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CASE REPORT
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HORIZONTALNI PRELOM KORENA ZUBA: STUDIJA TROGODIŠNJEG PERIODA PRAĆENJA

HORIZONTAL FRACTURE OF THE TOOTH ROOT: 3-YEAR FOLLOW UP STUDY

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Sažetak

Uvod: *Traumatske povrede zuba predstavljaju značajan uzrok hitnih stomatoloških intervencija, jer pored samih zuba često zahvataju i okolna potporna tkiva, uključujući gingivu, alveolarnu kost i periodontalni ligament. Ove povrede mogu varirati od jednostavnih fraktura do kompleksnih oštećenja, a nastaju usled različitih uzroka, kao što su saobraćajne nesreće, sportske povrede, padovi ili fizički udarci. Horizontalne frakture korena najčešće se lokalizuju u srednjoj trećini korena, dok su frakture u koronarnoj i apikalnoj trećini znatno ređe. Dijagnoza se postavlja kliničkim pregledom i radiografski, a izbor terapije zavisi od položaja frakture, stepena zahvaćenosti korena, tačne dijagnoze, adekvatnog kliničkog pristupa i redovnog praćenja.*
Prikaz slučaja: *Predstavlja lečenje horizontalne frakture korena maksilarnog desnog centralnog sekutića uz primenu mineral trioksid agregata (MTA) i trogodišnjeg kliničkog i radiografskog praćenja.*
Zaključak: *Stalni zub sa frakturom korena može imati povoljnu prognozu, uz očuvanje estetskog izgleda i psihološkog integriteta pacijenta. Ključno je naglasiti značaj kontinuiranog kliničkog i radiografskog praćenja radi obezbeđivanja dugoročnog uspeha terapije, naročito kod zuba sa horizontalnim frakturama korena.*

Ključne reči: *trauma, horizontalna fraktura korena, MTA*

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Abstract

Introduction: *Traumatic dental injuries are a significant cause of emergency dental visits, impacting not only the teeth but also the surrounding supporting tissues, such as the gums, jawbone, and ligaments. These injuries can range from simple fractures to complex damage, and they can be caused by various factors, including accidents, sports injuries, falls, or physical trauma. Horizontal root fractures are most frequently located in the middle third of the root, with much less frequent occurrences in the coronal and apical thirds. Root fractures are diagnosed through clinical and radiographic examinations. Treatment depends on the position of the fracture, the extent of root involvement, correct diagnosis, clinical management, and radiographic follow-up.*
Case report *presents the treatment of a maxillary right central incisor with a horizontal root fracture, using MTA, along with a follow-up period of 3 years.*
Conclusion: *A permanent tooth with a root fracture that is endodontically treated may present a good prognosis, preserving the esthetic and psychological integrity of the patient. It is crucial to emphasize that continuous clinical and radiographic follow-up is necessary for ensuring the long-term success of the treatment, particularly for teeth with horizontal root fractures.*

Key words: *trauma, horizontal root fracture, MTA*

Introduction

Horizontal root fractures are relatively rare compared to other types of dental injuries, with an incidence of 0.5–7% in permanent teeth that have been injured[1]. Maxillary central incisors are most commonly affected by traumatic injuries, accounting for approximately 68% of cases, likely due to their position in the dental arch. The next most commonly affected teeth are the maxillary lateral incisors (27%), followed by mandibular incisors (5%)[2].

Root fractures are more commonly observed in male patients, possibly due to the higher incidence of trauma associated with activities such as automobile accidents, sports injuries, and physical altercations. These fractures are often seen in permanent, fully erupted teeth that have completed apex formation. The increased occurrence of root fractures in these teeth may be attributed to the support provided by the surrounding bone and periodontium.

Initial management typically involves repositioning and stabilizing the coronal fragment in its correct alignment, followed by ongoing monitoring to assess pulp health. Healing is successfully observed in approximately 83% of cases[3]. The management of horizontal root fractures depends on the location of the fracture, as well as the mobility and vitality of the tooth. Fractures located in the apical third of the root typically show no mobility and often do not require treatment. In contrast, fractures in the cervical third frequently necessitate extraction. If the coronal fragment is severely mobile, extraction may be the only viable treatment option. Root fractures in the middle third generally have a more favorable prognosis. When the coronal fragment is displaced, the first step in treatment is usually repositioning the fragments, followed by stabilization to allow the surrounding periodontal tissues to heal. However, in 5–25% of cases, horizontal root fractures may necessitate endodontic therapy if the pulp of the coronal segment shows signs of pathology, such as necrosis[4]. Andreasen et al. in their study found that necrosis of pulp after horizontal root fracture occurs in nearly 25% of cases[2,5].

Endodontic intervention is required for nonhealing fractures. Anderson and Hjorting Hanser[5] described four types of healing sequelae: 1) Healing with calcified tissue - there is close contact between fragments but the fracture line can be seen radiographically; 2) Healing with interproximal connective soft tissue - when viewed radiographically, the separation between the fragments is seen as narrow radiolucent line and the fractures edges appear narrow; 3) Healing with interproximal bone and connective tissue - the separation between fractured fragment as seen radiographically is through distinct bony bridge; and 4) Interproximal inflammatory tissue without healing - fracture line seems to widen when viewed radiographically[6].

Case report

A 21-year-old male patient presented to the Department of Pediatric and Preventive Dentistry at the University Dental Clinic “St. Pantelejmon”, Skopje, after experiencing trauma to the upper front region. Clinical examination revealed that the crown of the tooth was mobile. A complicated crown fracture of the right maxillary central incisor was observed, classified as grade II mobile according to Miller's classification of tooth mobility (Figure 1). Radiographic examination showed a horizontal root fracture in the middle third of the right maxillary central incisor, with no radiographic pathologies detected in the fracture line or the periapical area (Figure 2). Initial treatment involved repositioning, applying firm finger pressure to the coronal segments. An orthodontic stainless steel arch was then fitted, using rigid fixation with a 0.5 mm orthodontic wire sealed with a photopolymeric resin after careful assessment of lateral canine to lateral canine occlusal contacts (Figure 3). Anti-inflammatory drugs and antibiotics were prescribed for seven days. The treatment plan was explained to the patient, and his consent was obtained.

Root canal treatment was initiated in the maxillary right central incisor. Access opening was done using a round bur and a safe-end bur. Following pulp extirpation, working length was determined correctly using an electronic apex locator and radiograph. Working length was determined to the apex of the apical fragment (Figure 4). Both the coronal and apical fragments were cleaned and shaped. The canal was irrigated thoroughly using 3% sodium hypochlorite and 0.9% normal saline for the removal of remaining pulp tissue and debris. The calcium hydroxide paste was then placed as an intracanal medicament and a temporary pack with Cavit (3M™ Cavit™). On the second visit, after three weeks, the

temporary dressing was removed and the canal was irrigated using saline and 3% sodium hypochlorite and dried with paper points. The root canal was filled with mineral trioxide aggregate (MTA - BIO MTA®, (PPH CERKAMED Wojciech Pawlowski 37-450 Stalowa Wola, Poland) and it was obturated with gutta-percha using lateral condensation technique and restored with composite resin (Tetric Evo Ceram Bulk Fill, Ivoclar Vivadent, Schaan, Liechtenstein) (Figure 5). Immediate post-operative periapical radiographs were taken. Despite this therapeutic solution, correct oral hygiene was maintained thanks to professional hygiene and strong motivation of the patient. Moreover, the absence of the fracture line with the oral environment prevented any bacterial penetration. The splint was removed after 4 weeks. After the splint was removed, the mobility of the right maxillary incisor was within normal limits, and the patient reported no discomfort with his teeth and no pain during horizontal and vertical percussion tests. No sign of pathology was visible on the radiograms. Periodic clinical and radiographic follow-up evaluations were performed at 1, 3, 6, 12 months and after 3 years of the injury.

At 1, 3, 6 and 12-month recall, the clinical examination revealed no mobility or discomfort during percussion of the maxillary right central incisor. On radiographic examination, no pathological changes. After three years, there were no clinical symptoms, and the intraoral periapical radiograph revealed healing with interproximal bone and connective tissue, radiologically characterized by the clear separation of the two fragments (Figure 6).

Figure 1. Preoperative intraoral view

Figure 2. Preoperative radiographic view showing HRF at the junction of the middle and apical third of the tooth[11]

Figure 3. Stabilization with a composite wire splint

Figure 4. Working length measurement of teeth[11]

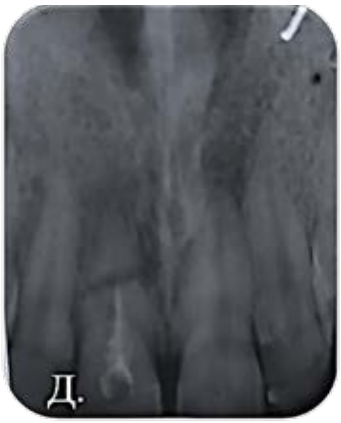

Figure 5. Post-obturation radiograph with MTA

Figure 6. 3-year follow-up

Discussion

Preserving natural dentition and restoring its normal function is one of the goals of dentistry. Extraction of the tooth and its replacement with an osseointegrated implant should always be considered the last treatment option when all other means of retaining the natural tooth have been tried[7].

Root fractures typically result from an impact force applied to the crown of the tooth. Frontal forces cause compression to the labial and lingual/palatal sides of the root, splitting it into coronal and apical segments. This injury can damage the surrounding periodontal tissues, potentially causing displacement of the root fragments[8]. Accurate diagnosis of root fractures requires both thorough clinical and radiographic assessments. The clinician should assess the mobility of the coronal fragment and check the vitality of the pulp. Radiographs usually show a radiolucent line separating the coronal and apical fragments[9,10]. Ideally, two or three radiographs taken at different angles may be necessary to accurately assess the angle of the fracture.

Most root fractures occur in the middle third of the root, followed by fractures in the apical and coronal thirds. In permanent teeth with closed apices, mid-root fractures are most common, as the fully developed root is well-supported by the periodontal tissues. The healing process following such fractures depends largely on two conditions: whether the pulp is severed and whether bacteria invade the fracture site. If the pulp remains intact after trauma, a dentin callus typically forms between the fractured fragments, followed by cementum deposition on the peripheral edges of the fracture. This healing process can take several years. However, if the pulp is ruptured, revascularization of the coronal portion is required, which may occur through two potential mechanisms: either cell invasion from the apical pulp or cells from the periodontal ligament, leading to the union of the fragments via interposed connective tissue[11]. Root fractured teeth often possess a vital apical fragment[12,13];hence it was decided to perform the endodontic treatment of the coronal fragment leaving the apical fragment as such.

This report presents a case of a horizontal root fracture in the middle third of the root, and endodontic treatment using MTA. The 3-year follow-up shows the closure of the space between the fractured segments. This could be due to connective tissue formation, where PDL cells are the dominant contributors. Re-modelling via resorption at the edges of the fracture line is a common phenomenon, creating rounded corners. Cementum formation may have also occurred, which grows into the space, reuniting the two fragments to some extent. Regular follow-ups are necessary to ensure the success of the treatment[14,15].

Maintaining the position of fractured teeth in the dental arch is the main objective of treating such teeth. In recent times, there has been tremendous improvement in bonding agents and restorative resins, and also various new bioceramic materials used for endodontic fillings. Advantages of bioceramic materials include better biological properties, easier manipulation, radiopacity, dimensional stability, acceptable mechanical properties, and overall clinical performance. Bioceramic materials used in endodontics are calcium silicate-based materials[16].

One of the desirable properties of these materials, including the MTA, is the ability to form interfacial calcium-phosphate deposits between the materials and dentinal wall or bone, possibly resulting in direct and adherent bonding with hard tissues[17]. This property provides clinicians with various treatment options for managing fractured roots. MTA is a highly recommended material for teeth that have necrotic pulp and an open apex. Various studies have compared the apical closure using calcium hydroxide and MTA. Additionally, it has been observed that the success rate, as seen clinically and radiographically, is higher with MTA in terms of fracture resistance, hard tissue formation and inflammation. Therefore, MTA was selected for this case as it might improve treatment outcome[18]. When we consider the prognosis of permanent teeth with root fracture, this is related to the amount of dislocation, stage of root development at the time of injury and to some extent, it also depends upon whether the treatment was done.

MTA is the most biocompatible endodontic cement material, capable of promoting tissue regeneration[13]. Recently, MTA was used for root fracture repair. The use of MTA in intra-alveolar root fractures was described in some case reports. Eraden et al.[19] and Kusgoz et al.[20] reported the repair of horizontal root fracture sealing with MTA. During a follow-up period of 1 to 3 years, all teeth showed excellent clinical and radiographic healing. Yildirin and Gencoglu observed that the area of the MTA and fracture line was fully surrounded by new hard tissue formation. Healing with the interposition of connective tissue was found in the 10-year follow-up radiographic, although MTA was extruded between the fragments[21]. Kim et al. initially identified 22 teeth in 21 patients who

had horizontal intra-alveolar root fractures and who had received endodontic treatments with MTA. Seventeen teeth exhibited healing of the root fracture, and 2 teeth showed interposition of granulation tissue[22]. Furthermore, Taschieri et al. reported that 10 incomplete vertical root fracture repair surgical procedures were performed[23]. At 12-months follow-up, all cases remained successful. Hadrossek et al. also reported reimplantation with MTA repair VRFs teeth could be kept in situ after 2 years[24]. Those data show MTA was recommended to repair VRFs by preparing a groove along the entire vertical fracture, placing MTA in the groove, and covering it with a resolving membrane.

Treating such fractures can be challenging, particularly when dealing with an open apex at the fracture site. Mineral trioxide aggregate (MTA), a biocompatible material, has demonstrated excellent sealing properties, making it an ideal choice for managing cases with open apices[25].

Conclusion

Maintaining the position of fractured teeth in the dental arch is the main objective of treating such teeth. A permanent tooth with a root fracture that is endodontically treated may present a good prognosis, preserving the esthetic and psychological integrity of the patient. However, it is crucial to emphasize that continuous clinical and radiographic follow-up is necessary for ensuring the long-term success of the treatment, particularly for teeth with horizontal root fractures. These monitoring efforts are essential to detect any potential complications early and to verify that the tooth remains functional and stable over time. From this report, it is concluded that in dental trauma of teeth with root fracture, different healing processes occur in teeth in close proximity to each other; and that the long-term follow-up is recommended, so that any necessary procedures may be performed to maintain the teeth in the oral cavity.

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Conflict of Interest: Nil

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