Formosa Journal of Multidisciplinary Research (FJMR)
Vol. 5 No. 5, 2026: 1387-1398

Case Report: Management of Fractures in Anterior Teeth among Adolescents

Ratih Delio Rakhmadian[1*], Meidi Kurnia Ariani[2], Musthika Jathiasih[3]
Department of Conservative Dentistry, Faculty of Dentistry, Jember University
Corresponding Author: Ratih Delio Rakhmadian ratih.delio@gmail.com

ARTICLEINFO
Keywords: Fracture of Anterior Teeth, Pulp Necrosis, Endodontic Therapy, Fiber Post Restoration, Porcelain-Fused-To-Metal Crown

Received : 29, March
Revised : 30, April
Accepted: 23, May

ABSTRACT
The occurrence of fractures in permanent anterior teeth among adolescents, resulting from trauma, can lead to both aesthetic and functional deficits, as well as complications involving the pulp if not addressed in a timely manner. This case report examines the management of a maxillary left lateral incisor in a 13-year-old female patient who experienced a crown fracture due to a fall three years prior. A clinical assessment indicated a fracture extending through the enamel and dentin, with only the cervical third of the crown remaining intact. Tests for vitality and cavity responses returned negative results, while radiographic analysis indicated involvement of the pulp chamber and widening of the periodontal ligament. The diagnosis for the maxillary left lateral incisor was established as pulp necrosis accompanied by asymptomatic apical periodontitis. The treatment protocol included performing a root canal therapy followed by the insertion of a fiber post, a composite core build-up, and concluding with the placement of a porcelain fused-to-metal (PFM) crown. This treatment underscores the efficacy of a well-executed endodontic and restorative approach in preserving traumatized teeth, thereby restoring function and enhancing aesthetics in adolescent patients.

INTRODUCTION

Traumatic injuries resulting from impact or pressure can inflict damage on bodily tissues. Injuries to the head and face frequently lead to harm to the teeth and gums, manifesting in various forms such as avulsions, luxations, and fractures. Tooth fractures occur when the hard tissue of a tooth cracks or breaks, predominantly affecting the maxillary anterior teeth in adolescents. This prevalence is attributed to the protruding position of these teeth, rendering them particularly susceptible to impact or excessive force. The intensity of the impact, along with undue pressure, can result in fractures affecting the enamel or dentin, including crown fractures, crown and root fractures, root fractures, tooth luxations, and possible tooth avulsions. Fractures that compromise the hard tissue of the tooth, whether involving the crown or the root, lead to damage of the dental pulp. Such damage may result in varying outcomes: the pulp may remain viable and heal, may die instantaneously, or may progressively degenerate before ultimately ceasing to be vital. When the dental pulp is damaged to the extent that it becomes non vital, the tooth fracture is classified as an Ellis Class IV fracture.

In adolescents, Ellis Class IV fractures necessitate comprehensive treatment strategies. Treatment modalities encompass root canal therapy, succeeded by crown restoration. The objective of root canal therapy for fractured teeth is to maintain the tooth within the oral cavity for as prolonged a period as feasible while excising necrotic tissue located within the root canal, which is a consequence of trauma. This treatment entails shaping the root canal in preparation for the insertion of filling materials and ensuring the entire root canal system is sealed. Proper sealing of the root canal system is essential to avert the accumulation of residual fluids in the tissue and eliminate the formation of a culture medium for microorganisms.

The effectiveness of the root canal treatment significantly influences the overall prognosis for successful treatment outcomes. This process commences with a thorough diagnosis, followed by the formulation of a suitable treatment plan and the selection of appropriate materials for the procedure. Following root canal therapy, a fiber post is positioned to enhance retention, and the final restoration is completed by cementing a porcelain-fused-to-metal crown. This case report examines the management of a fractured anterior tooth in the permanent maxillary left lateral incisor of a 13-year-old patient diagnosed with an Ellis Class IV fracture.

LITERATURE REVIEW

A 13-year-old female patient presented at the Jember University Dental Hospital, accompanied by her parents, with a primary concern regarding a fractured maxillary left lateral incisor. This injury had occurred three years prior as a result of a fall, during which the patient experienced intermittent spontaneous pain that had since resolved by the time of her visit. The patient expressed feelings of insecurity regarding the affected tooth and requested treatment. Oral hygiene assessment, based on the debris index and calculus index, was found to be satisfactory. Clinical examination revealed normal

gingiva characterized by a coral pink, stippling, and a normal texture. Inspection of the maxillary left lateral incisor indicated a fracture that affected both the enamel and dentin, leaving only the cervical third of the tooth intact (Figure 1). A thermal vitality test using chloroethyl on tooth 36 yielded a negative response, suggesting the tooth was nonvital. This was followed by a palatal cavity test which also returned negative results, and a needle test demonstrated the ability of the needle to penetrate 18 mm into the root canal. Further evaluation included radiographic imaging, which displayed significant hard tissue loss extending to the pulp chamber and widening of the periodontal ligament adjacent to the root (Figure 1). The diagnosis established for the maxillary left lateral incisor was pulp necrosis accompanied by asymptomatic apical periodontitis. The proposed treatment plan involved performing root canal therapy, followed by the placement of a post and crown. The prognosis for the patient was deemed favorable.

Figure 1. Documentation of the clinical condition and dental radiographs upon the Patient's initial examination.

The treatment was conducted over the course of four visits, culminating in the successful placement of the crown. Initially, both subjective and objective assessments were performed alongside comprehensive documentation, leading to an established diagnosis and treatment plan. The patient was thoroughly informed about the procedure, associated costs, and timeline. Upon confirming the patient, understanding and agreement, informed consent was obtained. The subsequent phase involved executing root canal treatment under aseptic conditions with an isolated working area. This included the removal of carious tissue, locating the canal orifice, determining the working length, preparing the root canal, sterilizing it, and ultimately obturating the canal. The removal of carious tissue was accomplished using an excavator and a round metal bur, after which the cavity walls were shaped appropriately to align with the tooth's anatomy utilizing a fissure-shaped diamond bur. Once the orifice was located using a smooth broach, further debridement was performed with a barbed broach, followed by irrigation of the root canal with 2.5% NaOCl.

The working length was measured with a radiograph and verified with an electronic apex locator, resulting in an estimated length of 19 mm after accounting for radiographic distortion. A #15 K-file was then introduced into the

root canal with a working length of 18 mm, and following additional radiographic assessment, a consistent working length of 18 mm was confirmed. Root canal preparation was carried out using the step-back technique with K-files (Sybron Endo) with a taper of 0.2. The preparation commenced from the apical section and proceeded to the Master Apical File (MAF) in accordance with the established working length. K-files numbered #10, #15, #20, #25, #30, #35, and #40 were inserted along a working length of 19 mm. Root canal preparation was executed through a combination of filing, reaming, and watch-winding movements, with irrigation using 2.5% NaOCl following each file change. The MAF was determined to be #40.

Preparation continued with K-files #45 (working length 18 mm), #50 (17 mm), and #55 (16 mm). Final preparation utilized K- files #60 and #70 (working length 16 mm) with circumferential filing motion to achieve smooth root canal walls. Subsequently, a trial photograph was taken utilizing a No. 40 gutta-percha according to the predetermined working length, and this was confirmed via periapical radiography to ascertain the correct apical position (Figure 2). Upon completion of root canal preparation, the canal was irrigated with 5 ml of 2.5% NaOCl solution for approximately five minutes, followed by 1 minute of 17% EDTA solution (Smear Clear, SybronEndo), and then disinfected with 2% chlorhexidine digluconate (Cavity Cleanser, Bisco) for 30 seconds. Aquadest solution was utilized as an intermediary rinse. The root canal was dried with paper points before introducing calcium hydroxide (Calplus, Prevest Denpro) into the canal. The cavity was subsequently sealed with a temporary filling (Caviton, GC).

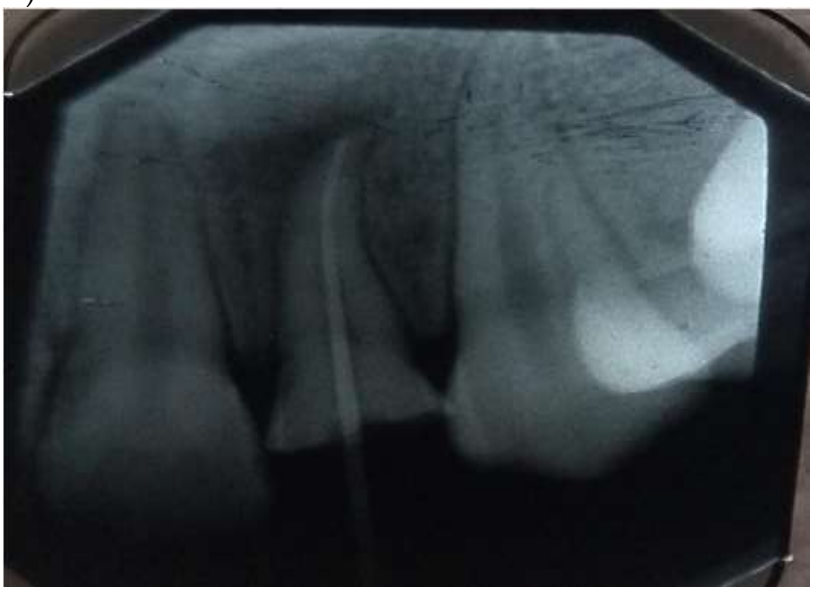

Figure 2. Image depicting the gutta-percha trial conducted following root canal preparation via the step-back technique.

During the subsequent visit, an intraoral examination confirmed the integrity of the temporary filling. Negative results were obtained from percussion and pressure tests, and there were no signs of swelling, erythema, or fistula formation. Examination of the paper points indicated a dry, colorless, and odorless root canal. The root canal was meticulously dried with sterile paper

points until the entirety of the working length was dry and clean. A master cone was selected in accordance with the final file size at the apical working length, followed by the application of a thin layer of endodontic sealer to the root canal walls. Obturating was conducted employing the lateral condensation technique in conjunction with additional gutta-percha. Any excess gutta-percha was trimmed below the orifice of the root canal. A periapical radiograph confirmed a dense, homogeneous filling without voids and adequate filling margins. The cavity was sealed with glass ionomer cement (GIC) to mitigate the risk of coronal leakage prior to the placement of the post and crown (Figure 3).

Figure 3. Image showcasing the obturation.

Four months after the endodontic treatment, the canal was prepared for fiber post insertion. The post working length was determined to be two-thirds of the root length, preserving approximately 4-5 mm of apical gutta-percha. The gutta-percha was carefully removed using Gates Glidden drills No. 1-3 up to the established working length of the post (15 mm), with repeated irrigation utilizing distilled water. The canal was then enlarged using a Peso reamer and K-files appropriate to the chosen fiber post system, ensuring that the diameter of the post canal did not exceed one-third of the root diameter. A trial insertion of fiber post No. 1 was performed to confirm proper adaptation and stability, which was further verified through periapical radiography.

Figure 4. Image showcasing the post-canal enlargement phase and the subsequent trial within the root canal.

The fiber post was affixed utilizing an adhesive resin system, commencing with the isolation of the treatment area, subsequent irrigation of the root canal

with distilled water, and drying with paper points. An etching procedure employing 37% phosphoric acid was conducted on both the pulp chamber and clinical crown for a duration of 15 seconds, followed by thorough rinsing and drying. Subsequently, bonding agents were applied to the root canal, crown, and post, and the area was subjected to light curing. Resin cement was introduced into the root canal using a lentulo instrument and applied to the fiber post. The post was then inserted, with any excess material being trimmed away before light curing until it reached a hardened state.

A core was constructed utilizing a packable A3 composite, contoured to align with the anatomical features of the tooth, and light-cured for 20 seconds. Once the core had hardened, the tooth was prepared for the porcelain-fused-to-metal (PFM) crown. Preparation of the crown involved reducing the labial, proximal, and palatal sections by approximately 1.5 mm and the incisal portion by 2 mm (refer to Figure 5). The final preparation was chamfered supragingivally, and the smoothness and finish were verified using a probe. Occlusion was assessed to evaluate the available space for the thickness of the jacket crown, followed by the finishing and polishing processes.

Figure 5. Image illustrating the preparation and formation of the core.

A double impression was then obtained using an elastomer through a one-step technique. After the patient's oral cavity was properly molded, a temporary crown was installed. The working model was filled with type III plaster stone and dispatched to the laboratory for the fabrication of the PFM crown. The operator and patient jointly selected the tooth shade for the jacket crown utilizing the Vitapan Shade Guide, ultimately deciding on shade A3.5 (see Figure 6).

Figure 6. Image capturing the color matching process utilizing a shade guide.

During a follow-up visit, try-in and cementation of the definitive PFM jacket crown were conducted on the maxillary left lateral incisor. Both subjective and objective examinations indicated no complaints, normal supporting tissues, and an intact temporary crown. After the removal of the temporary crown, a try-in of the PFM crown was carried out to assess occlusion, marginal fit, and aesthetic contour, all of which yielded satisfactory results. Final cementation was executed using glass ionomer cement (GIC) type I at a 1:1 powder-to-liquid ratio. The crown was accurately positioned, excess cement eliminated, and occlusion confirmed with the assistance of articulating paper (refer to Figure 7). At the conclusion of the visit, the patient received post-procedure instructions regarding oral hygiene practices, specifically advising against biting hard foods with the affected tooth and recommending rinsing with mineral water after the consumption of colored foods or beverages.

Figure 7. Image taken after the placement of the crown on the maxillary left lateral incisor.

METHODOLOGY

This study employed a case report method aimed at describing in detail the management of anterior tooth fracture in an adolescent patient. The subject

of this study was a 13-year-old female patient who experienced a fracture of the maxillary left lateral incisor due to a fall three years prior.

The research process began with subjective and objective examinations, including anamnesis, clinical examination, vitality testing, and radiographic evaluation to establish the diagnosis. Based on the findings, the patient was diagnosed with pulp necrosis accompanied by asymptomatic apical periodontitis.

The treatment procedures were carried out in several stages:

1. Root canal treatment using the step-back technique with K-files, accompanied by irrigation with NaOCl, EDTA, and chlorhexidine.
2. Root canal obturation using the lateral condensation technique.
3. Fiber post placement to improve restoration retention.
4. Core build-up using composite resin.
5. Final restoration with a porcelain fused-to-metal (PFM) crown.

The success of the treatment was evaluated through clinical and radiographic examinations at each visit, indicated by the absence of subjective complaints, normal supporting tissues, and satisfactory functional and aesthetic outcomes.

RESEARCH RESULT AND DISCUSSION

Trauma to the anterior teeth, particularly the permanent maxillary incisors, is a prevalent issue among children and adolescents due to their anatomical prominence, which makes them more vulnerable to external forces. Such injuries not only result in the loss of hard dental structures but can also adversely impact the functionality, aesthetics, and overall quality of life for the affected individual. In the adolescent demographic, concerns regarding aesthetic deficiencies from anterior tooth trauma often lead patients to seek dental intervention, as these concerns are intimately linked to self-esteem and social integration.

In this particular case, a 13-year-old female patient presented with a fractured maxillary left lateral incisor, the injury having persisted for three years as a consequence of a fall. Clinical assessment indicated a fracture that extended through both the enamel and dentin layers, although a cervical segment of the crown remained intact. Vitality tests and cavity examinations yielded negative results, and radiographic imaging revealed involvement of the pulp chamber and widening of the periodontal ligament, corroborating a diagnosis of pulp necrosis accompanied by asymptomatic apical periodontitis. These observations suggest that the trauma not only resulted in the structural loss of the dental crown but also precipitated ongoing damage to both the pulp and periapical tissues.

The prolonged nature of the traumatic incident was a critical factor contributing to the case development. Delayed management of post-traumatic dental injuries can compromise pulp vascularization, ultimately leading to necrosis and subsequent bacterial infection within the root canal system, followed by inflammation of the periapical tissues. Consequently, it is imperative that even in the absence of spontaneous pain at the time of presentation, the source of infection within the root canal must be effectively addressed. In light of

these circumstances, root canal therapy emerges as the appropriate intervention to preserve the tooth within the oral cavity while eradicating the infectious focus.

The initial phase of treatment in this case involved root canal therapy, which commenced with the identification of the working length through radiographic imaging, subsequently verified using an apex locator. This methodological approach is justified, as establishing an accurate working length is vital for successful canal preparation and obturation. The subsequent preparation utilized a step-back technique employing K-files. This technique continues to be pertinent for single-root canals due to its effectiveness in maintaining control over the canal taper from the apex to the coronal region. From a biological standpoint, biomechanical preparation is focused on the elimination of necrotic tissue, reduction of microbial load, and the shaping of the root canal to facilitate optimal irrigation and filling.

Successful mechanical preparation necessitates complementary chemical irrigation. In this instance, a solution comprising 2.5% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), and 2% chlorhexidine digluconate was utilized. This combination adheres to contemporary endodontic principles, as NaOCl serves to dissolve organic tissue and exhibits antimicrobial properties, EDTA aids in the removal of the smear layer, and chlorhexidine contributes additional disinfection. Following preparation, the root canal was treated with calcium hydroxide, which is effective due to the alkaline environment it generates, thereby inhibiting bacterial proliferation and enhancing infection management prior to obturation.

During the follow-up appointment, no subjective complaints were reported; the temporary filling remained intact; percussion and pressure tests yielded negative responses; and the paper point was found to be dry, colorless, and odorless. These findings suggested that intracanal conditions were sufficiently favorable to proceed with obturation. The obturation was accomplished using the lateral condensation technique, with radiographic evaluations revealing a dense, homogeneous filling devoid of voids and with adequate filling margins. These outcomes indicate that the fundamental objectives of endodontic treatment—namely, the cleaning, disinfection, and hermetic sealing of the root canal system—have been successfully attained.

Subsequent to the obturation process, the cavity is sealed with glass ionomer cement (GIC) to preserve the coronal seal prior to the placement of the final restoration. This step is vital as the efficacy of endodontic treatment hinges not merely on the thoroughness of the root canal cleaning and filling but also on the capability of the coronal restoration to avert re-leakage from the oral cavity. Contemporary literature underscores the importance that post-endodontic dental restorations should take into account factors such as restorability, the maintenance of the coronal seal, and the requisite for core retention, especially when the remaining crown structure is severely diminished.

Following a four-month period post-root canal treatment, and upon confirmation of the absence of complaints, the preparation of the post space is undertaken. This interval permits a clinical assessment prior to the placement of the definitive restoration, which is particularly critical in instances of trauma. The

length of the post is ascertained to be approximately two-thirds of the total root length, while leaving 4-5 mm of apical gutta-percha intact. This guideline is upheld because the retention of the post must be established without jeopardizing the integrity of the apical seal. Additionally, the widening of the post space should be executed judiciously to prevent compromise of the root wall's structural integrity.

The selection of a fiber post in this context is deemed apt, given the significant loss of coronal structure that the tooth has sustained. Fiber posts exhibit a modulus of elasticity that is more closely aligned with that of dentin compared to metal posts, resulting in a more uniform distribution of load and a diminished likelihood of root fracture. Moreover, fiber posts offer superior aesthetic properties in anterior teeth. Consequently, their utilization in this scenario is appropriate, as they provide enhanced retention for the restoration core while facilitating aesthetic rehabilitation.

Upon the cementation of the fiber post using an adhesive resin system, a core build-up was executed with packable composite resin. This core not only substitutes for the absent crown structure but also acts as the underlying support for the ultimate restoration. In teeth that have undergone root canal therapy, particularly those exhibiting substantial tissue loss, the efficacy of the post-endodontic restoration is significantly influenced by the extent of remaining dental structure, the necessity of a post, and the presence of a ferrule. Empirical studies indicate that a circumferential ferrule markedly enhances the success rates of restorations in teeth that utilize fiber posts.

In this instance, the definitive restoration was a porcelain fused-to-metal (PFM) crown, a choice deemed appropriate due to the anterior tooth's requirement for structural protection, reliable retention of the restoration, and satisfactory aesthetic outcomes. The design of the full crown preparation featured a supragingival chamfered finish, facilitating improved hygiene maintenance and marginal assessment. For post-endodontic teeth with considerable loss of crown structure, opting for a full crown restoration is a rational decision, as it affords superior structural protection compared to a direct restoration.

The management of tooth 22 in this case report adhered to thorough therapeutic principles, commencing with the elimination of infection via root canal therapy, followed by both functional and aesthetic rehabilitation through the use of a fiber post, core build-up, and PFM crown. The success of this case was contingent upon not only the quality of the obturation but also the caliber of the post-endodontic restoration, which preserved the coronal seal, supported functional load distribution, and restored the visual appearance of the patient's anterior dentition. While the initial prognosis was assessed as favorable, continuous monitoring remains essential to assess periapical tissue healing, the integrity of the restoration, post stability, and the health of the surrounding periodontal tissues.

CONCLUSION

Based on this case report, it can be concluded that:

1. Anterior tooth fractures in adolescents that are not treated promptly can lead to complications such as pulp necrosis and apical periodontitis**.**
2. Properly performed root canal treatment is effective in eliminating infection and preserving the tooth in the oral cavity.
3. The use of fiber post, core build-up, and PFM crown restoration is proven to effectively restore both function and aesthetics in severely damaged teeth.
4. Treatment success is influenced not only by endodontic therapy but also by the quality of the final restoration, which ensures a proper coronal seal and load distribution.

RECOMMENDATIONS

1. Dental trauma should be managed as early as possible to prevent more severe complications.
2. Dentists should perform comprehensive diagnosis before determining the treatment plan.
3. The selection of restorative materials and techniques should consider the remaining tooth structure and aesthetic aspects, especially for anterior teeth.
4. Patients should be educated about maintaining oral hygiene and attending regular follow-up visits.
5. Long-term monitoring is necessary to evaluate treatment success and periapical tissue condition.

ADVANCED RESEARCH

For future research, it is recommended to:

1. Conduct studies with larger sample sizes to obtain more generalizable results.
2. Compare the effectiveness of different types of posts (fiber post vs metal post) on long-term restoration success.
3. Investigate the use of new restorative materials with improved strength and aesthetics compared to PFM.
4. Perform longitudinal studies to evaluate the long-term durability of restorations and periapical healing.
5. Examine additional factors such as patient habits, oral hygiene, and repeated trauma that may influence treatment outcomes.

REFERENCES

Al-Dabbagh RA, Sindi MA, Sanari MA, Manna AI, Al-Dabbagh MA. Effect of a circumferential ferrule on the survival and success of endodontically treated teeth restored with fiber posts: a systematic review and meta-analysis. *J Prosthet Dent*. 2024;132(6):1251-1259.

Das P, Mishra L, Jena D, Govind S, Panda S, Lapinska B. Oral health-related quality of life in children and adolescents with a traumatic injury of

permanent teeth and the impact on their families: a systematic review. *Int J Environ Res Public Health*. 2022;19(5):3087.
Gartshore L, Haq T, Djemal S. Endodontic implications of dental trauma: useful tips for primary dental care. *Br Dent J*. 2025;238(7):545-550.
Patel SR, Youngson C, Jarad F. Principles guiding the restoration of the root-filled tooth. *Br Dent J*. 2025;238(7):508-516.
Zou X, Zheng X, Liang Y, et al. Expert consensus on irrigation and intracanal medication in root canal therapy. *Int J Oral Sci*. 2024;16:23.