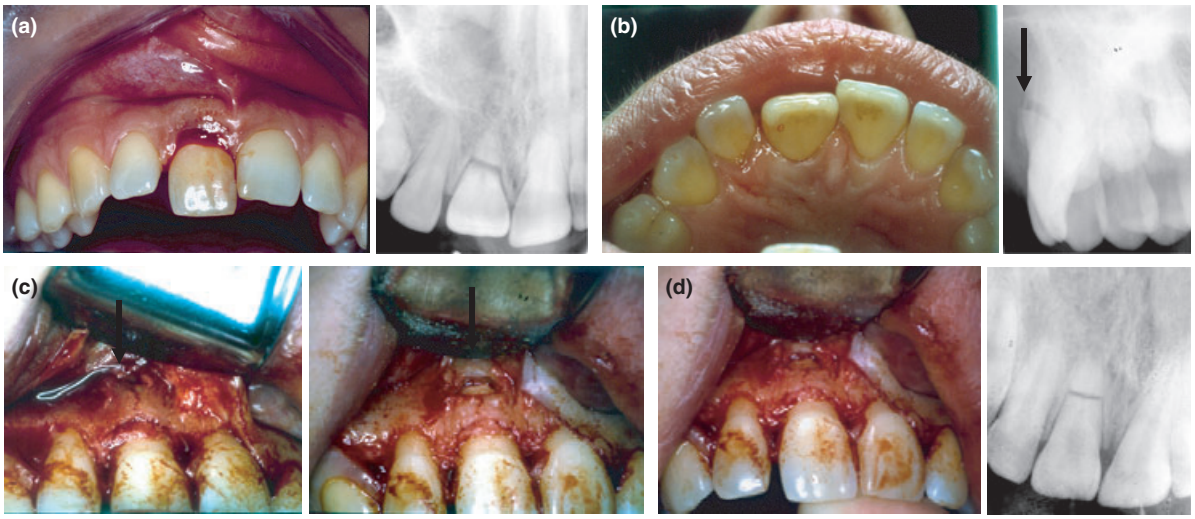

Fig. 1. The initial condition of the injured tooth (1984). (a) Clinical photo of the dislocated upper right central incisor, showing haemorrhage of the gingival sulcus. To the right, a periapical radiograph illustrating the horizontal mid-root fracture of the injured tooth. (b) An occlusal photo showing the upper right central incisor with lateral luxation. To the right, a lateral periapical radiograph illustrating the horizontal mid-root fracture with palatal luxation of the coronal fragment and impaction of the coronal fragment in the facial aspect of the labial bone plate. (c) Photo taken after full-thickness flap lifting showing the alveolar fracture at the level of impaction of the coronal fragment. The photo to the right was taken after performing window osteotomy, by removing the external alveolar bone in the region where the coronal fragment was impacted. (d) The repositioning of the coronal fragment to its original position. The periapical radiograph shows the horizontal fracture which has been reset.

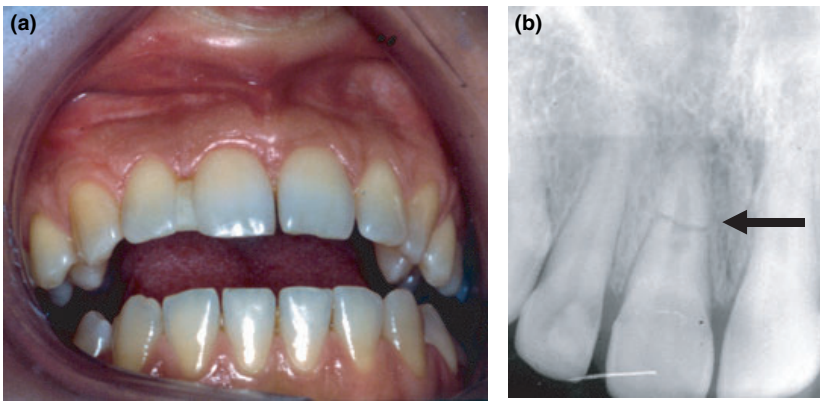

Fig. 2. Short-term follow up of the injured tooth (1984–85). (a) Clinical photo (left) and periapical radiograph (right) taken 1 month after the intervention and before the removal of the composite resin splinting. (b) Periapical radiograph taken 2 years later. The arrow points to radiolucency (internal resorption) of the principal root canal in both apical and coronal fragments.

Two-year follow up

Two years later, the patient reported complete absence of any painful symptoms. Radiographic exploration revealed an unaltered status of the tissues around the root (Fig. 2b) with the exception of an increase in the area of radiolucency in the region of the pulp canal. Nevertheless, pulpal vitality tests continued to be positive. These findings were interpreted as possible signs of internal root resorption. The patient was informed correspondingly and advised to periodically attend the clinic to monitor the evolution of the pulpal and periaradicular condition. However, the patient did not further attend the clinic, having felt further interventions were not necessary because of the absence of any troubling symptoms. Finally, 21 years later, the patient returned and agreed to an examination to evaluate the status of the affected tooth.

Twenty-one-year follow up

The patient reported the complete absence of any troubling symptoms in the upper right central incisor. Radiography revealed tissue repair at the level of the fractured fragment, which appeared to involve interposition of connective tissue, but without displacement of the fractured fragment (Fig. 3a). What previously appeared as radiolucency in the root canal, which we interpreted as internal resorption, now showed signs of pulpal calcification. The periradicular hard tissues presented an appropriate hard layer. Sensibility testing using carbon dioxide was indicative of pulpal vitality, although the response was somewhat slow and painful, but discomfort disappeared after removing the stimulus. This type of pulpal response to a biophysical stimulus corresponds to that of healthy pulp (5). Thus, our diagnosis 21 years later is one of healthy hard and soft

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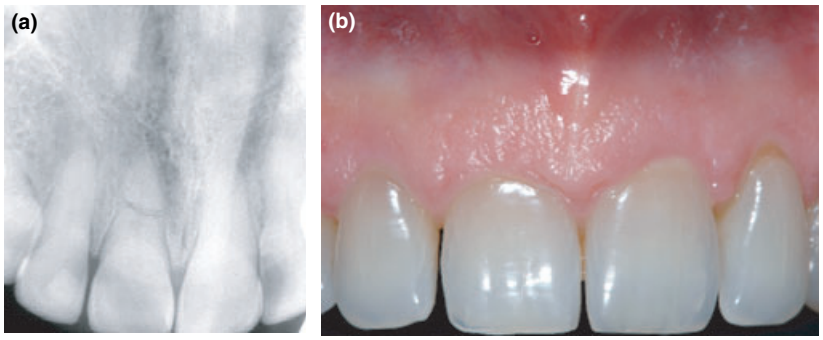

Fig. 3. Long-term follow up of the horizontal mid-root fracture (2005). (a) Periapical radiograph taken 21 years after the injury and therapeutic intervention, showing repair of the fragments and maintenance of the lamina dura. (b) Clinical photo showing the healthy colour of the crown of the affected tooth and the surrounding soft tissues 21 years later.

tissues, which had been affected by dental injury and adequate repair of the horizontal root fracture.

Discussion

The prognosis of teeth which present horizontal root fracture depends on the modality of repair of the fractured fragments (6, 7). These repair modalities are conditioned in turn by the degree to which the affected pulpal, periodontal and alveolar tissues have been injured and by the therapeutic interventions employed by the dental surgeon. The initial therapeutic procedures require the repositioning and splinting of the fractured fragment and a constant vigilance of the evolution of the pulpal response to the aggression.

Procedures to reposition fractured fragments may be complicated, as in the present case, by alveolar fracture because of labial luxation. This situation may not be easily diagnosed. Nevertheless, a simple and yet very useful procedure is to obtain a lateral, periapical radiograph, which serves as a type mode of teleradiograph (Fig. 1b, right), facilitating an evaluation of the displaced fragment and a verification of lateral luxation involving fracture of the alveolar bone. In a similar manner, a simple raising of a full-thickness flap exposes the fractured hard tissues and facilitates a more efficacious repositioning.

This injury could be classified as being 'type D' in accordance with Andreasen's scheme of classification of root fractures based on the degree of luxation of the coronal fragment. The optimal type and duration of the splinting of the coronal fragment is a much disputed issue (8, 9). In this particular case, we used the therapeutic approach which we considered to be most efficacious, in the light of the urgency of the situation and of the limited means at our disposal. One month later, the composite resin splinting was removed, having confirmed the firmness of the repositioned tooth and the complete absence of any clinical symptoms or signs reported by the patient (Fig. 2a(6)).

The appearance of radiolucency, corresponding to pulp tissue, which was diagnosed as internal root resorption [Fig. 2b(7)] is worthy of comment. Pulpal vitality continued to be positive and we suggested to the patient the possibility of beginning root canal treatment, if on posterior revisions this pulp resorption continued to increase in size (10). The patient did not return for a subsequent check-up, which was likely because of the fact that, being asymptomatic, she considered the tooth to be perfectly healthy. Curiously, upon revising this case 21 years after the injury, we found that this resorption had disappeared. This is likely because of dentine apposition inherent in the physiological process of pulp ageing (sclerosis) (11).

The maintenance of pulpal vitality is very relevant in terms of prognosis and our therapeutic approach to this type of injury. Thus, the prognosis for mid-root fractures is good to the extent that the affected tooth is capable of maintaining healthy pulp. In these cases, root canal treatment is not recommended. It is thus critically important to perform the pulpal vitality tests correctly and with precision. According to most recent reports, the most reliable test to measure pulpal microcirculation is laser Doppler flowmetry (12–15). However, this device is not yet routinely available for chairside dentistry. We thus consider that the use of biophysical pulpal stimulation tests involving application of carbon dioxide (Odontotest®, Miltex, Inc., York, PA) is currently the most practically reliable clinical test for the measurement of pulpal vitality (5, 16–18). In the clinical case which we have presented, the pulpal response to stimulation with carbon dioxide was positive, painful and of rapid onset in all of the tests carried out during the first 2 years. This stimulation was positive, painful but less intense and 4 s slower upon revision 21 years later.

Conclusion

The evaluation of a clinical case 21 years following injury illustrates the repair of a horizontal mid-root fracture involving the interposition of what appears to be connective tissue. The patient has maintained her tooth and it continues to show healthy pulpal, periapical and periodontal aspects. Vitality tests continue to be positive. The maintenance of pulpal vitality appears to be the best index of a good prognosis for the tooth. To the extent that vitality continues to be positive and pulpal healing continues, root canal treatment is not recommended.

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