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Case Report

Management of horizontal root fracture with root resorption at apical third using calcium silicate-based cement -A case report

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ABSTRACT

Root fractures are more prevalent in teeth that have fully erupted and have closed apices, where the entire root is firmly anchored in the bone and surrounding tissues. The results can become complex because of the pulp, dentine, cementum, bone, and periodontium injury. The handling of horizontal root fractures encompasses numerous factors, resulting in the suggestion of different treatment methods. This report presents the steps and post-treatment period of two lower central incisors with root fractures at the apical third, which were treated using root canal therapy and mineral trioxide aggregate, respectively.

1. Introduction

Root fractures are traumatic injuries involving dentin, cementum, and the pulp. They have been reported to occur in 0.2% to 7%of all traumatic injuries to teeth. Horizontal root fractures commonly occur in the anterior maxillary region, and incisors with complete root formation are the most affected teeth because of the elasticity of the alveolar bone cavity.[1]

Diagnosing a horizontal root fracture relies on the data gathered from clinical and radiographic assessments. Clinically, the fractured tooth may exhibit slight extrusion and palatal displacement.[2]

The outcome of treating fractured teeth can be affected by various factors, including the extent of displacement, the stage of root development, the site of the fracture, the time elapsed between the injury and treatment, and the type of dental trauma (whether the coronal fragment is displaced or not).[3]

The recovery of horizontal fractures is influenced by various factors, including the patient's age, the mobility of the coronal fragment, the position of the root fracture, and the stage of root development. Throughout the healing process, different types of tissues form between the fractured fragments. These include calcified tissue healing, connective tissue interposition, bone and connective tissue interposition, and granulation tissue interposition.

If the fractured tooth is nonvital, endodontic therapy will be necessary for the coronal portion of the root. An intracanal calcium hydroxide dressing can create a hard tissue barrier at the apical end of the coronal part of the fracture. However, this treatment process is time-consuming and may require periodic material changes. Additionally, there is a potential risk of further fracture.[1]

Loma Linda University pioneered the creation of mineral trioxide aggregate (MTA), a highly recommended material for restorative purposes. Its numerous advantages over calcium hydroxide have propelled its popularity. MTA possesses exceptional sealing properties, can solidify even in the presence of blood, exhibits bactericidal effects, and showcases excellent biocompatibility. As a result, MTA

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has garnered recommendations and has shown successful utilization in treating teeth with necrotic pulp and open apices.[4]

MTA is a reliable option for establishing an apical barrier in endodontic procedures. It is a biocompatible material that has various clinical applications in the field of endodontics.[5]

MTA materials support the growth and specialization of Dental Pulp Stem Cells (DPSC), leading to the formation of reparative dentin. As MTA sets, it releases calcium ions that trigger signalling molecules such as interleukin and TGF-β, regulating cell development and specialization.[6]

This case report presents the management and post-treatment evaluation of mandibular incisors with horizontal root fractures at the apical third, which were successfully treated using MTA as an apical plug.

2. Case Report

A 42-year-old male patient came to the department with a chief complaint of pain and swelling with mobility in the lower front teeth region for one week. He had a history of trauma 4 months back and had initiated root canal treatment then which was not completed.

Clinical examination revealed a soft, fluctuant, and well-circumscribed swelling present on the attached gingiva which was 2x3mm in diameter at the region of 31 with a reddish appearance and a Grade II mobility irt 31 and 41.(Figure 1)

Figure 1: Swelling present on the attached gingiva

There was no evidence of sinus discharge. Electric pulp testing was done for lower anteriors and teeth 31 and 41 showed no response and 32 showed delayed response compared to contralateral tooth 42.

Radiographic examination of 31 & 41 revealed a horizontal root fracture with a radiolucency measuring about 3mm between the coronal and apical 3rd and a diffuse periapical radiolucency was seen irt 32.(Figure 2)

Based on the above findings this case was diagnosed as Horizontal root fracture associated with Root resorption secondary to trauma irt 41,31 and chronic apical periodontitis irt 32 and root canal treatment was planned for these teeth followed by placement of MTA irt 31 and 41.(Figure 3)

Figure 2: Horizontal root fracture at the apical third of 31 and 41

The treatment plan was to stabilize the tooth using a splint followed by endodontic treatment. Teeth were stabilized using composite and wire splint (semi-rigid splint).

Refinement of Access cavity was done, working length determined, Master apical file was selected as #35ISO K-file, and the root canal was cleaned, shaped, and disinfected using intracanal medicament like calcium hydroxide and triple antibiotic paste which was placed intermittently for 3 weeks.

Apical 5mm of root was filled with MTA using pluggers by orthograde approach and the remaining canal space was obturated using thermoplasticised gutta-percha by vertical condensation and the access cavity was sealed with composite.(Figure 4)

A 6-month follow-up showed decreased radiolucency between the fragments and a resorbing apical fragment showing a good prognosis of healing.(Figure 5)

3. Discussion

Horizontal root fractures, also known as transverse fractures, are not commonly observed in dental injuries.

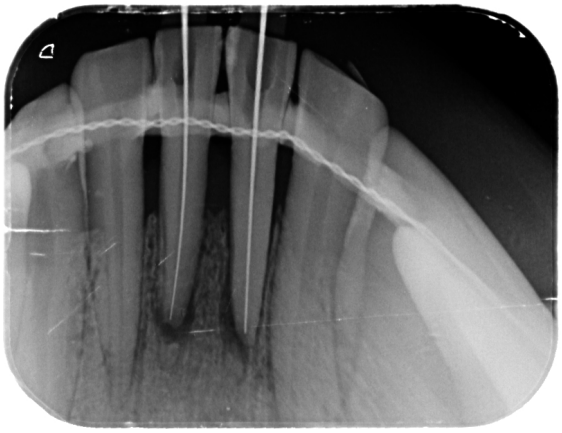

Figure 3: Working length determination

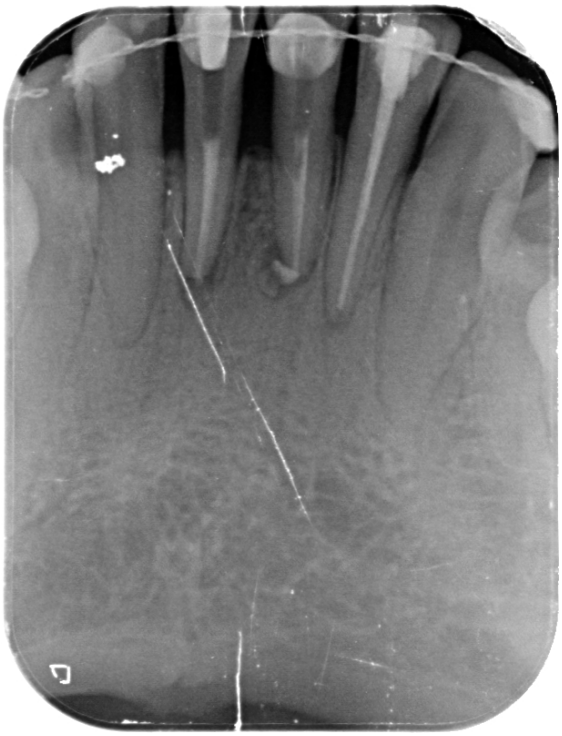

Figure 4: Obturation by orthograde filling of MTA at the apical third

However, like any other dental injury, they necessitate proper management, which in turn requires a comprehensive understanding of the injury. The management of horizontal root fractures is influenced by numerous factors, with the level of fracture in the root being particularly important. Unless the fracture is situated supracrestally, a conservative approach should be prioritized for management.[7]

Root fractures occur when a tooth is subjected to direct trauma, typically from a horizontal, frontal impact caused by a hard object or during a physical altercation.[8] These fractures affect various tissues within the teeth and

Figure 5: Resorbing apical fragments

their supporting structures, resulting in intricate healing processes that involve dentin, cementum, dental pulp, periodontal ligament (PDL), and bone.[7]

When a root fracture takes place, the dentin and cementum, which are the hard tissues of the tooth, fracture. On the other hand, the dental pulp, which is the soft tissue of the tooth, may sustain different types of injuries depending on whether the coronal fragment of the root has been displaced or not.[8]

Andreasen et al have outlined four distinct types of responses exhibited by the tooth and its associated tissues following root fractures.[9] These four responses include:

1. Healing with hard dental tissue.
2. Healing with connective tissue.
3. Healing with bone and connective tissue.
4. No healing where granulation tissue (inflammatory tissue) forms in the fracture line because of pulp necrosis and infection of the pulp space in the coronal fragment.

Preserving pulp vitality by repositioning the coronal fragment and utilizing splints for 4 weeks is the primary treatment option for horizontal root fractures.

If the coronal section of the root is found to be necrotic or if the tooth displays signs of irreversible pulpitis, it is necessary to remove the necrotic pulp tissue from the coronal fragment to create suitable conditions for healing.[10]

In cases where the teeth have open apices, the conventional treatment approach involves creating an apical plug using calcium hydroxide, which has been proven to be a reliable and effective treatment option. Nonetheless, this method does have certain drawbacks, including the need for numerous visits, the likelihood of patient non-compliance, and a prolonged treatment duration.[11]

Mineral Trioxide Aggregate (MTA) is a bioactive substance used in endodontic therapy due to its efficacy in sealing and treating teeth with open apices, significantly improving patient outcomes. The use of MTA has been recommended and proven to be efficient as a single-visit apexification material for treating teeth with open apices.[12]

Due to the similarity in obturating the coronal fragments, MTA is a viable choice for apexification procedures and can also be considered for filling the coronal fragments in cases of horizontal root fractures.

Due to its biocompatible properties and superior sealing ability, MTA promotes wound healing in these conditions. Its exceptional sealing ability is attributed to its expansion during the setting reaction.[13]

MTA, like calcium hydroxide [Ca $(OH)_2$], triggers the formation of dentin bridge. The tricalcium oxide content of MTA interacts with tissue fluids and forms CaOH2, resulting in the creation of hard tissue similar to $Ca(OH)_2$. The dentin bridge formed with MTA is comparatively faster and exhibits better structural integrity than $Ca(OH)_2$. MTA not only stimulates the formation of reparative dentin but also maintains the integrity of the pulp.[14] Additionally, MTA has the potential to induce cementoblastic cells to produce hard tissues. The effect of MTA on cementogenesis has been assessed by evaluating the expression of Osteocalcin, cell growth, and the morphology of cementoblast-like cells.[15]

MTA can enhance the production of pro-inflammatory and anti-inflammatory cytokines from osteoblasts. Additionally, MTA can promote the formation of bone, dentin, and cementum, as well as facilitate the regeneration of periapical tissues such as periodontal ligament and cementum. This versatile material acts as an osteoconductive, osteoinductive, and cementogenic agent, promoting the formation of hard tissues. Furthermore, MTA stimulates immune cells to release lymphokines and bone coupling factors necessary for the repair and regeneration of cementum, aiding in the healing of osseous periapical defects. Lastly, MTA serves as a reliable biological seal and can function as a scaffold for the formation and/or regeneration of hard tissue in periapical regions.[15]

4. Conclusion

As in all dental applications, the diagnosis and treatment plan have a significant role in the success of the treatment of traumatic injuries. Therefore, being aware of the advances and knowing the treatment choices are crucial. MTA has shown to be a suitable choice for an apical plug in the management of horizontal root fractures, making it a viable option for such cases.

5. Conflict of Interest

None.

6. Source of Funding

None.

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