Orthodontic movement of teeth with horizontal root fracture: A case report

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WORD COUNT 2116
TIME SUBMITTED 29-MAY-2024 12:29PM
PAPER ID 109292682

Word Count – Words: 2116

Orthodontic movement of teeth with horizontal root fracture: A case report

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ABSTRACT

Horizontal root fractures combine injuries of dentin, pulp, cementum and the periodontal ligament. Although this type of injury is less frequent comprising only 0.5–7% of all trauma cases in the permanent dentition, the orthodontist should have sufficient knowledge to deal with cases involving this type of traumatic dental injury.

This case study reports the successful outcome of orthodontic management for a patient with class ii division 2 malocclusion complicated by crowding and horizontal root fracture for an upper permanent central incisor. the root fractured tooth was moved successfully.

This approach allowed the patient to retain his natural tooth and provided a viable alternative to tooth extraction and prosthetic replacement for teeth with horizontal root fracture in patients in need for comprehensive orthodontic treatment.

Keywords: Horizontal root fractures, Pulp vitality, panoramic x-ray, orthodontic management

Introduction

Management of traumatized teeth requires a sufficient amount of knowledge and clinical experience. There are different forms of tooth injuries, including concussion, subluxation, luxation injuries, crown fracture, and root fracture. An orthodontist should be well versed in the management of these conditions since more than 10% of patients presenting for orthodontic treatment would show some evidence of trauma [1].

Horizontal root fractures are a combination of pulp, dentin, cementum, and periodontal ligament injuries. While not common, it still accounts for 0.5–7% of all trauma cases involving permanent dentition [2]. Horizontal root fractures are more common among 11–20 years old male patients [2] and are mostly observed in the maxillary anterior area, i.e., in the middle third of the root, followed by the apical and coronal thirds [3]. Moving root-fractured teeth horizontally via orthodontic appliances is possible but certain precautions must be taken. This paper sheds light on the orthodontic movement of a tooth with a previous horizontal root fracture.

Case report information - Diagnosis and etiology

A 16 years-old male patient was referred to the orthodontic clinic for malocclusion. The patient was medically fit and healthy. His dental history revealed a previous trauma to his anterior teeth five years ago. He complained of irregular front teeth. Clinical and radiographic examinations were performed. The extraoral examination revealed the presence of a symmetric face, an average smile line and reduced lower anterior facial height. The intraoral examination revealed the presence of class II division 2 incisor relationship on skeletal base class II complicated by crowding in both dental arches and an impacted lower right 2nd premolar (Figure 1). The radiographic examination revealed the presence of a horizontal root fracture (in the middle third) of the upper right central incisor (Figure 2). Upon examination, all maxillary anterior teeth responded to electric pulp-testing.

Treatment Objectives

After thorough clinical and radiographic examinations, the treatment aims were to:

A. Align the crowded teeth.
B. Open enough space to align the impacted mandibular second premolar.
C. Normalize the overbite.
D. Obtain a class I incisor, canine, and molar relationship.
E. Maintain the vitality of the root fractured maxillary right central incisor at the end of orthodontic treatment.

Treatment alternatives

The patient was given two treatment options of which both involved the use of a fixed orthodontic appliance. The two options were:

a) Fixed orthodontic treatment with extraction of the maxillary right central incisor and replacement with a dental implant and prosthesis.
b) Fixed orthodontic appliance treatment with a non-extraction approach.

The patient chose the second option. A written informed consent was obtained from the patient after explaining the risk of root fragments separation and loss of pulp vitality at the end of the orthodontic treatment.

Treatment progress

The fixed orthodontic appliance was bonded on both arches (0.022 slot-MBT prescriptions). The treatment started with the placement of 0.014 NiTi arch wires on both dental arches to initiate teeth alignment. Then 0.016 NiTi, 0.016x 0.022 NiTi, 0.017 x 0.025 NiTi and 0.019x 0.025 NiTi arch wires were placed sequentially to complete teeth alignment over a period of six months. Then, 0.019 x 0.025 stainless steel orthodontic arch wires were placed in both arches

to serve as the working arch wires. In the lower arch, an active NiTi open coil spring was placed between the lower right 1st premolar and 1st permanent molar to create enough space for the impacted lower right 2nd premolar. The impacted tooth erupted spontaneously without any surgical intervention following sufficient space creation and thus the lower teeth were re-aligned. After that, a 0.017 x 0.025 NiTi arch wire with a reverse curve of spee was placed in the lower arch to level the curve of spee via middle teeth extrusion as well as intrusion and proclination of lower incisors. The leveling stage lasted for four months. Following the overbite correction, the 0.019 x0.025 stainless steel arch wires (with a reverse curve of spee in the lower arch) were placed in both arches as working arch wires. Next, the patient was given class II intermaxillary elastics to achieve class I incisor, canine, and molar relationships. Lastly, a 0.021 x 0.025 TMA arch wire was placed as a finishing arch wire. Overall, the treatment took 20months.

Treatment results

At the end of the 20 months of active orthodontic treatment, the maxillary and mandibular teeth (including the impacted mandibular second premolar) were aligned. The incisors, canines, and molars were in a class I relationship with an average overbite (Figure 3). The post-operative panoramic x-ray revealed the separation of the apical and coronal root segments (Figure 4) of the maxillary right central incisor. The vitality test using ethyl chloride also revealed the presence of a vital pulp. Table 1 shows the flowchart for the orthodontic treatment.

Discussion

According to the management guidelines of traumatic dental injuries by the International Association of Dental Traumatology, the treatment for teeth with transverse root fracture involves repositioning and stabilizing the coronal fragment in its anatomically correct position. This step must be taken as soon as possible to optimize the healing of the periodontal ligament and neurovascular supply while maintaining the esthetic and functional integrity [4]. *Cvek et al. 2001* found that root development and repositioning of dislocated fragments were highly predictive of the frequency and type of healing, as compared to other factors such as splinting and its duration. In other words, teeth with no or slight loosening of the coronal fragment may not require splinting [5]. In this case, there was no previous intervention

including splinting for the fractured tooth. Similar to the literature findings, up to 80% of transverse root fractures would heal with or without initial treatment. However, the extent of healing would vary from granulation tissue (worst prognosis), connective tissue formation, bone formation, to hard tissue formation in the best scenario [6].

There is a lack of published reports on the orthodontic movement of root fractured teeth. However, the guidelines are consistent in recommending an observation period of at least two years after the initial orthodontic tooth movement [7]. Our patient was exposed to trauma five years before the orthodontic consultation. Thus, the tooth was considered to have moved orthodontically after a sufficient observation period.

For teeth healed with hard tissue formation, orthodontic movement can be accomplished without separating the apical and coronal fragments if they remain consolidated. However, root fractured teeth healed with connective tissue formation pose a higher separation risk of apical and coronal fragments following orthodontic force application [2]. Therefore, the patients must be informed about this possibility before the start of orthodontic treatment, especially if the fracture occurs in the middle-third region as it may result in a short tooth with reduced periodontal support at the end of orthodontic treatment. In our case, a specialist endodontist was consulted. The patient was informed about the risk of root segment separation at the end of active treatment. The patient understood and accepted the risk. He preferred to maintain his injured tooth rather than extracting it and replacing it with a dental implant and prosthesis. At the end of the active treatment, the clinical and radiographic examinations revealed the presence of a rigid and vital tooth even though there was evidence of root segment separation.

At every stage of orthodontic treatment, the risk of root injury is kept to a minimum. During the alignment stage, only a light level of orthodontic force was applied. The follow-up visits were kept at six-week intervals to minimize any harm on the roots, especially the injured upper right central incisor. During the management of deep bite while in the leveling stage, a 0.017 x 0.025 NiTi arch wire (with a reverse curve of spee) was placed in the lower arch rather than the upper arch to avoid any intrusive forces on the upper incisors, especially the upper right central incisor. This is important since traumatized maxillary incisors with severe periodontal

injuries have a higher susceptibility to pulp necrosis during orthodontic intrusion compared to non-traumatized teeth [8].

At the end of the active treatment, the appliance was de-bonded and the patient was given two types of retainers in each arch; a bonded fixed retainer and a removable Essex retainer. Although teeth with horizontal root fracture have a higher potential of maintaining a vital dental pulp than luxated teeth without fracture, pulp necrosis can still occur in 20 to 44% of the cases. For teeth with retained vitality, the reason may be attributed to the force that occurs during the fracture being transmitted to the apical region of the tooth, thus leading to decreased force and the likelihood of obtaining revascularization in the fracture line. Furthermore, it is believed that the fractured area provides an avenue of escape for fluid pressure from edema, therefore allowing collateral circulation from the periodontal ligament to assist in maintaining the vitality of the traumatized pulp [9]. In our case, the patient was followed up for 18 months and the subsequent clinical and radiographic examinations were found to be satisfactory (figures 5 &6).

Conclusion

Orthodontists should be well-versed in dealing with traumatized teeth as more than 10% of patients presenting for orthodontic treatment would show some evidence of trauma. Orthodontic movement of a horizontally root fractured tooth with healed connective tissue is possible after a sufficient observation period and light force application. In this case, although the root segments were separated at the end of treatment, the tooth maintained its vitality and rigidity and the patient was satisfied with the result.

Acknowledgment: the authors provided the equipment and materials used to treat the patient without any external funding source.

Disclosure of conflict of interest:

All the authors declare that they do not have any conflict of interest or any financial interest in this article.

References

1. Bauss O, Röhling J, Schwestka-Polly R. Prevalence of traumatic injuries to the permanent incisors in candidates for orthodontic treatment. Dent Traumatol. 2004 Apr;20(2):61-6.
2. Giudice RL, Lizio A, Cervino G, Fabiana N, Francesco P, Ausiello P, Cicciù M. The Horizontal Root Fractures. Diagnosis, Clinical Management and Three-Year Follow-Up. The Open Dentistry Journal, 2018, 12, 687-695.
3. Gharechahi M. Horizontal root fracture accompanied by luxation of coronal fragment in a maxillary central incisor: A case report. J Dent Res Dent Clin Dent Prospect 2013; 7(4): 244-7.

4. Bourguignon C, Cohenca N, Lauridsen E, Flores MT, O'Connell AC, Day PF, Tsilingaridis G, Abbott PV, Fouad AF, Hicks L, Andreasen JO, Cehreli ZC, Harlamb S, Kahler B, Oginni A, Semper M, Levin L. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations. Dent Traumatol. 2020 Aug;36(4):314-330.

5. Cvek M, Andreasen JO, Borum MK (2001). Healing of 208 intra-alveolar root fractures in patients aged 7-17 years. Dent Traumatol, 17(2): 53–62.

6. Wilson R, Manfrin T, Holland R. Repair characteristics of horizontal root fracture: a case report. Dental Traumatology. 2002;18(2):98–102.

7. .O.Andreasen,F.M.Andreasen,L.Andersson. Textbook and color atlas of Traumatic injuries to the Teeth.4th ed. England. Blackwell publishing Ltd;2007.p.671

8. Bauss O, Röhling J, Sadat-Khonsari R, Kiliaridis S. Influence of orthodontic intrusion on pulpal vitality of previously traumatized maxillary permanent incisors. Am J Orthod Dentofacial Orthop. 2008 Jul;134(1):12-7.

9. Erdemir A, Ungor M, Erdemir EO. Orthodontic movement of a horizontally fractured tooth: a case report. Dent Traumatol. 2005 Jun;21(3):160-4.

Figures

14

Figure 1: Pre-treatment extraoral and intraoral photographs (taken using Nikon digital SLR Camera D3200)

14
figure 2: Pre-treatment panoramic & CBCT X-rays

Figure 3: Post-operative frontal view for the occlusion (taken using Nikon digital SLR Camera D3200)

Figure 4: post-operative x-rays

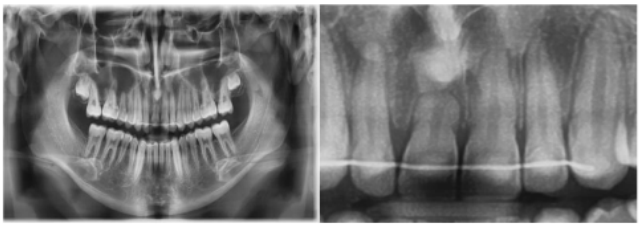

Figure5: Follow-up extraoral and intraoral photographs (taken using Nikon digital SLR Camera D3200)

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Figure 6: follow up panoramic x-ray

Table # 1: Flow chart of the orthodontic treatment

Word Count – Words: 2116