



Conservative Management of a Complicated Crown-Root Fracture with Partial Pulpotomy and Fragment Reattachment: Long Term Follow-Up Case Report

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Abstract

Complicated crown fractures in immature permanent teeth present significant functional and esthetic challenges, particularly when accompanied by pulpal exposure and a mobile coronal fragment. This case describes the management of a 10-year-old systemically healthy male patient who presented with a complicated crown-root fracture of the left maxillary central incisor following trauma. The patient attended our clinic three days after injury. Clinical and radiographic examination revealed a crown-root fracture with subgingival extension; the mesial coronal fragment was mobile and subsequently removed, after which pulpal exposure was identified. A partial pulpotomy (Cvek pulpotomy) was performed to preserve pulp vitality. The original fragment was reattached using an adhesive protocol, and the coronal defect was restored with composite resin to achieve functional and esthetic rehabilitation. The tooth was followed clinically and radiographically for 32 months, remaining asymptomatic with a positive vitality response and no radiographic evidence of periapical pathology. Both the reattached fragment and composite restoration maintained stable structural and esthetic integrity throughout the follow-up period. This case suggests that the combination of partial pulpotomy and fragment reattachment may represent a minimally invasive and reliable treatment option for complicated crown-root fractures in young permanent teeth, supporting long-term pulp vitality and favorable esthetic and functional outcomes.

Keywords: Complicated crown-root fracture; Fragment reattachment; Partial pulpotomy

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Introduction

Dental trauma is commonly observed in children and adolescents, with anterior maxillary teeth being particularly susceptible due to their position in the dental arch. Complicated crown-root fractures involving enamel, dentin, and pulp exposure are among the most severe traumatic injuries, as they may compromise both esthetics and pulpal integrity. In immature permanent teeth, preservation of pulp vitality is essential for continued root development and long-term tooth survival [1,2].

Management of exposed immature permanent teeth is primarily aimed at maintaining pulp vitality. Partial pulpotomy (Cvek pulpotomy) is a conservative vital pulp therapy in which the superficially inflamed pulp tissue is removed while healthy pulp is preserved, allowing continued root maturation and apexogenesis. When properly indicated, it demonstrates high clinical and radiographic success rates [3,4].

The clinical success of partial pulpotomy is influenced by multiple factors, including appropriate case selection, effective control of pulpal bleeding, and the application of bioactive pulp-capping materials. Although calcium hydroxide has been traditionally used in vital pulp therapy, modern biomaterials such as Mineral Trioxide Aggregate (MTA) are now more commonly preferred due to their enhanced sealing ability, biocompatibility, and capacity to induce hard tissue formation [5,6].

Fragment reattachment is a conservative treatment option for crown-root fractures that enables restoration of the original tooth structure with minimal intervention while preserving esthetic and functional characteristics. Advances in adhesive systems have increased its predictability, and the use of the patient's own fragment also offers psychological benefits in young patients [7].

This case report describes the conservative management of a complicated crown-root fracture

in the left maxillary central incisor of an immature permanent tooth, treated with partial pulpotomy and fragment reattachment, with a successful clinical and radiographic outcome after 32 months of follow-up.

Case Presentation

A 10-year-old systemically healthy male patient was referred to our clinic following bicycle-related trauma involving the anterior maxillary region. Medical history was non-contributory, and no soft tissue injuries were detected during clinical examination.

Intraoral examination revealed a fragmented crown-root fracture of the left maxillary central incisor (Figure 1 and 2). The mesial coronal fragment was mobile, and a composite material applied at a previous dental visit was observed on the tooth surface. Radiographic examination confirmed the fracture configuration without periapical pathology (Figure 3). Informed consent was obtained from the patient's legal guardian for publication of clinical and radiographic images.

Following topical anesthesia with lidocaine spray, infiltration anesthesia was administered using articaine. Due to the fracture morphology and clinical limitations associated with the traumatic



Figure 1: Initial intraoral frontal view showing a crown fracture line in the maxillary anterior tooth with displacement of the coronal fragment.



Figure 2: Initial intraoral occlusal view showing the extent of the crown-root fracture line.



Figure 3: Initial periapical radiograph showing the fracture line extending subgingivally with no evidence of periapical pathology.



Figure 4: Clinical view after partial pulpotomy showing application of white mineral trioxide aggregate (MTA) over the exposed pulp tissue.



Figure 5: Postoperative intraoral view demonstrating reattachment of the original tooth fragment using an adhesive protocol and composite resin restoration.



Figure 6: Postoperative periapical radiograph showing adequate adaptation of the restoration immediately after treatment.

presentation, rubber dam isolation was not feasible.

The mobile mesial fragment was carefully removed using forceps and immediately preserved in sterile saline-moistened gauze to prevent dehydration. After removal of the mobile mesial fragment, pulpal exposure was detected and the fracture line extended subgingivally through the root. Approximately 2 mm to 3 mm of superficially inflamed pulp tissue was gently removed using a sterile round bur under copious irrigation to obtain a clean and healthy pulpal wound surface. A partial pulpotomy (Cvek technique) was then performed. The remaining exposed pulp tissue was covered with white Mineral Trioxide Aggregate (MTA), as shown in Figure 4. Subsequently, the MTA layer was sealed with resin-modified glass ionomer cement to ensure adequate sealing and proper setting conditions.

After completion of pulpal therapy, the internal surface of the original fragment was etched with 37% phosphoric acid for 15 seconds, rinsed thoroughly, and prepared according to the adhesive protocol. The original fragment was then repositioned and reattached using a universal adhesive system under LED light-curing. The



Figure 7: 3-month follow-up periapical radiograph.



Figure 8: 6-month follow-up periapical radiograph.



Figure 9: 1-year follow-up periapical radiograph.

procedure outcome is shown in Figure 5 and Figure 6. Final coronal reconstruction and contouring were completed with composite resin to restore optimal esthetics, function, and anatomical form.

The patient was placed under a structured follow-up protocol, including clinical examinations, periapical radiographs, and pulp sensibility testing with the cold test at regular intervals. Radiographic follow-up at 3 months, 6 months, and 1 year is shown in Figures 7-9. At the 1-year follow-up, the tooth was asymptomatic, responded positively to vitality testing, and radiographically demonstrated complete apical closure. Long-term follow-up at 32 months (Figures 10-11) confirmed continued absence of symptoms, a positive vitality response, and no radiographic evidence of periapical pathology. Both the reattached fragment and composite restoration remained stable in terms of esthetic and functional integrity throughout the observation period.

Discussion

Traumatic dental injuries are commonly encountered in clinical dental practice. In permanent dentition, the majority of these injuries involve the maxillary central and lateral incisors. They are most



Figure 10: Follow-up intraoral view at 32 months demonstrating stable esthetic and functional outcomes of the restored tooth.



Figure 11: Follow-up periapical radiograph at 32 months showing maintained periapical health and absence of pathological changes.

frequently observed in children and young adolescents with immature permanent teeth, typically between the ages of 6 and 12. When the spectrum of traumatic dental injuries is considered, crown fractures with or without pulp exposure are reported to be the most common type, accounting for 26.2% to 44.1% of all dental traumatic injuries. In contrast, crown-root fractures with or without pulp exposure are among the least frequent types of dental trauma, with a reported prevalence ranging from 0.56% to 1.1% [8-10]. Therefore, the present case is clinically significant, as it demonstrates that a conservative treatment approach may allow long-term preservation of pulp vitality and favorable restorative outcomes even in a relatively uncommon complicated crown-root fracture involving pulpal exposure and subgingival extension in an immature permanent tooth.

Although vital pulp therapy is commonly used in combination with fragment reattachment in complicated crown fractures, its use in complicated crown-root fractures remains relatively limited. In most reported crown-root fracture cases, fragment reattachment has been performed following root canal treatment and post placement, particularly when the fracture margin extends subgingivally [11-13]. In a similar case report involving a complicated crown-root fracture in an immature permanent incisor, partial pulpotomy and adhesive fragment reattachment were successfully performed after mucoperiosteal flap reflection and rubber dam isolation [11]. Unlike that case, rubber dam isolation was not feasible in the present case due to the fracture morphology and clinical limitations; nevertheless, favorable clinical and radiographic outcomes were maintained throughout the 32-month follow-up period.

When multiple traumatic forces act on the same tooth, the extent of tissue damage tends to increase due to a combined or synergistic effect, especially in the presence of luxation injuries [2]. However, in the present case, the injury was limited to an isolated complicated crown-root fracture without any associated periodontal or soft tissue involvement, which may have contributed to a more favorable

prognosis.

Cvek pulpotomy aims to remove the superficially inflamed pulp tissue while preserving the underlying healthy pulp free of significant inflammatory changes. Experimental studies have shown that inflammation in exposed pulps is initially minimal and remains confined to the coronal 2 mm to 3 mm of the pulp even up to 7 days after injury [14-16]. Based on this biological response, removal of the affected superficial tissue may allow preservation of a vital and functional pulp [17]. This biological pattern supports a conservative approach aimed at preserving vitality rather than complete pulp removal [14]. In the present case, treatment was initiated three days after trauma, and clinical findings confirmed pulp vitality, allowing a partial pulpotomy to be performed under appropriate conditions.

Adhesive fragment reattachment is a conservative restorative procedure based on bonding the fractured fragment back to its original position [11]. Reusing the patient's own tooth fragment provides an immediate restoration of natural morphology, translucency and occlusion. It also reduces treatment time and offers psychological advantages, particularly in young patients [18]. Being a minimally invasive and cost-effective approach, fragment reattachment enables rapid recovery of function, aesthetics, and phonetics [19]. With the development of modern adhesive systems, the reported success rate of adhesive reattachment in crown fractures has increased from 55% to 84% to 93% after a 2-year follow-up [13,20,21]. In crown-root fractures, however, the reported success rate appears to be lower than that observed in crown fractures, reaching 56.4% over a 9.5-year period, likely due to factors such as subgingival fracture extension, limited isolation, and reduced adhesive accessibility [22]. In the present case, despite the subgingival extension of the fracture line and the inability to achieve rubber dam isolation, the original fragment was successfully reattached using a universal adhesive system, and stable esthetic and functional outcomes were maintained throughout the 32-month follow-up period.

Despite the favorable outcome, it should be noted that traumatic dental injuries require careful long-term monitoring. Pulpal status after trauma is not always stable, and complications such as necrosis or resorption may develop over time [2]. Similarly, adhesive fragment reattachment may be associated with potential failures such as debonding or marginal discoloration [23]. For these reasons, periodic clinical and radiographic follow-up, along with vitality testing, remains essential in such cases.

The combined use of partial pulpotomy and adhesive fragment reattachment resulted in a favorable conservative outcome over a 32-month follow-up. Preservation of pulp vitality should be prioritized in immature permanent teeth whenever possible, as it supports continued root development and long-term structural integrity. This case suggests that a biologically based conservative approach may be a viable option for carefully selected complicated crown-root fractures involving pulpal exposure and subgingival extension, even in situations where rubber dam isolation cannot be achieved; however, the findings are limited to a single case.

Conclusion

This case highlights the successful conservative management of a complicated crown-root fracture with pulpal exposure and subgingival extension in an immature permanent tooth. Partial pulpotomy combined with adhesive fragment reattachment enabled preservation of pulp vitality, continued root development, and stable

esthetic and functional outcomes over a 32-month follow-up. Despite clinical challenges such as subgingival extension and isolation difficulties, this biologically based approach may be a viable option in carefully selected cases. Long-term clinical and radiographic follow-up remains essential to monitor pulpal and periodontal status as well as restoration stability.

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