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Management Of A Horizontally Fractured Central Incisor By Intra-Radicular Splinting -A Case Report

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Abstract
Horizontal root fracture refers to the presence of a fracture line that is perpendicular to the long axis of the tooth's root. Clinicians find it challenging to manage horizontal root fractures due to the difficulties of creating a stable reunion of fracture fragments. This case report typically illustrates a scenario where MTA & MTA based root canal sealer was used in conjunction with an endodontic file as an intracanal splint for repair of horizontally fractured root with minimal displacement of the fragments. This approach offered the patient to retain their natural dentition & preserved the natural proprioception and function of the roots at an affordable cost and provided a viable alternative to the use of more invasive and expensive alternatives. Short-term follow-up of the case showed promising results both clinically and radiographically.

Keywords- *Horizontal root fracture, Intra-radicular splint, Mineral trioxide aggregate (MTA)*

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I. Introduction

Dental trauma includes injuries to the teeth and surrounding hard and soft tissues. This type of injury is produced by direct/indirect force to a tooth or teeth and/or their supporting structures, which often results in subluxation, luxation injuries, minor to major crown-root fractures and even avulsions.[1] Of all dental injuries, crown fractures of the permanent teeth account for 26–76% of cases, making them the most common type. While root fractures are relatively uncommon among all dental traumas, with an overall incidence of 0.5-7% in permanent teeth and 2% to 4% in primary teeth.[2]

Root fractures are defined as a crack in a tooth that extends into the root, involving the dentin, cementum, and pulp. Root fractures are described according to the direction of the fracture lines as horizontal root fractures or vertical root fractures. Root fractures usually occur in maxillary central incisors (68%), followed by maxillary lateral (27%) and mandibular incisors (5%).[3]Although root fracture can occur in the cervical, middle, or apical third of the root, middle-third fractures are most frequent. These fractures usually tend to be oblique in the apical and middle root segments and horizontal in the cervical segment. Multiple root fractures are an uncommon finding, with most cases involving a single fracture. Unilateral root fracture of thin canal walls can be seen in teeth with incomplete root formation.[4]

As root fractures cause injury to all oral tissues, including the pulp, dentin, periodontal ligament, cementum, and occasionally the supporting alveolar bone, the healing process for these fractures can be complex. Pulp necrosis, root canal obliteration, external and internal surface resorption, inflammation surrounding the fracture, and periapical inflammation are pathological consequences that follow horizontally fractured teeth.[5]

The prognosis of fractured tooth depends on many factors like age of the patient, maturity of root formation; time elapsed between trauma and treatment, site of fracture and approximation of the fractured fragments. Fractures in the cervical 1/3rd have a guarded prognosis, while those in middle and apical third have a better prognosis. The immediate treatment involves splinting and stabilization of the fractured root and is successful in approximately 80% cases with middle and apical root fractures. Endodontic treatment may be required in cases with irreversible pulpitis, necrosis or when considerable time has elapsed between treatment

and trauma.[5] 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 intra-radicular splinting to unite the fracture.[6]

Intra-radicular splinting technique involves connecting the tooth fragments through the root canal using a metal pin together with a root canal sealer. It is indicated in cases in which the fracture line is in the middle or coronal segment and is known to correct the mobility of the coronal segment and aid in the healing of periodontal tissue around the fracture site.[5,7]

This case report discusses the endodontic management and six-month follow-up of a horizontally fractured central incisor using the intra-radicular splinting technique. Thus, presenting a conservative approach in the management of horizontal root fractures & to allow for retention of natural dentition.

II. Case Report

A 20-year-old male patient reported to the Department of Conservative Dentistry and Endodontics at CSMSS Dental College and Hospital, Chh. Sambbhajinagar, with a chief complaint of broken teeth and pain in upper front region of jaw. History revealed he met with a road traffic accident few weeks ago and experienced trauma to upper front teeth causing them to fracture and cause discomfort while chewing. Medical history was not contributory.

Clinical examination revealed complicated crown fractures w.r.t 11,12, 21 (maxillary right and left central incisors & maxillary right lateral incisor). Grade 1 mobility was observed with 11, and it was non-tender to percussion. No mobility and no tenderness on percussion was observed with 12,21. The electric pulp vitality test gave a negative response for teeth 11,12,21. While remaining anterior teeth were clinically normal. (Fig1)

On radiographic examination, a horizontal fracture located in the mid-root segment w.r.t 11 was detected separating the coronal and apical root fragments from each other by about 1mm. Minimal displacement of fracture fragments was noted. Periapical rarefaction and PDL space widening was seen with 11. Also, coronal fracture involving enamel, dentin, extending into the pulp chamber was noted with 11,12,21. (Fig 2)
A diagnosis of ELLIS CLASS VI fracture w.r.t 11 and ELLIS CLASS III FRACTURE w.r.t 12,21 was made.

Treatment Plan

The patient was given various treatment options, and informed consent was obtained. After local anaesthesia administration and rubber dam application (Fig 3), access cavity preparation was done with 11,12,21. (Fig 4). A no. 15k file was passed through the fracture line to access the apical root segment of 11 (Fig 5). Working lengths were determined for 11,12,21 (Fig 6). Pulp tissue was extirpated and the canals were irrigated with saline. Cleaning and shaping of the canals was done by conventional method using 2% taper instruments along with copious irrigation. 11,12,21 were prepared till apical file size 80 k. Calcium hydroxide with iodoform (Neopex) Intracanal medicament was placed inside the canals for a period of 3 weeks to ensure complete disinfection of canal. Access was temporized with cavit. (Fig 7)

In the second visit, the medicament dressing was carefully removed from the canal. A new autoclaved 90 no. H file was selected for intra-radicular splinting of horizontal root fracture with 11. Snug fit of the instrument was assessed (Fig 8). A notch was prepared on the shaft of the file using a diamond disc to serve as a weak point, which would aid to separate the head of the file after insertion. A MTA-based root canal sealer (Fillapex, Angelus) (Fig 9) was mixed in a 1:1 ratio, and the no.90 H file was completely coated with it (Fig 10). The file was inserted into the canal of 11 and advanced in clockwise manner, until a snug fit was obtained due to the binding of the flutes into the dentin. Once the file got wedged into the canal, the handle of the file was separated at the weakened area. More MTA (ProRoot, Dentsply) was mixed in a 3:1 proportion and was condensed into the canal (Fig 11).

Finally, the file which was used as an intra-radicular splint was also used as a post for 11 and core buildup was done using composite resin restoration (Fig 12). Subsequently, obturation was completed with 12 and 21 using lateral cold compaction technique (Fig 13).

During the next appointment, post space preparation was done with 12,21(Fig 14) and wax pattern were recorded for cast post fabrication with 12,21(Fig 15). At a later appointment, cast post cementation was done with teeth 12,21 (Fig 16) and Porcelain fused metal crown (PFMC) preparation was done with 11, followed by impression making of upper and lower arch (Fig 17). Finally, after designing a CAD CAM digital mock-up (Fig 18), PFM crowns were fabricated and cemented for 11,12,21(Fig 19).

At the 1-month recall, the tooth was asymptomatic and the mobility of the tooth was normal. On 6-month follow-up, the patient was comfortable with no complaints with the treated teeth. Pain on percussion was negative and no mobility was detected clinically. Also, radiographic healing of the attachment apparatus was evident as lamina dura formation was seen along the distal root outline. Also, no untoward periapical changes

had occurred indicative of any resorptive activity (Fig 20).

III. Discussion

Clinical management and prognosis of horizontal root fractures differ depending on the severity of injury, age of the patient, site of fracture, presence or absence of communication of the fracture line with the oral environment, degree of separation of the fragments, time elapsed between trauma and treatment, mobility of the coronal segment, pulp vitality status and occlusion.[8]

Various histological healing patterns observed at the fracture line in the roots can be categorised into four types: type I, interposition of calcified tissue (callus formation, radiographically fractured fragments appear in close contact); type II, interposition of connective tissue (peripheral rounding of the fracture's ends visible); type III, interposition of bone and connective tissue (appears on a radiograph as a clear separation between fractured ends); and type IV, the interposition of granulation tissue, caused by an infected or necrotic pulp. The type of tissue response varies with the degree of trauma, and Type II is amongst the most common outcome reported in cases with successful outcomes.[9,10]

The most common types of root fractures are in the middle third of the root (57%), followed by fracture in the apical third (34%), and in the coronal part. There have been reports of spontaneous healing in cases of fractures in the apical third of root even without any medical intervention.[11] Endodontic treatment, if required can be limited to the coronal segment in such cases as the apical pulp is mostly vital. Cases where the fracture line is in the cervical/middle one-third of the root and there is luxation of the coronal segment, immediate treatment of choice is rigid stabilisation of the tooth for few weeks, followed by intra-radicular stabilisation of the root.[12]

Intra-radicular splinting is a proven technique in the successful management of teeth with mid-root fractures demonstrating pulp necrosis and mobility. Steel pins, titanium endodontic implants, prefabricated titanium dowels and posts, and ceramic, silver, or alloy cast dowels and posts have been used for intra-radicular splinting. The use of endodontic files has also been reported in literature.[13,14] Histologically, Luhr et al. showed that with intra-radicular splinting and good adaptation of the fragments, the fracture site could be bridged with a newly formed osteocementum plug.[15]

In the present case, the fracture line was in the middle of the root & fracture fragments were minimally displaced also a considerable time had elapsed between trauma and his dental visit, so immediate endodontic therapy was planned along with an intra-radicular stabilization of roots which allowed to improve crown by root ratio as the file could negotiate both the root fragments thus improving the prognosis of the case.

Cementation of an intracanal stabilizer has been traditionally carried out with GIC or Polycarboxylate cement in the past. With the availability of MTA a reliable bioceramic material, it is possible to try to induce regenerative tissue formation at the fracture line by using it.[16] MTA has been used in the past to strengthen weakened roots and has shown to have excellent biocompatibility, it is cementogenic, has good sealing and antimicrobial properties and ability to set in the presence of blood.[17] The newly introduced MTA based sealer MTA Fillapex was chosen in this case as it has good flow characteristics and overcomes one major disadvantage of MTA, i.e. poor handling characteristics. Thus, it serves as a good sealing material in fracture sites where both root reinforcement and cementogenesis are desirable.[6,18]

Six months after the treatment, the tooth was serving normally and appeared to have no signs of periradicular inflammation clinically and radiographically. The healing of this tooth may have involved the interposition of bone and connective tissue.

IV. Limitations

It should be noted that it was not possible to differentiate the presence of a cervical resorption with the classic radiographic technique used in this study. The imperfect contrast in the radiographs may mask the cervical root resorption. Furthermore, absence of clinical signs is not a definitive criterion for success as many asymptomatic endodontic cases may exhibit persistent chronic reactions histologically. Long term follow-ups and further investigations are necessary to confirm the success of such treatments.

V. Conclusion

Trauma followed by fracture and mobility of a tooth creates great distress for a patient. In such a situation, a patient appreciates all efforts made by the treating dental professional to retain his/her natural tooth. This case demonstrated that intra-radicular splinting using endodontic file and MTA based sealer can be an alternative treatment technique for managing horizontally fractured tooth with necrotic and mobile coronal segment. Thus, horizontal root fracture following trauma should not be considered as an indication for extraction. Intra-radicular splinting a conservative non-surgical management of horizontal root fracture allows for aesthetic, economic alternative in developing economies.

VI. Clinical Pictures And Radiographs

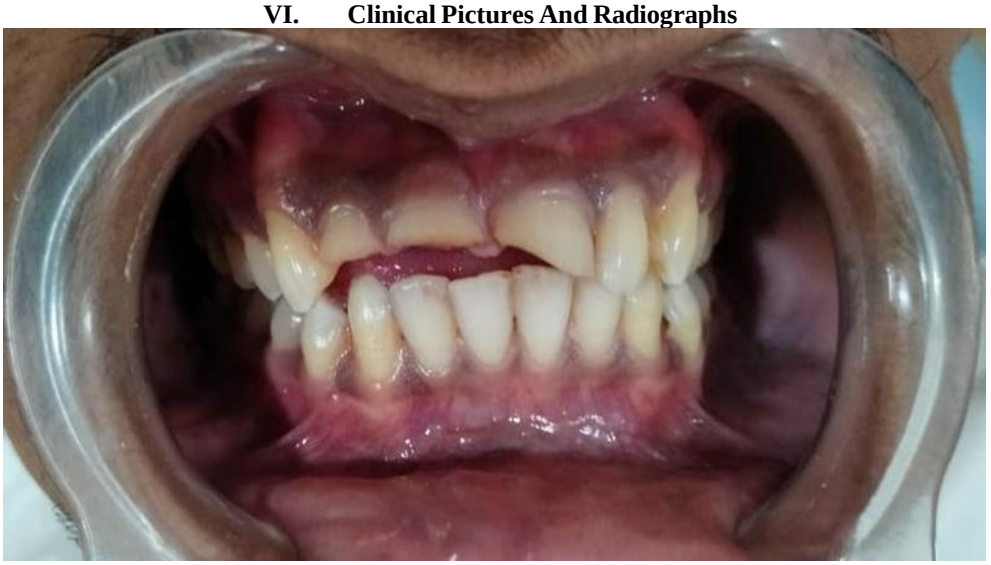

Fig 1: Pre-operative clinical photograph

Fig 2: Diagnostic IOPA radiograph

Fig 3: Rubber dam isolation

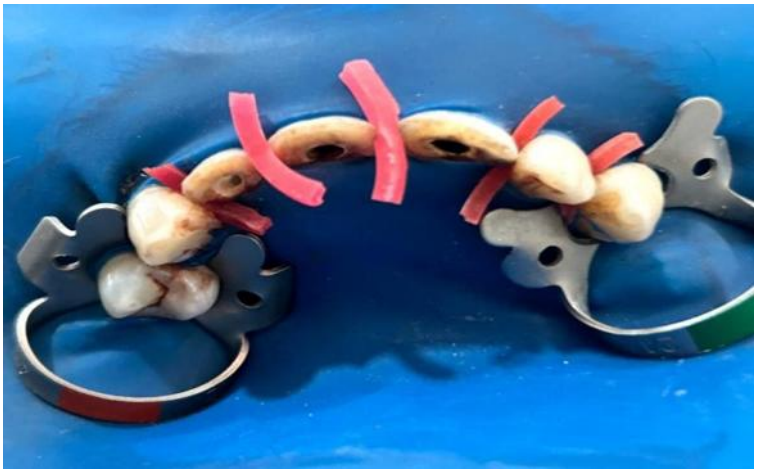

Fig 4: Access cavity preparation w.r.t 11,12,21

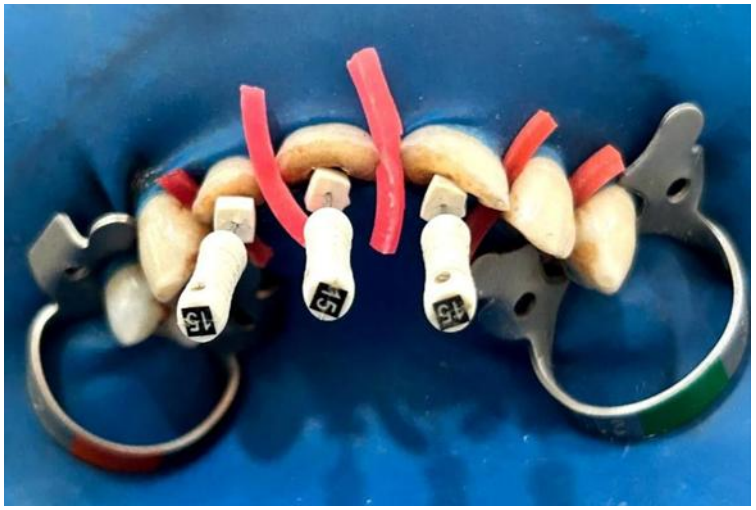

Fig 5: A no. 15k file passed through the fracture line to access the apical root segment of 11.

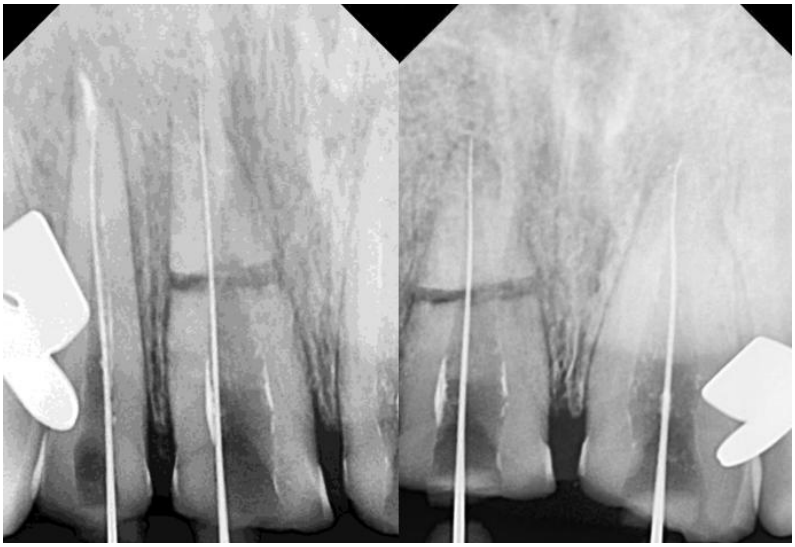

Fig 6: Working length determination with 11,12,21

Fig 7: Calcium hydroxide with iodoform (Neopex) Intracanal medicament placed inside the canals for a period of 3 weeks

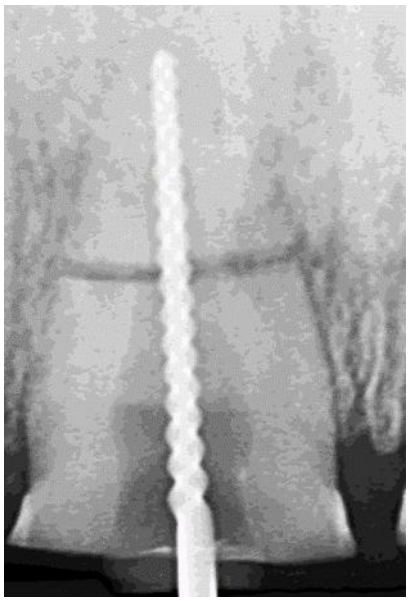

Fig 8: Snug fit of autoclaved 90 no. H file assessed before intra-radicular splinting of 11.

Fig 9: MTA-based root canal sealer (Fillapex, Angelus)

Fig10: no.90 H file completely coated with MTA-based root canal sealer

Fig 11: H File used for intra-radicular splinting with 11

Fig 12: H file used as an intra-radicular splint, also used as a post for 11 and core buildup done using composite resin restoration.

Fig 13: Obturation completed with 12 and 21

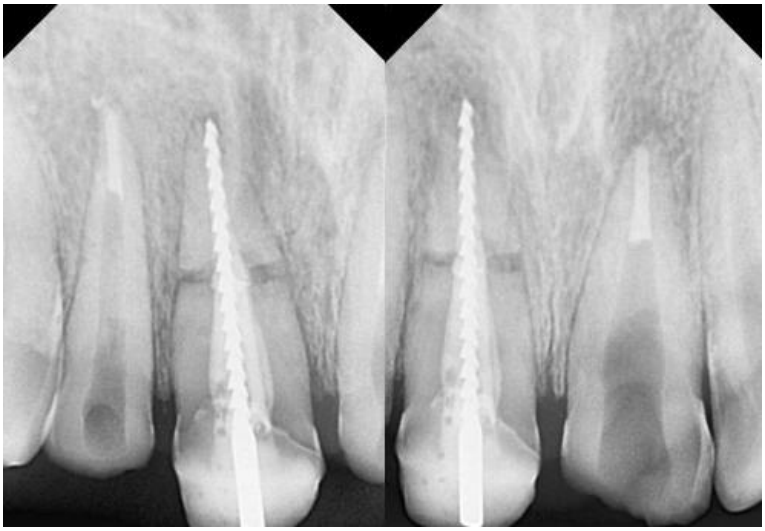

Fig 14: Post space preparation done with 12,21

Fig 15: Wax pattern recorded for cast post fabrication with 12,21

Fig 16: Cast post cementation was done with teeth 12,21

Fig 17: Upper impression recorded in silicone rubber-based impression material and lower impression recorded in alginate impression material

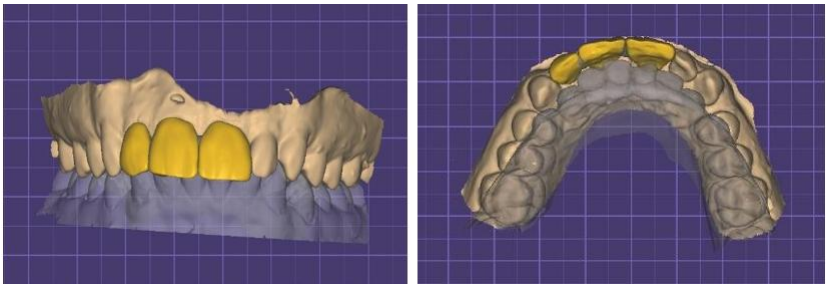

Fig 18: CAD CAM digital mock-up for PFM crowns w.r.t 11,12.21

Fig 19: Post-operative clinical picture showing cementation of PFM Crowns w.r.t 11,12,21

Fig 20: 6-month follow-up radiographic showing healing of the attachment apparatus & no untoward periapical changes w.r.t intra radicular splinting of 11.

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