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Case Report

A novel approach in the treatment of horizontal root fracture using self adjusting file with MTA as an intra-radicular splint

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ABSTRACT

Management of horizontal root fractures presents a challenge to clinicians because of the difficulty in achieving a stable reunion of fracture fragments. This case report describes a novel approach in the management of a horizontally fractured central incisor by intra-radicular splinting using a self adjusting file and use of mineral trioxide aggregate as an obturating material. Short-term follow-up of the case showed promising results both clinically and radiographically.

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1. Introduction

Dental traumatic injuries vary in severity ranging from enamel fractures to avulsions. Crown fractures of the permanent dentition comprise the most frequent form of traumatic dental injuries, accounting for 26–76% of all injuries, while root fractures account for 0.5–7% of trauma in the permanent dentition.[1]

Root fractures are described according to the direction of the fracture lines as horizontal root fractures or vertical root fractures. Horizontal root fractures, mostly affect the maxillary central incisors, mainly in the middle third of the root; however, apical and coronal third fractures are also reported.[2]

The healing of such fractures is usually complicated since the wound involves damage to all dental tissues, including the pulp, dentine, periodontal ligament, and cementum and is sometimes associated with damage to the supporting alveolar bone as well. Pathological complications following horizontally fractured teeth include pulp necrosis, root canal obliteration, inflammation around the fracture, internal or external surface resorption, and periapical inflammation.[3]

In accordance with the level of fracture line and associated hard/soft tissue pathology, various treatment modalities have been suggested for the management of horizontally fractured teeth. These include disinfection and obturation of the coronal segment only, surgical removal of the apical segment, removal of the coronal segment, orthodontic or surgical extrusion of the apical segment, removal of the apical segment, stabilisation of the coronal segment with endodontic implants, and intraradicular splinting to unite the fracture.

Intraradicular splinting is indicated in cases, in which the fracture line is in the middle or coronal segment. This technique is known to correct the mobility of the coronal segment and aid in the healing of periodontal tissue around the fracture site. The technique involves connecting the tooth

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fragments through the root canal using a metal pin together with a root canal sealer.[4]

Successful treatment of a horizontal mid-root fracture cases with intraradicular fixation through insertion of endodontic files has been reported in literature.[4,5]

The self adjusting file (SAF) represents a totally different approach in endodontic file design. The SAF is a hollow file designed as a compressible, thin-walled, pointed cylinder, 1.5 mm in diameter, composed of a thin nickel-titanium lattice. When inserted into a root canal, it adapts itself to the canal's shape, both longitudinally and also along the cross section.[6] In a round canal, it will attain a round cross-section, whereas in an oval or flat canal it will attain a flat or oval cross-section, thus providing three-dimensional adaptation.[7]

Mineral trioxide aggregate (MTA) was introduced in Endodontics in 1993 and is recommended for use as a repair material.[8] It has several potential clinical applications because of its superior sealing property[9] including the ability to set in the presence of blood, bactericidal effects, and biocompatibility. MTA has been successfully used in teeth with horizontal root fractures.[10]

This case report presents a novel treatment strategy – the endodontic management of a horizontally fractured maxillary central incisor using the SAF as an intraradicular splint along with MTA as an obturating material.

2. Case report

A 19-year-old female patient reported to the Department of Conservative Dentistry and Endodontics, with a history of trauma to the anterior teeth due to a fall two months back. The patient complained of pain and discomfort in the maxillary right central incisor since the last two weeks. On clinical examination, the tooth elicited grade II mobility and was tender on percussion. It responded negatively to the electrical pulp and cold tests. The remaining anterior teeth were clinically normal (Fig. 1).

Two radiographs taken with different vertical angulations revealed the presence of a horizontal fracture at the junction of the middle and apical thirds of the maxillary right central incisor with a mild radiolucency in the adjoining and widening of the PDL (Fig. 2).

A diagnosis of horizontal root fracture with 11 with associated pulp necrosis and apical periodontitis was made.



Fig. 1 – Pre-operative view.



Fig. 2 – Pre-operative radiograph.



Fig. 3 – Approximation of the coronal and radicular segments using a 15 No. K-file.

3. Treatment plan

The patient was given various treatment options, and informed consent was obtained. Splinting of upper anterior teeth (canine to canine) was carried out using a 21 gauge stainless-steel wire and light-cured composite resin (Fig. 4).

Endodontic treatment was initiated under local anaesthesia. A number 15K-file was passed through the fracture line to access the apical root segment (Fig. 3). The necrotic pulp tissue was extirpated, and the root canal was cleaned and shaped using hand ProTaper files up to F3. Calcium hydroxide medicament was placed inside the canal for a period of 15 days.

An appropriate size of SAF of 25 mm length, and 1.5 mm diameter was chosen by taking pre-fitted radiographs with the file in the canal till the working length (Fig. 5).



Fig. 4 – Wire-composite splinting.

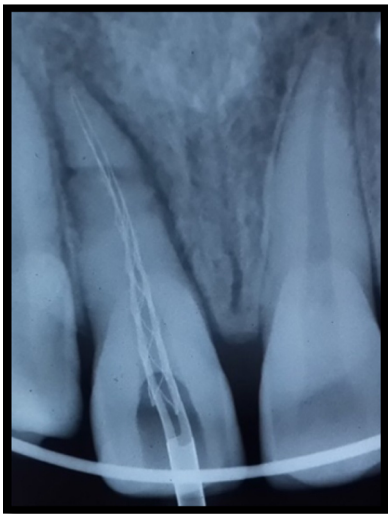


Fig. 5 – Fit of the SAF checked radiographically.

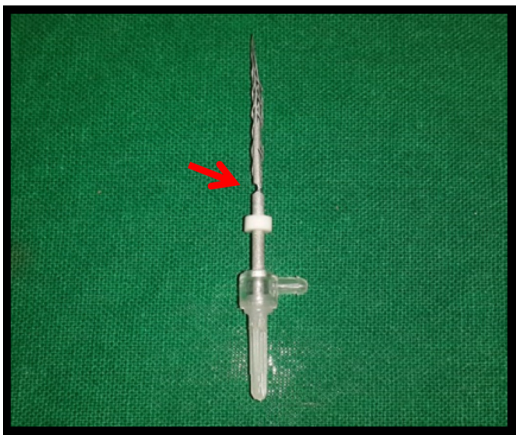


Fig. 6 – Horizontal notch made on the SAF.

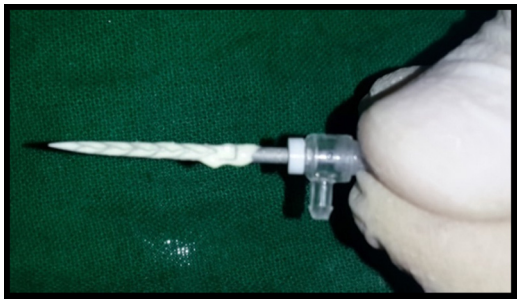


Fig. 7 – The SAF coated with MTA Sealer.



Fig. 8 – Immediate post-obturation radiograph

A notch was prepared on the shaft of the file to serve as a weak point, which would aid to separate the head of the file after insertion (Fig. 6). A MTA based root canal sealer (Fillapex, Angelus) was mixed in a 1:1 ratio, and the SAF was completely coated with it (Fig. 7). The file was inserted into the canal and advanced until it reached beyond the fracture line and got wedged into the canal. The head of the file was separated at the orifice level, where the notch was present. More MTA (ProRoot, Dentsply, Tulsa Dental. Tulsa USA) was mixed in a 3:1 proportion and was condensed into the hollow meshwork of the file until resistance was met. The orifice was sealed using Glass Ionomer Cement (Fig. 8).

The patient remained asymptomatic for the next 8 weeks, after which the splint was removed. The tooth was not tender to percussion, and the mobility had significantly reduced. The access cavity was permanently sealed using a composite resin restoration. At a 6-month recall visit, the tooth was asymptomatic and responded normally to percussion and palpation (Fig. 9). A one-year follow-up radiograph demonstrated significant healing of the attachment apparatus (Fig. 10).

4. Discussion

Root fractures heal differently depending on the degree of separation of the fragments, the severity of injury, and the ability of the pulp to heal. If the dental pulp is necrotic, repair does not occur without endodontic treatment. A factor, which significantly influences the healing process in cases of horizontal fractures, is the presence or absence of communication of the fracture line with the oral environment because of contamination from bacteria present in the sulcus.[3] The prognostic considerations, which favoured the use of an intraradicular splint in the present case were: the young age of the patient, the completed stage of root development, the level of



Fig. 9 – Follow-up radiograph at 6 months.



Fig. 10 – Follow-up radiograph at 1 year.

fracture away from the alveolar crest and close approximation of the coronal and apical fragments. These factors significantly improved the rate of healing in the present case.

Treatment options with root fractures typically include reduction of the fracture and stabilisation by rigid fixation for about 8–12 weeks as initial treatment.[11] Successful results of such treatments in horizontal fractures have been reported as ranging from 54% to 77%.[12] In this case, the patient presented with a horizontal root fracture in the middle third of her upper right central incisor (11) The pathosis was evident, owing to the development of pulp necrosis. The space between the fractured segments appeared minimal, and a widened PDL was visible surrounding the fracture. It was decided to splint the tooth to stabilise the mobile coronal fractured fragment.

Endodontic treatment was carried out in the present case. Although a negative response to the electric pulp test at early examination is not indicative for endodontic treatment, slight discolouration of the crown increased the probability of pulpal necrosis. Thus endodontic treatment was initiated immediately and was justified, when necrotic pulp tissue was observed after access cavity preparation.

Intraradicular splinting is a proven technique in the successful management of teeth with mid-root fractures demonstrating pulp necrosis and mobility.[13] Steel pins, titanium endodontic implants, prefabricated titanium dowels and posts, and ceramic, silver, or alloy cast dowels and posts have been used for intraradicular splinting.[14] The use of endodontic files has also been reported in literature.[4,5,15,16]

Using a rigid endodontic file could be problematic because of its lack of adaptability to the canal walls.

The SAF was considered to be used in the above case, since the file consists of a unique hollow design with extreme flexibility and compressibility. During its operation, the file is designed to be compressed, while inserted into a narrow root canal. The file then attempts to regain its original dimensions, thus contacting all the canal walls longitudinally as well as cross-sectionally.[7] The function of the SAF was to also provide a metal framework for the MTA to adapt as well as to retain it so as to provide a seal apically as well as along the fracture line.

MTA has emerged as a reliable bioceramic material, and there are stray reports of its use at horizontal root fracture sites.[10,17] Bramante et al.[19] used MTA as root canal filling in association with an intra-radicular post to reinforce an immature maxillary central incisor with horizontal root fracture and reported repair of the horizontal root fracture after 18 months.

MTA was chosen in this case in order to fill the fragile fractured roots with a material of excellent biological and physical properties.[8] However, placing this material beyond the fracture line into the apical segment and containing it at the fracture site has posed a problem. To overcome these difficulties, we attempted to use the SAF as a 3-D matrix, which will adapt to the canal walls both longitudinally and cross-sectionally and hold the MTA, which in turn sets as a rigid intra-radicular splint. The SAF was coated with an MTA-based sealer (Fillapex, Angelus). This sealer was used to take advantage of its flow property, adaptation to the canal walls and its regenerative biological potential. In addition, the MTA sealer sets even in the presence of moisture and blood.[18]

The insertion of the SAF into the canal coupled with the rigid set of MTA helped to obtain a proper approximation of the fracture fragments. This proper repositioning of the coronal fragment is essential for successful healing of the horizontal root fracture.[19] The use of the SAF in management of horizontal root fracture cases has previously not been reported in literature and presents a novel approach.

5. Conclusion

This article describes the successful conservative management of a horizontal root fracture, using a new approach. Stabilisation of the fractured fragments was performed using the SAF with MTA as an obturating material, which improved the prognosis of the tooth.

Conflicts of interest

The authors have none to declare.

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