

# Orthodontic movement of a maxillary central incisor with a horizontal root fracture treated using an intra-radicular fibre splint

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## Abstract

This paper reports the case of a 15-year-old boy with a horizontal root fracture in the left maxillary central incisor along with class II division 1 malocclusion for whom a fixed orthodontic treatment was planned. The fracture was present at the junction of apical and middle-third as a result of trauma 2 years back. No splinting was carried out at that time and the tooth was found to be vital, asymptomatic and showed a type-1 repair pattern. An intentional root canal treatment was carried out for placement of an intra-radicular fiber splint, nearly 3 mm beyond the fracture line. Orthodontic treatment was initiated after a month; to which the fractured and splinted tooth responded successfully. This report highlights the successful use of an intra-radicular splint for horizontally fractured tooth requiring orthodontic treatment.

**Keywords:** Horizontal root fracture, intra-radicular splint, orthodontic treatment

## Introduction

A horizontal root fracture is the result of impingement of heavy frontal forces, which result in separation of the root into coronal and apical fragments.<sup>[1]</sup> It is most commonly seen in the maxillary region in 11 year to 20-year-old males.<sup>[2]</sup> The type of healing patterns associated with this type of fracture are, type 1: Interposition of calcified tissue, type 2: Interposition of connective tissue, type 3: Interposition of bone and connective tissue, type 4: Interposition of granulation tissue.<sup>[2]</sup> The type of healing depends on various factors such as (i) degree of dislocation of the two fragments, (ii) stage of growth of alveolar process, (iii) presence of infection etc.<sup>[1,2]</sup> Teeth with horizontal root fracture have been reported to have a greater possibility of maintaining pulp vitality than luxated teeth without fracture.<sup>[2,3]</sup> This paper illustrates a case of horizontally fractured tooth that remained vital for nearly 2 years post-trauma until it was endodontically treated

to receive a fiber post as an intra-radicular splint prior to orthodontic treatment, to which it responded successfully.

## Case Report

A 15-year-old boy with class II division 1 malocclusion was referred from the unit of Orthodontics for evaluation of a 2-year-old, asymptomatic, horizontal root fracture in the left maxillary central incisor, prior to undergoing fixed orthodontic treatment [Figure 1]. There was a history of trauma at the age of 13 years due to fall during play a recent intra-oral peri-apical radiograph revealed a horizontal root fracture at the junction of apical and middle-thirds of 21 showing a type 1 healing pattern with evidence of calcific nodules narrowing the pulp space [Figure 2]. On clinical examination, the tooth was found to be grade 1 mobile with no discoloration or tenderness to percussion. The electric pulp test showed the pulp of 21 to be vital. Three treatment options were considered for its management prior to orthodontic intervention (i) surgical removal of the apical fragment and endodontic treatment of the coronal segment, (ii) no treatment of the segments and observe the response to orthodontic forces and later carry out the above mentioned procedures, if required, (iii) endodontic treatment of both the fragments, if feasible and placement of a fiber post-splint. It was possible to negotiate both the fragments with the endodontic files, though with difficulty [Figure 3]. The apical 3 mm was sealed with mineral trioxide aggregate and a fiber post (3M, Rely X) measuring nearly 10 mm and at least 2-3 mm beyond the fracture site, was placed in the canal and sealed with resin modified light cure glass ionomer cement (3M) [Figure 4]. The coronal access was sealed with composite. Patient was then later subjected to orthodontic forces for correction of an over jet of nearly 7 mm, which involved both retraction and torque control, to which he responded favorably with both fragments moving as a unit [Figures 5-6].

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Access this article online	
Quick Response Code: 	Website: <a href="http://www.contemplindent.org">www.contemplindent.org</a>
	DOI: 10.4103/0976-237X.114889



**Figure 1:** Intra oral periapical X-ray taken immediately after trauma, 2 years back, reveals a horizontal root fracture in 21



**Figure 2:** Recent intra oral periapical X-ray of 21 reveals a type 1 healing pattern with evidence of calcific nodules



**Figure 3:** Diagnostic X-ray of 21 showing canal negotiated beyond the fracture line



**Figure 4:** The fiber post in place in horizontally fractured 21



**Figure 5:** Intra oral periapical X-ray taken during orthodontic treatment

## Discussion

Orthodontic treatment of horizontally fractured teeth has been



**Figure 6:** Intra oral periapical taken 3 months after orthodontic treatment

scantly reported. Response of such teeth to orthodontic forces is still an enigma to the clinicians. Hovland *et al.*,<sup>[4]</sup> in 1983 reported a case showing successful orthodontic movement of a maxillary central incisor with a horizontal root fracture, 2 years

after trauma. The only significant change at 8-year follow-up was obliteration of the root canal space in the apical third in response to palatal movement and intrusion of the tooth.

Clark and Eleazer,<sup>[5]</sup> in 2000 reported another case of successful orthodontic movement of an endodontically treated, horizontally fractured left maxillary central incisor in a 9-year-old boy who showed possible resorption at the fracture site and apical migration at a 6 year follow-up.

Erdemir *et al.*,<sup>[2]</sup> in 2005 reported a case of tooth mobility within 3 months of start of orthodontic treatment in a case with horizontally fractured maxillary incisor, nearly 6 years old. The tooth, which was vital and asymptomatic, showed mobility due to movement of the coronal segment compared with the apical segment for which the orthodontic treatment had to be stopped.

Duggan *et al.*,<sup>[6]</sup> in 2008 reported successful orthodontic movement in two cases with horizontal root fractures in incisors, which were vital and showed good evidence of periodontal ligament (PDL) connective tissue healing. One of the two cases, however, showed a slight increase in the diastasis with bone and connective tissue interposed between the two fragments and pulp canal obliteration of the apical segment at 18 years follow-up.

In the present case, the horizontally fractured tooth had maintained its pulp vitality for nearly 2 years post-trauma; was not discolored and responded normally to pulp testing. No splinting had been carried out at the time of trauma.<sup>[7]</sup> Various mechanisms have been reported in literature by which a horizontally fractured tooth maintains its pulp vitality such as: (i) Prevention of transmission of forces of trauma to the apical region, (ii) revascularization achieved at the fracture line, (iii) escape of fluid pressure from edema and allowing collateral circulation from PDL.

Malmgren *et al.*,<sup>[8]</sup> have suggested that when there the fracture site of a root heals with calcified tissue i.e., with dentin and cementum, the fracture gets consolidated and orthodontic movement of such a tooth can be performed without breaking up the fracture site. In comparison, orthodontic movements of teeth with connective tissue repair (i.e., when fracture edges are covered with cementum

and PDL) leads to further separation of the fragments.

Keeping in view, the unpredictability of response, as found in the available literature and the nature of orthodontic treatment, which involved correction of over jet of 7 mm, placement of intra-radicular fiber splint was preferred over direct application of orthodontic forces, in this case. The root canal was negotiated until the apex, with difficulty, but successfully. There was evidence of apical root resorption at the end of treatment in all the four incisors and it was not different for the traumatized 21 and the contralateral 11.

This paper highlights the use of intra-radicular splint as a treatment approach for horizontally fractured teeth requiring orthodontic treatment, with successful and predictable results.

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**How to cite this article:** Kapur A, Utreja A, Goyal A, Pankaj P. Orthodontic movement of a maxillary central incisor with a horizontal root fracture treated using an intra-radicular fibre splint. *Contemp Clin Dent* 2013;4:271-3.

**Source of Support:** Nil. **Conflict of Interest:** None declared.