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Endodontic Management of Traumatized Maxillary Central Incisor with Root Fracture: Case Report and Review of Literature

Mou Banerjee [(a)], Bodhisatta Mukherjee [(b)], Rajib Kumar Seal [(c)]

(a) *Assistant Professor, Department of Dentistry, R.G. Kar Medical College & Hospital, Kolkata, West Bengal, India*.

(b) *Assistant Professor, Department of Prosthodontics and Crown & Bridge, North Bengal Dental College & Hospital, Darjeeling, West Bengal, India.*

(c) *Associate Professor, Department of Dentistry, R.G. Kar Medical College & Hospital, Kolkata, West Bengal, India.*

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KEYWORDS

Calcium Hydroxide, Endodontic Management, Mineral Trioxide Aggregate (MTA), Pulp Necrosis, Root Fracture

ABSTRACT:

The present case study delves into the intricate endodontic treatment of a 44-year-old female patient who had a root fracture and a damaged maxillary central incisor. The backdrop highlights the complex issues of horizontal root fractures and highlights the need for an all-encompassing, empirically supported treatment plan customized to the particulars of the situation at hand. The case study provides a detailed overview of how important tactics such as calcium hydroxide, mineral trioxide aggregate (MTA), and maintaining the apical third were successfully applied. Together, these procedures helped the damaged tooth's symptoms to go away and its functioning to return. In order to maximize therapeutic efficacy and reduce potential negative effects in comparable clinical circumstances, the abstract looks ahead and predicts that innovative materials and techniques will continue to be explored. Precise and reliable results for traumatized teeth depend on ongoing research into innovative biomaterials, improved diagnostic techniques, and standardized methods. The successful case study's publication acts as a useful manual for medical professionals and adds to the body of information that develops the area of endodontics. The abstract emphasizes how crucial it is to continue study and work together to enhance the treatment of damaged maxillary central incisors with root fractures to maintain patient outcomes and dental health.

1. Introduction

The treatment of endodontically treated maxillary central incisor that has undergone a traumatic injury, especially those involving root fractures, presents considerable difficulties. Treatment for root fractures must be tailored to the specifics of the fracture, as they might happen at different levels, transversely, or horizontally[1,2,3]. Hence, there exist numerous studies and case reports that provides a vivid overview of the endodontic care of damaged maxillary central incisors with an emphasis on root fractures.

Epidemiology and etiology of traumatic root fractures-

Accidents, falls, and sporting events can result in traumatic injuries that cause root fractures. Because they are conspicuous anterior teeth, the maxillary central incisors are especially vulnerable to damage[2,4]. It is essential to comprehend the epidemiology and etiology of these injuries to prevent them and to effectively manage them.

Horizontal root fracture: causes and consequences-

There are many different reasons why people get traumatic root fractures in their maxillary central incisors, but they frequently result from sports-related injuries, falls, or other traumatic events. The maxillary

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central incisors are especially sensitive to high-impact injuries, which can cause major stresses on the anterior dentition in contact sports or automobile accidents[2,4]. The frequency of root fractures is also increased by collisions or falls during routine activities. After traumatic root fractures, there are both short- and long-term effects in addition to the initial physical injury. Pain, edema, and poor appearance are examples of acute repercussions that need for quick attention and action. Furthermore, if left untreated, root fractures can result in long-term problems such apical periodontitis, pulp necrosis, and possibly even the loss of the affected tooth. Therefore, creating preventive measures and creating efficient management plans in the field of endodontics require a thorough grasp of the many causes and their possible effects.

Challenges in diagnosis and untreated consequences-

The best course of therapy for injured maxillary central incisors is largely dependent on an accurate diagnosis, with horizontal root fractures presenting unique difficulties because of their modest clinical symptoms[1,2]. Because the symptoms of these fractures might vary and typical radiography techniques might not fully capture the degree of the damage, diagnosing them can be challenging[2]. Improvements in imaging modalities and diagnostic techniques are crucial in addressing increased diagnostic complexity because they let doctors create customized treatment regimens and improve precision. Undiagnosed or poorly treated root fractures can have serious implications, including but not limited to tooth loss, apical periodontitis, and pulp necrosis[2,3]. Timely detection and adequate therapy of potential difficulties are critical to the long-term health and functionality of impacted maxillary central incisors.

Contemporary approaches to Endodontic Management strategies-

When treating traumatized maxillary central incisors with root fractures, endodontists can use a variety of techniques. Application of Mineral Trioxide Aggregate (MTA) is one example of a non-surgical technique that has demonstrated potential, especially in cases with apical third root fractures[3,5]. Because of its established sealing qualities and biocompatibility, MTA is becoming a more popular option for treating root fractures in endodontic procedures[6]. Avulsion of two maxillary permanent central incisors combined with apical root fracture management[7], insights into the characteristics of horizontal root fracture repair[8], and non-surgical management of apical third root fractures with MTA[3] are a few examples of successful strategies that are highlighted by notable case reports. These examples highlight how treatment plans that are customized to the unique characteristics of the root fracture.

Notwithstanding progress, there are still difficulties in the endodontic treatment of traumatized maxillary central incisors with root fractures, necessitating a sophisticated strategy determined by variables such the location, severity, and pulpal involvement of the fracture as well as patient-specific considerations[2,9,10]. To meet these challenges, a thorough comprehension of the body of existing literature and the prudent implementation of evidence-based approaches are required. The complex management of traumatized maxillary central incisors requiring horizontal root fractures calls for a combination of traditional endodontic principles and cutting-edge therapeutic modalities.

A thorough review of earlier research, a few case studies, a wide range of clinical experiences, and modern methods essential to the successful treatment of root fractures have been provided[4,5,7,8,11]. An evidence-based approach to navigating the complexities of root fractures in traumatized maxillary central incisors is based on the synthesis of these knowledge. The principal aim of this case report is to present a thorough synopsis of the difficulties associated with horizontal root fractures in traumatized maxillary central incisors, along with an analysis of current advancements that have been made to attain successful results. A month after the injury, the maxillary central incisors of a 44-year-old female patient with a history of dental trauma has been presented in this case report that depicts how endodontic therapy was administered to alleviate discomfort and restore Grade I mobility. This report emphasizes how challenging it can be to treat both immediate symptoms and long-term effects, underscoring the need for a thorough, multimodal approach to the management of horizontal root fractures.

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2. Case Report

Case presentation:-A 44-year-old female patient with a history of dental trauma was referred to a public oral health service for endodontic treatment of the maxillary central incisor. The patient reported constant irritating pain and grade I mobility of teeth - 11 and 21, one month after the traumatic incident.

Clinical examination:-The tooth was found to have grade I mobility upon initial inspection. Electrical and thermal pulpal tests produced negative results. Positive results were found in both the horizontal and vertical impact tests.

Radiographic examination:-The damaged tooth's apical third had a root fracture, with no evidence of root resorption, as shown by radiographic and CBCT studies. The broken pieces remained *in situ. [Fig 1]*

Diagnosis:-The diagnosis for tooth number 11 was suggestive of pulp necrosis resulting from buccodental trauma with a fracture in the apical third of the root based on the clinical and radiographic findings.

Treatment plan:- The choice was taken to keep the apical third of the root and treat the remaining part of the tooth with endodontic therapy according to the type of root fracture that existed.

Clinical procedure:-

a. Pulp Chamber Opening: After opening the pulp chamber, mucus bloody intracanal exudate was observed. *[Fig 2]*

b. Working Length Determination: Under rubber dam isolation, the working length was carefully determined. *[Fig 3]*

c. Biomechanical Preparation (BMP): The biomechanical preparation of the canal was performed to remove any necrotic tissue and shape the canal appropriately.

d. Calcium Hydroxide Medicament: A calcium hydroxide medicament was placed in the canal to promote healing and disinfection. The tooth was closely monitored until it became asymptomatic.

e. MTA Apical Plug Placement: Once the tooth was asymptomatic, a 4mm MTA apical plug was placed. A moist cotton pellet was positioned over it for 24 hours. *[Fig 4]*

f. Obturation: After confirming the hardening of MTA, the rest of the canal was obturated with gutta-percha. *[Fig-5]*

3. Discussion

A rigorous and evidence-based strategy is necessary for the endodontic management of traumatized maxillary central incisors with root fractures, since they provide a unique set of problems. Clinicians must handle the difficulties of treating pulp necrosis while maintaining tooth integrity in this complex dental scenario. It becomes essential in this situation to have thorough awareness of modern endodontic principles and effective treatment techniques. The present discourse explores the intricate facets of endodontic therapy in cases of this nature, drawing upon pertinent literature and pivotal research to offer a comprehensive analysis of diagnostic techniques, treatment approaches, and the pivotal elements that contribute to favourable results.

The case study of a 44-year-old female patient who experienced dental trauma leading to a root fracture in the apical third of her maxillary central incisor provides a complex understanding of the difficulties and approaches to treating such injuries. The present review explores the results and the current case's treatment strategy, making connections with pertinent research and citing important studies along with their corresponding methods, processes, and conclusions.

Pulpal necrosis was diagnosed because of a thorough physical and radiographic evaluation in the present case. This diagnosis is in line with previous research done by Abbott PV (2019)[2], Bardini G et al. (2021)[7], and Bhaisare A et al. (2017)[3]. The aforementioned findings underscore the significance of thorough assessments in precisely identifying root fractures and related pulpal diseases. The diagnostic strategy emphasizes the need of having a complete grasp of clinical and radiographic findings, which is consistent with the ideas presented in these studies.

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The treatment method, which preserves the apical third of the root and proceeds with endodontic therapy, is consistent with the recommendations made by Sathyanarayanan K (2014)[9], Heydari A et al. (2019)[4], and Poi WR et al. (2002)[8]. These investigations highlight how crucial it is to preserve the broken area in order to properly treat pulpal pathology and preserve tooth integrity. The choice to keep the apical third is consistent with these results, supporting the idea that using this strategy can help patients with root fractures have positive outcomes.

The use of a 4 mm mineral trioxide aggregate (MTA) apical plug in the tooth that is asymptomatic is consistent with the findings of Shafie L et al. (2011)[11], who showed that MTA was effective in treating teeth that had horizontal root fractures. This is due to the sealing capability and biocompatibility of MTA that has become more and more common in endodontic operations, especially when root fractures are involved as was proposed by Torabinejad M et al. (999)[6] and Abbott PV et al. (2019)[2]. The selection of MTA is consistent with current procedures and is supported by the favorable results shown in the literature. Furthermore, using a calcium hydroxide medication for cleaning and healing aligns with guidelines from Rangareddy et al. (2013)[5] and Bhaisare et al. (2017)[3]. These findings support the use of calcium hydroxide as part of the treatment strategy in the case that is being reported by highlighting its critical function in periapical healing promotion and bacterial load reduction.

The protocols that are being used in the clinical procedures pulp chamber opening, working length determination, and biomechanical preparation are consistent with the standard features of endodontic therapy as reported by Heydari A et al. (2019)[4], Poi WR et al. (2002)[8], Aras MH et al. (2008)[12], Oztan MD et al. (2001)[13], and Cvek M (1974)[14], Polat-Ozsoy O et al. (2008)[15] and Demiriz L et al. (2016)[16]. These operations are essential for treating root fractures successfully, guaranteeing the elimination of necrotic tissue, and properly structuring the canal in preparation for further treatments.

In accordance with data reviewed by Krastl G et al. (2021)[10], the presence of blood filled mucinous intracanal exudate during pulp chamber opening may be suggestive of the traumatic character of the injury. This particular detail emphasizes how crucial clinical acumen is in spotting non-obvious clues that could reveal information about the type and intensity of the traumatic event. The general course of treatment, which included vigilantly watching the tooth until it stopped causing problems, aligns with ideas covered by Heydari A et al. (2019)[4]. This method stresses the value of close observation and guarantees that any new problems are dealt with immediately thus assuring the treatment's long-term success.

Additionally, it is normal endodontic procedure to obturate the canal with gutta-percha after verifying that MTA has hardened[8]. By guaranteeing the closing of the canal, this procedure helps to assure the overall success of the endodontic treatment by preventing microbial infiltration. The case that is being described is consistent with accepted endodontic principles and fits in with earlier research, which emphasizes the need of precise diagnosis, careful planning of therapy, and a customized strategy for treating root fractures in traumatized maxillary central incisors. The application of MTA, calcium hydroxide, and close observation is consistent with effective tactics used in comparable clinical situations that have been reported in the literature. The example highlights the difficulties in treating horizontal root fractures and the significance of an all-encompassing therapeutic strategy. It contributes significantly to the body of knowledge regarding successful treatment plans for fractured roots in traumatized maxillary central incisors. The efficacy of the therapy is consistent with current best practices, which emphasizes the importance of evidence-based approaches in endodontic care. Hence, this case highlights the successful treatment of a horizontal root fracture and emphasizes on the value of a methodical approach. By highlighting the need of continued research and therapeutic innovation in the field, it makes a substantial contribution to the ongoing discourse on optimal endodontic management.

Advantages and disadvantages

In the given root fracture example, the method of keeping the apical third of the root and using mineral trioxide aggregate (MTA) for apical sealing has certain benefits. MTA, well-known for its sealing

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abilities and biocompatibility, helps horizontal root fractures heal successfully[11]. Adequate periapical healing could be achieved by the application of calcium hydroxide, as was advised by Bhaisare A et al. (2017)[3] and Rangareddy MS et al. (2013)[5]. Notwithstanding these benefits, there could be drawbacks such as the intricacy of the process and the prolonged term of treatment linked to keeping an eye on the tooth until it stops exhibiting symptoms. In addition, the cost and availability of the materials might be factors. The present case study shows the efficacy of the selected technique and materials in treating traumatized maxillary central incisors with root fractures, as demonstrated by the remission of symptoms and functional restoration.

4. Conclusion

Therefore, the effectiveness of the endodontic therapy selected for a traumatized maxillary central incisor with a root fracture is well-accepted. The application of evidence-based techniques, such as keeping the apical third, adding calcium hydroxide, and using MTA, produced positive results by reducing symptoms and regaining functionality. By highlighting the significance of a thorough treatment to horizontal root fractures, this case adds to the body of knowledge. In the future, increasing treatment efficacy will need investigating cutting-edge materials and methods, with ongoing studies in innovative biomaterials and diagnostic approaches. The goal of standardized procedures for damaged teeth is to provide accurate and consistent results. To provide better patient results and long-term dental health, ongoing research and collaboration will improve the management of traumatized maxillary central incisors with root fractures.

Fig. 1 Ragiograph damaged tooth's apical third root fracture (IOPAR & CBCT)

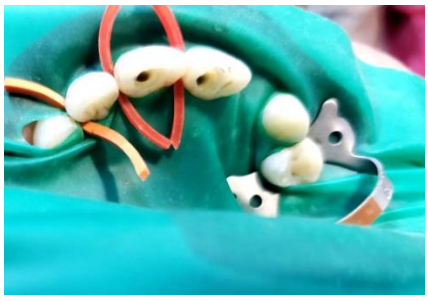

Fig 2- Pulp Chamber Opening

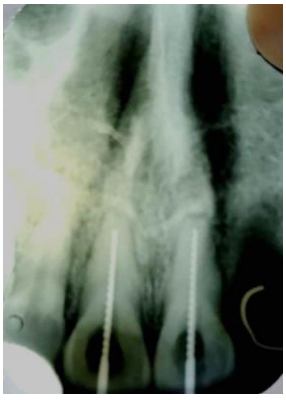

Fig 3 - Working Length Determination

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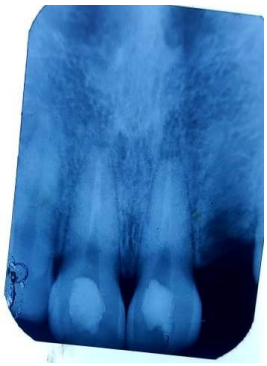

Fig 4 - MTA Apical Plug Placement

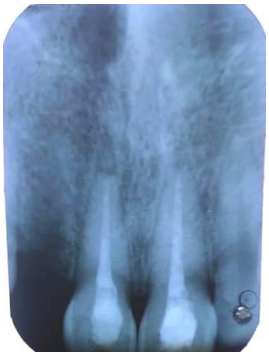

Fig 5 - Obturation

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