Case report

Management of Complicated Crown Fracture with Rapid Orthodontic Extrusion and Glass Fibre Post: A Case Report

ABSTRACT

Complicated crown fractures involving the pulp present significant challenges in dental trauma management, particularly when the fracture extends subgingivally. This case report describes a multidisciplinary treatment approach involving rapid orthodontic extrusion and glass fibre post placement for the restoration of a fractured maxillary lateral incisor. The treatment effectively repositions the fractured tooth structure, allowing for optimal restoration while maintaining the integrity of the natural tooth. This protocol highlights a minimally invasive, aesthetic, and functional solution for complex crown fractures.

1. INTRODUCTION

Complicated crown fractures involving the pulp account for a significant percentage of dental injuries, especially in children and young adults. The incidence of complicated crown fractures ranges from 2% to 13% of all dental injuries and the most commonly involved tooth is the maxillary central incisor.Management of these kinds of fractures necessitates a tailored approach, taking into account the severity of the fracture, the extent of remaining tooth structure, aesthetic requirements, and functional demands. An array of treatment strategies may be employed, including removal and restoration of the fractured segment, reattachment of the fractured fragment, gingivectomy and crown lengthening, orthodontic extrusion with or without gingivoplasty, and, in certain cases, extraction followed by prosthetic replacement with a fixed partial denture or dental implant(1).This case report demonstrates the successful management of a complicated crown fracture with a novel approach involving rapid orthodontic extrusion and reinforcement using a glass fibre post.

2. PRESENTATION OF CASE

A 28-year-old male patient reported to the department of Conservative Dentistry and Endodontics of Govt Dental College Kottayam with a history of trauma of front tooth 4 days back. Clinical examination showed complicated crown fracture with margins extending sub gingivally in relation to upper left lateral incisor. The fractured segment was lost and the tooth was negative to electric pulp test. The periodontal condition was normal, with no

abnormal mobility.Complete medical, dental and trauma history was taken. Periapical radiographs (PA) were taken at different angulations. PA radiograph revealed mature root and complicated crown fracture of maxillary left lateral incisor.

Treatment Plan:

The treatment plan involved three main phases:

1.Root Canal Therapy (RCT): The immediate priority was to manage the pulp exposure through endodontic treatment.

2.Rapid Orthodontic Extrusion: To manage the subgingival fracture line and allow adequate tooth structure for crown placement.

3.Glass Fibre Post Placement and Final Restoration: Reinforcement of the remaining tooth structure with a glass fibre post followed by a full-coverage crown.

Treatment Procedure

Root canal treatment was completed in a single visit. Pulp extirpation was performed, and the working length was determined using an electronic apex locator (J Morita Root ZX mini). Biomechanical preparation was done with ProTaper Gold files, enlarging the apex to F4. Since the canal was very wide, final refinement done with hand files and obturation using lateral condensation technique to ensure a dense, three dimensional fill of the canal followed by temporary restoration (3M ESPE Cavit ™ G). Four days later, peeso reamer (size 3) was utilized to remove coronal gutta percha, leaving a 5 mm apical seal intact.

Orthodontic extrusion was performed using a fixed appliance to re-establish the biological width. A 0.018- inch round stainless steel orthodontic wire (Konark ever bright dental stainless steel wire) was fixed with orthodontic brackets bonded to the labial surface of the maxillary left central incisor and maxillary left canine, at the incisal third, to provide the necessary anchorage for tooth movement. A 19 gauge stainless steel wire (Konark ever bright dental stainless steel wire) was bent to form a 2-mm diameter loop with a 4-mm radicular extension, which was further roughened with diamond disks to provide retention and was cemented with glass ionomer cement (GC Gold Label 1) in the coronal root canal third of the fractured tooth. Next, a 1/8 diameter orthodontic elastic was placed through the coronal loop and tied to the labial wire fixed between the neighbouring teeth. The elastic string was changed once a week. Orthodontic extrusion was terminated when a circumferential ferrule of 1 mm was achieved, which was in 45 days.

After obtaining adequate ferrule, the prefabricated glass fibre post was selected according to root canal width. A prefabricated glass fibre post of diameter 1.80 mm was cemented into the canal using dual curing resin cement. The fibre post provided additional support to the weakened tooth structure. Core buildup was completed using the Paracore system, followed by crown preparation. A porcelain jacket crown was fabricated and cemented onto the prepared tooth. Patient was put on follow up. At 12 months follow up there were complete absence of any signs and symptoms and with no radiographic changes.

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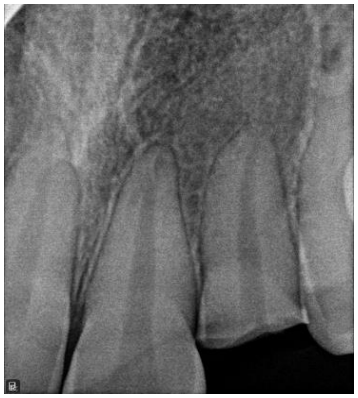

Fig.1 Preop Radiograph

Fig.2 Preop Clinical - Buccal View

Fig.3 Preop Clinical -Palatal View

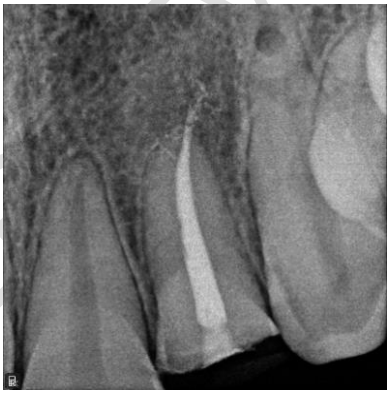

Fig.4 Radiograph - After RCT

Fig. 5 Orthodontic extrusion -After 1 month.

Fig. 6 After orthodontic extrusion (after 45 days)

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Fig. 7 After orthodontic extrusion – Palatal View

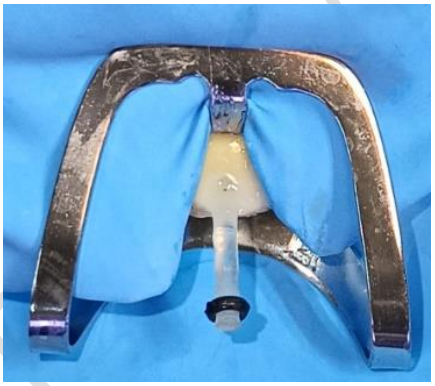

Fig. 8 Fibre post placement

Fig. 9 Crown preparation

Fig. 10 Post OP after crown placement

3. DISCUSSION

The successful functional and aesthetic management of complicated crown-root fractures largely depends on a multidisciplinary approach, involving surgery, endodontics, periodontics, and prosthodontics (2). Studies indicate that restoring teeth with crown-root fractures is often difficult, especially when the fracture extends below the bone level (3), as was the case in this instance.

Treatment of crown-root fractures requires individualized approaches considering fracture severity, tooth structure, aesthetics, and functional needs. The treatment option includes removal of fractured segment and restoration, reattachment of fractured fragment, gingivectomy and crown lengthening, orthodontic extrusion with/without gingivoplasty or even extraction followed by fixed partial denture or implant (1)

Given the patients' desire to preserve their teeth, rapid orthodontic extrusion and crown lengthening were chosen as treatment modalities. Crown lengthening procedures offer a viable solution to prevent disparities in bone levels and associated periodontal complications. However, this approach often necessitates surgical intervention, which may involve adjacent teeth, thereby presenting significant aesthetic challenges, particularly in the anterior region. Consequently, the application of crown lengthening procedures should be judiciously reserved for specific situations, such as cases involving posterior teeth, fractures with minimal depth, or instances where only a palatal gingivectomy and osteotomy are required (3)(4). Here, orthodontic extrusion was specifically chosen for its conservative approach, as it enables tooth retention, promotes restoration of periodontal attachment, and supports preservation of the alveolar bone (1).

This technique is deemed safe concerning the risk of root resorption if the forces are appropriately controlled and it does not compromise the periodontal support or bone tissue of adjacent teeth, thereby enhancing aesthetics. (5), (6), (7)

Additionally aesthetics is the primary concern in the anterior region, and orthodontic extrusion helps maintain the position of the gingiva. (8) However, rapid orthodontic extrusion has certain limitations, including the necessity for patient cooperation, (9) which is crucial since it requires an extended retention period for the stabilization of the periodontium in its new position. Additionally, there may be aesthetic concerns during the treatment process. The increased traction forces applied during rapid orthodontic extrusion also pose risks of root resorption or tooth ankylosis (10). In this case,1mm of tooth was extruded over a period of 45 days to prevent the above mentioned adverse effects.

In this case the use of a glass fibre post reinforced the remaining tooth structure, ensuring long-term stability of the restoration. Glass fiber posts offer several advantages over other types of posts, including superior flexural strength, ease of handling, suitability for high-stress areas, aesthetic appeal, and compatibility with various composites. (11)

Rigid posts with a high elastic modulus can create localized stress concentrations, leading to root fractures when subjected to force. In contrast, fiber posts, which closely mimic the

natural dentin structure, function as shock absorbers and help dissipate stress causing favourable restorable fractures (12).

Additionally, glass fiber posts are translucent and create a monoblock effect, bonding all components either directly or indirectly. This enhances the intra-radicular tooth structure, providing excellent transverse strength(12).
Due to their similar modulus of elasticity to dentin, fiber posts distribute stress more evenly, significantly lowering the risk of catastrophic root fractures that are often associated with cast posts(13).
In this case, orthodontic extrusion, combined with a glass fiber post, enabled the successful restoration of the severely compromised teeth.

4. CONCLUSION

The combination of rapid orthodontic extrusion and glass fibre post placement presents an effective and conservative strategy for managing complicated crown fractures. This multidisciplinary approach not only enhances functional and aesthetic outcomes but also prioritizes the preservation of the natural tooth structure. Additionally, the minimally invasive nature of this technique reduces the need for extensive surgical interventions, thereby promoting better patient comfort and satisfaction. Long-term follow-up is essential to assess the treatment's success, ensure the stability of the restoration, and monitor the health of the surrounding tissues. Future studies may further elucidate the benefits and limitations of this approach, contributing to improved protocols for managing dental trauma.

CONSENT

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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