DOI: https://doi.org/10.54361/LJMR.20.2.107

Libyan Journal of Medical Research

www.lmjr.ly/ eISSN: 2413-6096

Case Report

Management of Complicated Crown Fractures of Maxillary Central Incisors with Pulpal Involvement: A Case Report

Zohir Alaosta, Aihab Albaden, Rahma Alahresh, and Aseel Othman Mami
Department of Oral Pathology and Prosthodontics, Faculty of Dentistry, University of Zawia, Libya.
Corresponding Author, Zohir Alaosta: Email: z.alaoata@zu.edu.ly

Received:18-09-2026-***Accepted:*** 03-11-2026 -***Published:*** 14-11-2026

Abstract
Traumatic dental injuries frequently affect the maxillary central incisors and may result in complicated crown fractures involving pulp exposure. These injuries require prompt diagnosis and appropriate management to prevent pulpal and periapical complications while restoring the affected teeth's function and esthetics. This case report describes the management of traumatic complicated crown fractures involving both maxillary central incisors in a 10-year-old male patient following a fall. Clinical and radiographic examinations revealed enamel–dentin fractures with pulp exposure involving teeth 11 and 21. Radiographic assessment demonstrated completed root development with closed apices. Following clinical assessment and treatment planning, endodontic treatment was performed on both affected teeth. The root canals were prepared using a rotary instrumentation technique, irrigated with 2.5% sodium hypochlorite, and obturated with gutta-percha in combination with a bioceramic root canal sealer. Subsequently, the teeth were restored using direct adhesive composite resin to re-establish their anatomical form, function, and esthetic appearance.
The patient was followed up for six months to monitor the clinical and radiographic status of the treated teeth and the integrity of the restorations. [Insert the documented six-month clinical and radiographic findings.]
This case highlights the importance of early diagnosis, appropriate treatment selection, effective infection control, and adhesive restorative techniques in managing traumatic crown fractures of permanent anterior teeth. It also emphasises the importance of assessing root development and documenting the pulpal condition when selecting an appropriate treatment approach.
Keywords: Traumatic dental injury; Complicated crown fracture; Pulp exposure; Maxillary central incisors; Root canal treatment; Composite resin restoration.

Introduction

Dental trauma is a common clinical condition that primarily affects the anterior teeth, particularly the maxillary central incisors, due to their anterior position and increased exposure to external traumatic forces. Common causes of traumatic dental injuries include falls, sports-related accidents, and road traffic accidents, with a higher incidence reported among children and adolescents [1,2].

Complicated crown fractures are defined as fractures involving enamel and dentin with pulp exposure. These injuries may compromise the structural integrity, function, and esthetic appearance of the affected teeth. Furthermore, exposure of the dental pulp to the oral environment increases the risk of bacterial contamination, pulpal inflammation, and subsequent necrosis if appropriate treatment is not provided [1,3].

The management of complicated crown fractures depends on several clinical factors, including the patient's age, the size and duration of pulp exposure, the pulpal condition, and the stage of root development. According to the International Association of Dental Traumatology (IADT) guidelines, vital pulp therapy, particularly partial pulpotomy, is generally recommended for complicated crown fractures in permanent teeth when preservation of pulp vitality is feasible. This approach is especially important in immature permanent teeth because maintaining pulp vitality allows continued root development and apexogenesis [4].

However, when the pulp cannot be preserved because of its clinical condition or other treatment-related considerations, root canal treatment may be indicated. In teeth with completed root development, conventional root canal treatment may be considered when the clinical diagnosis and treatment indications support this approach [4].

This case report describes the endodontic and restorative management of traumatic complicated crown fractures involving both maxillary central incisors in a 10-year-old patient. Particular attention is given to the clinical presentation, endodontic procedures, and adhesive restorative rehabilitation of the traumatised teeth.

Case Presentation

A 10-year-old male patient presented to the dental clinic shortly after sustaining trauma to the maxillary anterior teeth following a fall while playing. The patient reported pain and fractures involving the upper front teeth. The injury had occurred a few hours before presentation.

The patient's medical history was non-contributory, with no reported systemic diseases, medication use, allergies, or previous traumatic dental injuries.

Clinical Examination

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Extraoral examination revealed no facial swelling, asymmetry, lacerations, or other associated soft tissue injuries. No abnormalities were detected on palpation of the facial structures.

Intraoral examination revealed traumatic crown fractures involving both maxillary central incisors (teeth 11 and 21). Both teeth exhibited enamel–dentin fractures with visible pulp exposure, consistent with complicated crown fractures.

The affected teeth were tender to percussion and exhibited slight mobility. The surrounding gingival and oral soft tissues were intact, with no evidence of associated lacerations or contusions.

Preoperative pulp sensibility tests, including cold testing and electric pulp testing, were not performed. Therefore, the pulpal status could not be established through sensibility testing before treatment.

Radiographic Examination

Periapical radiographs were obtained to evaluate the extent of the traumatic injuries and assess the condition of the affected teeth and surrounding supporting structures.

Radiographic examination revealed no evidence of root fractures, alveolar bone fractures, or periapical pathology. The periodontal ligament spaces were reported to be within normal limits, with no obvious radiographic signs of associated luxation injuries.

Both maxillary central incisors demonstrated completed root development with closed apices. No additional radiographic abnormalities were identified.

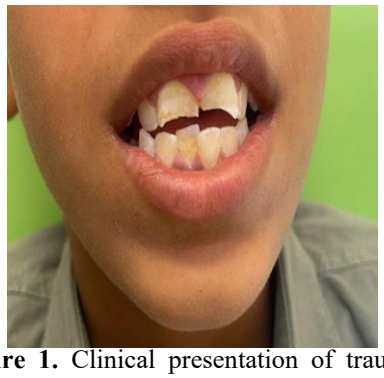


Figure 1. Clinical presentation of traumatic fractures involving the maxillary central incisors.

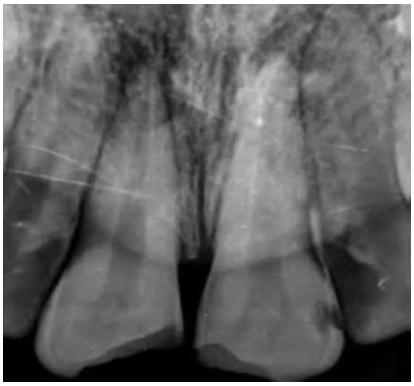


Figure 2. Preoperative periapical radiograph showing the traumatic crown fractures involving teeth 11 and 21.

Diagnosis

Based on the clinical and radiographic findings, the patient was diagnosed with traumatic complicated crown fractures of the maxillary central incisors (teeth 11 and 21), characterized by enamel–dentin fractures with pulp exposure.

Both teeth demonstrated closed apices radiographically. No associated root fractures, alveolar bone injuries, or radiographically detectable periapical pathology were identified.

A definitive preoperative pulpal diagnosis could not be established because pulp sensibility tests were not performed.

Treatment Procedure

Following comprehensive clinical and radiographic evaluation, a treatment plan was formulated to manage the complicated crown fractures involving teeth 11 and 21.

Before treatment, informed consent was obtained from the patient's parent or legal guardian after explaining the proposed procedures, potential risks, benefits, and alternative treatment options.

Endodontic Treatment

1. Local anaesthesia was administered to ensure adequate analgesia. The operative field was isolated using a rubber dam to maintain aseptic conditions, provide effective moisture control, and improve procedural visibility.
2. Endodontic access cavities were prepared in both maxillary central incisors under copious water irrigation. The coronal pulp tissue was removed, and the working length of each root canal was determined using an electronic apex locator and subsequently confirmed radiographically.
3. Chemomechanical preparation of the root canals was performed using a rotary instrumentation system. Sodium hypochlorite solution at a concentration of 2.5% was used as the primary irrigation solution throughout instrumentation. Normal saline was subsequently used as a final rinse to assist in the removal of residual irrigant and debris.
4. Following completion of canal preparation, the root canals were dried using sterile paper points. Obturation was performed using gutta-percha cones in combination with a bioceramic root canal sealer, employing the lateral condensation technique.

   The quality of the obturation was assessed radiographically to evaluate the length, density, and homogeneity of the root canal filling.

Definitive Coronal Restoration

5. Following completion of root canal treatment, definitive coronal restoration was performed using direct composite resin. The tooth surfaces were etched and treated with an adhesive bonding system according to the manufacturer's instructions.

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6. Composite resin was applied incrementally and light-cured to reproduce the original anatomical contour and restore the function and esthetic appearance of the maxillary central incisors.
7. Following restoration, occlusion was evaluated using articulating paper. Any premature or traumatic occlusal contacts were identified and adjusted to ensure appropriate occlusal harmony and patient comfort.
8. The composite restorations were subsequently finished and polished to achieve a smooth surface texture and satisfactory esthetic appearance. Final inspection was performed to assess restoration integrity, marginal adaptation, and occlusal contacts.



Figure 3. Postoperative periapical radiograph demonstrating the completed root canal obturation of teeth 11 and 21.



Figure 4. Clinical appearance of the maxillary central incisors following endodontic treatment and before definitive composite restoration.



Figure 5. Final clinical appearance following direct composite resin restoration of the maxillary central incisors.

Follow-up

The patient was followed up for a period of six months following completion of endodontic treatment and definitive coronal restoration.

Clinical and radiographic examinations were intended to assess the condition of the treated teeth, the integrity of the composite restorations, and the status of the periapical tissues.

[Insert the actual six-month findings, including the presence or absence of pain, tenderness to percussion, swelling, sinus tract, mobility, restoration failure, and any radiographic evidence of periapical changes or root resorption.]

Discussion

Traumatic dental injuries are frequently encountered in children and adolescents, with the maxillary central incisors being the most commonly affected teeth due to their anterior position and increased exposure to external forces. Falls are among the common etiological factors associated with these injuries, particularly in younger individuals [1,2].

Complicated crown fractures involving pulp exposure require prompt diagnosis and appropriate management to minimise bacterial contamination, preserve tooth structure, and prevent subsequent pulpal and periapical complications.

The selection of an appropriate treatment approach depends on several factors, including the patient's age, the extent of pulp exposure, the time elapsed since injury, the pulpal condition, and the stage of root development.

According to the IADT guidelines, vital pulp therapy, particularly partial pulpotomy, is generally considered the preferred approach for complicated crown fractures in permanent teeth when the pulp is suitable for preservation. This is particularly important in immature permanent teeth because maintaining pulp vitality promotes continued root development, apical closure, and increased root wall thickness [4].

In the present case, complete root canal treatment was performed on both maxillary central incisors. Radiographic examination demonstrated completed root development with closed apices. This finding is relevant to treatment planning because the teeth did not require further root maturation. Nevertheless, the presence of closed apices alone does not establish an indication for complete root canal treatment.

An important limitation of this case is that preoperative pulp sensibility tests were not performed. Consequently, the preoperative pulpal condition could not be definitively established, and the decision to perform complete root canal treatment cannot be retrospectively justified by a documented diagnosis of irreversible pulpitis or pulp necrosis.

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The authors acknowledge that vital pulp therapy, particularly partial pulpotomy, should be considered in cases of complicated crown fractures when preservation of pulp vitality is clinically feasible. Therefore, the clinical rationale for selecting complete root canal treatment should be clearly documented and interpreted in light of the clinical findings available at the time of treatment.

The use of rubber dam isolation during endodontic treatment is an important factor in maintaining aseptic conditions and minimising microbial contamination. Effective chemomechanical preparation using 2.5% sodium hypochlorite irrigation, appropriate canal preparation, and adequate root canal obturation are also essential components of endodontic treatment.

For coronal rehabilitation, direct composite resin was selected because of its favorable esthetic properties, conservative preparation requirements, and ability to bond effectively to enamel and dentin. The incremental layering technique allows anatomical reconstruction while helping to control polymerisation shrinkage stresses.

Furthermore, adhesive restorative techniques are particularly beneficial in young patients because they facilitate preservation of remaining healthy tooth structure while restoring the functional and esthetic characteristics of traumatised anterior teeth.

Regular clinical and radiographic follow-up is essential following traumatic dental injuries and endodontic treatment. Periodic assessment allows early identification of possible complications, including periapical inflammation, inflammatory or replacement root resorption, and restorative failure. In this case, a six-month follow-up period was established to assess the clinical and radiographic status of the treated teeth.

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Overall, the management of complicated crown fractures requires an individualized and evidence-based approach. Treatment selection should be guided by the pulpal condition and stage of root development, with preservation of pulp vitality remaining an important objective whenever clinically feasible.

Conclusion

Complicated crown fractures of permanent maxillary central incisors involving pulp exposure require prompt diagnosis and carefully planned treatment to achieve favorable functional and esthetic outcomes.

In this case, endodontic treatment followed by direct adhesive composite resin restoration was performed to manage the traumatic injuries involving both maxillary central incisors. The teeth demonstrated completed root development with closed apices radiographically.

The case emphasizes the importance of accurate pulpal diagnosis, assessment of root development, appropriate treatment selection, and effective infection control. In young patients, conservative vital pulp therapy should be considered whenever feasible to preserve pulp vitality and support continued root development.

Furthermore, regular clinical and radiographic follow-up is essential to assess treatment outcomes, detect potential complications, and establish the long-term prognosis of traumatized permanent teeth.

Ethical Considerations

Written informed consent for publication of the clinical information, photographs, and radiographs was obtained from the patient's parent or legal guardian.

The patient's identifying information has been removed from the manuscript to maintain confidentiality.