A long-term follow up of spontaneously healed root fractures later subjected to orthodontic forces – two case reports

CASE REPORT

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Abstract – There is evidence that many dental injuries which result in root fractures may not require active treatment in cases where the coronal fragment is minimally displaced and does not exhibit clinical signs or symptoms. This paper discusses two individual cases where spontaneous root fracture healing was observed and this healing was apparently not compromised by later orthodontic tooth movement. The observation periods for the two cases were 13 and 18 years since the original root fractures occurred.

Root fractures of the permanent dentition are an uncommon finding with reported incidences ranging from 0.5% to 7% of all dental injuries (1–3). A review of the literature reveals several retrospective studies, which have recorded root fracture prevalence during a specific time period, with studies having taken place within specialist paedodontic departments (4–7).

Nevertheless, the vast majority of root fractures appear to occur in those under 20 years of age (3) and most of those patients are males (1). Root fractures most commonly occur in the middle third of the root (8, 9). Root fractures most frequently occur in the anterior teeth, most often in the maxillary central incisors (1). A twofold increase in risk of injury occurred where protruded maxillary incisors lacked lip coverage (8). The following two case reports discuss horizontal mid-root fractures of maxillary central incisors. The two teeth involved have remained functional and symptomless since the original trauma, despite being later subjected to orthodontic forces, without apparently adverse effects.

Case number 1

This case involves an 8-year-old male who presented to the Dublin Dental School and Hospital in 1981 for orthodontic assessment. Functional appliance therapy in conjunction with the extraction of several deciduous teeth for orthodontic reasons was carried out between 1981 and 1985. In 1986, when the patient was 13 years old, he suffered a traumatic injury to the upper left

central incisor as a result of a road traffic accident. A follow-up orthodontic assessment was carried out in 1987. The patient reported no symptoms since the injury. Clinical examination revealed an upper left central incisor with grade 1 mobility, which responded normally to both thermal and electrical sensitivity testing. There were no other clinical signs or abnormalities observed. A decision was made at that time to provide fixed appliance therapy for both arches, but to limit the level of orthodontic forces applied to the traumatized upper central incisor. A radiograph taken at the orthodontic assessment of the patient aged 14, in 1987 reveals evidence of periodontal ligament connective tissue healing with rounding of the corners of the apical and coronal fragments at the fracture line level. A diastasis of less than 1 mm is visible between the fragments. There was no evidence of periodontal ligament breakdown either at the fracture level or periapically (Fig. 1). Seventeen years after the initial injury, at 30 years of age, the patient underwent a sagittal-split mandibular osteotomy. Following this procedure, a second phase of fixed-appliance orthodontic therapy was completed over a 1-year period. The root-fractured upper central incisor was subjected to protrusive and intrusive orthodontic forces during this course of the treatment. The patient had attended the Dublin Dental School and Hospital regularly since completion of the orthodontic/surgical therapy receiving various dental treatments unrelated to the root-fractured maxillary incisor. In 2004, a review visit was scheduled for the now 31-year-old patient
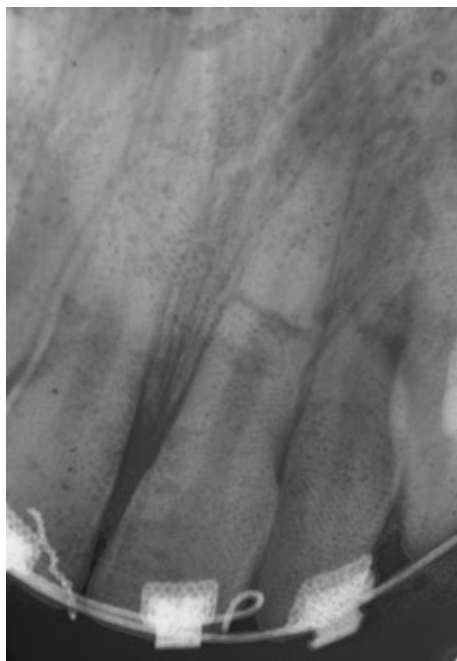
Fig. 1. A periapical radiograph showing evidence of periodontal ligament soft tissue healing of the root-fractured upper left central incisor, 1 year after the occurrence of the root fracture.

Fig. 2. No signs of pathology are evident on this recent periapical radiograph taken in 2004. However, orthodontic intervention appears to have transformed a type 2 healing pattern to a type 3 healing pattern.

regarding the root-fractured upper left central incisor. The affected tooth responded normally to both thermal and electric sensitivity tests on this occasion.

There are no clinical or radiographical signs of pathology related to this tooth to date. It was not possible to assess the mobility of the affected incisor because of the presence of a bonded palatal retainer extending from the upper left canine to the upper right canine. The patient has reported no symptoms to date (Fig. 2).

Case number 2

This second case concerns a 12-year-old female who sustained a fall in 1991, resulting in trauma to her upper left central incisor. Notably, the patient suffered from a rare inherited condition known as Friedreich's ataxia. This is a genetic, progressive, neurological movement disorder that typically becomes apparent before adolescence. The patient was initially treated for an enamel-dentine coronal fracture of the upper right central incisor, but radiographs taken as part of an orthodontic assessment in 1992 revealed the presence of a horizontal mid-root fracture of the upper left central incisor, which was subjected to fixed appliance therapy, beginning 2 years after the occurrence of the initial trauma (Fig. 3). There is evidence of periodontal ligament connective tissue healing of this root fracture with the patient aged 16 on a radiograph taken in 1995, on completion of 2 years of fixed appliance therapy (Fig. 4), which included application of torquing forces to retrocline the upper central incisors to decrease the overjet. No interventional treatment has been provided for the root fracture to date. Furthermore, the patient has sustained

Fig. 3. There is evidence of a horizontal mid-root fracture of the left maxillary central incisor in this 1992 radiograph, prior to being subjected to 2 years of orthodontic fixed appliance therapy, which commenced 2 years after the occurrence of the root fracture.

several further direct traumatic injuries to the root-fractured incisor since 1991. The tooth remains functional and symptom-free, and a recent radiograph taken in 2004, with the patient now 26 years, shows no apparent change in the original healed root fracture (Fig. 5). However, both upper central incisors exhibited grade 2 mobility at the most recent review, albeit only 2 weeks after the patient suffered yet another direct traumatic injury to these two teeth.

Fig. 4. On completion of 2 years of fixed appliance therapy, there is evidence of periodontal ligament connective tissue healing of the root-fractured upper left central incisor.

Fig. 5. A recent 2004 radiograph shows no apparent change in the appearance of the root fracture healing observed in the 1992 periapical radiograph.

Discussion

The incidence of root fracture healing is reported to be approximately 77–80% (4, 5, 9).

There are many reports in the dental literature of root-fractured incisors remaining functional and asymptomatic, having received no active treatment (10–12). This can be expected, because such active treatment frequently involves splinting the affected teeth, the benefit of which has been questioned in cases where the coronal fragment is not markedly displaced or mobile postinjury (4, 13). The first case report revealed radiographic evidence of periodontal ligament connective tissue healing at the fracture level. Along with positive pulp tests and limited mobility and displacement of the coronal fragment in this case, uneventful healing is likely (4–6, 13) whether splinting of the affected tooth was completed or not. Eighteen years later, with the patient was aged 31, radiographs revealed a diastasis of approximately 1.5 mm. Although there is no evidence of pathology, it appears that orthodontic intervention has transformed a type 2 healing pattern (where only connective tissue separated the fragments) to type 3 healing, with evidence of both bone and connective tissue interposed between the two fragments (14). Pulp canal obliteration is apparent in the apical fragment. Interestingly, the coronal fragment appears to be unaffected by pulp calcification from the evidence of the recent radiographs. The upper left central incisor had a porcelain veneer placed within the last 3 years. Consequently, an assessment of the colour of the affected crown is at present limited to the palatal aspect. No abnormal discolouration is evident from this aspect. In the second case report, evidence of type 2 connective tissue healing is apparent on all radiographs taken to date. There is little evidence of pulp canal obliteration in the most recent radiographs in either fragment. A diastasis of less than 1 mm suggests that once again, minimal dislocation at the time of initial trauma had resulted in spontaneous healing (13). Although in both cases the root-fractured teeth were subjected to orthodontic forces for almost 3 years, there is little evidence of resorption affecting either incisor. In both cases, the root lengths are similar to their counterpart in the upper right quadrant. It has been reported that in a tooth with a healthy pulp, orthodontic movement does not necessarily result in marked root resorption (15).

Conclusion

These two cases demonstrate how a root-fractured permanent tooth can spontaneously heal and remain both functional and symptom-free despite the additional trauma of orthodontic intervention. Although it has been previously reported that root-fractured teeth can remain functional and symptom-free despite the subsequent application of orthodontic forces (16, 17), there is a paucity of evidence-based research on this subject in the literature. Therefore, it is clear that further investigation into the possible effects of orthodontic movement on root-fractured teeth is warranted so that clinicians may be in a position to adopt a properly structured protocol in these testing circumstances to the benefit of their patients.

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