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Case Report

Endodontic and Restorative Rehabilitation of Traumatized Incisors with Orthodontically Induced External Root Resorption: A Case Report

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Abstract

Root resorption is a recognized complication of orthodontic treatment, particularly in teeth with previous trauma, posing diagnostic and therapeutic challenges. This case report describes an 18-year-old male who presented with an Ellis Class II fracture on tooth #21 following completion of a two-year orthodontic treatment. The patient had a history of dental trauma ten years earlier. Radiographic and cone beam computed tomography (CBCT) evaluations demonstrated apical root resorption affecting teeth #11, #21, and #12, with partial canal calcification in tooth #11. Endodontic therapy was performed on tooth #11 using advanced techniques for negotiating the calcified canal and biocompatible materials for obturation. The fractured tooth #21 was restored successfully with a layered direct composite resin restoration, emphasizing esthetics and function. Follow-up revealed satisfactory restorative outcomes. This case underscores the importance of thorough diagnostic evaluation, cautious orthodontic force application, and integrated endodontic-restorative management to optimize treatment outcomes in patients with complex dental histories. It highlights the need for regular follow-up and multidisciplinary care to identify and manage root resorption and trauma sequelae effectively in orthodontic patients.

Keywords: Root Resorption; Dental Pulp Necrosis; Spiral Cone-Beam Computed Tomography; Apical Periodontitis

Introduction

Dental trauma and orthodontic treatment are two common clinical scenarios encountered in dental practice, each carrying potential complications that can affect the long-term prognosis of teeth [1]. Orthodontic treatment, aimed at correcting malocclusions and improving esthetics and function, can induce changes in the periodontal ligament, alveolar bone, and root structure [1]. One of the most significant adverse effects associated with orthodontic tooth movement is root resorption, which is characterized by the loss of cementum and dentin at the root surface, frequently apical in location [1]. Root resorption can vary widely in severity, ranging from minor and clinically insignificant to severe forms leading to tooth mobility and possible loss [2].

The pathophysiology of orthodontically induced root resorption is complex and multifactorial [3]. Mechanical forces applied to teeth during treatment generate inflammatory responses in the periodontal ligament, leading to activation of clastic cells that resorb root structure in susceptible individuals [3]. Factors affecting the risk and severity of resorption include magnitude and duration of applied force, treatment duration, tooth type, and individual biological predisposition [3]. Previous dental trauma, especially luxation injuries or fractures occurring in childhood or adolescence, can predispose teeth to increased susceptibility for resorption during orthodontic treatment [4]. Trauma may lead to pulp canal obliteration or partial calcification, and these changes can complicate subsequent endodontic management [4].

Ellis Class II fractures entail loss of enamel and dentin without pulp exposure, commonly presenting as painful due to exposed dentinal tubules, and necessitate timely treatment to prevent further damage to the pulp and restore esthetics [5]. In young adults undergoing orthodontic treatment, the diagnosis and management of dental trauma sequelae require a multidisciplinary approach to address potential pulpal, periodontal, and restorative challenges [5].

Case Report

Patient history and examination

An 18-year-old male reported to the Department of Conservative dentistry and Endodontics, Yenepoya Dental Hospital with chief complaint of fractured tooth in the upper front region. He had a history of orthodontic treatment completed two months prior, which spanned two years. A traumatic injury to the area was reported from ten years before, with no prior endodontic intervention.

Clinically, tooth #21 exhibited an Ellis Class II fracture characterized by enamel and dentin involvement without pulp exposure (Figure 1,2). There was no tenderness on percussion or palpation, no sinus tract formation, and all teeth in the anterior region were periodontally firm. Teeth #11 and #12 appeared clinically intact without visible fractures.

Figure 1: Preoperative Clinical photograph (Frontal view).

Figure 2: Preoperative Clinical photograph (Maxillary occlusal view).

Diagnostic evaluation

Radiographic examination using periapical radiographs revealed apical root resorption in teeth #11, #21, and #12 (Figure 3-5). Tooth #11 exhibited partial canal calcification with narrowing of the canal space (Figure 4). To assess the three-dimensional extent of root resorption, a cone beam computed tomography (CBCT) scan was performed. The CBCT confirmed the apical root resorption seen on conventional radiographs and detailed the calcific changes in tooth #11 (Figure 6-10).

Pulp vitality was assessed using cold testing. Tooth #11 gave a negative response indicating non-vital pulp, while teeth #21 and #12 showed positive responses consistent with vital pulps. Based on clinical and radiographic findings, tooth #11 was diagnosed with pulp necrosis and asymptomatic apical periodontitis.

Figure 3: Preoperative periapical radiograph showing apical root resorption in teeth #11, #21, and #12.

Figure 4: Preoperative periapical radiograph of teeth #11 and #12 showing canal calcification in tooth #11.

Figure 5: Preoperative periapical radiograph of tooth #21.

Figure 6: Preoperative CBCT coronal view of tooth #11 revealing apical resorption and partial canal calcification.

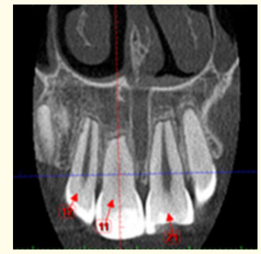

Figure 7: Preoperative CBCT coronal section showing apical root resorption in teeth #11, #12, and #21.

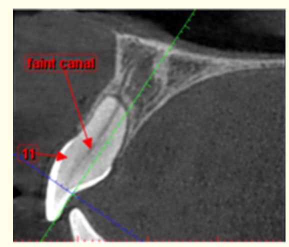

Figure 8: Preoperative CBCT sagittal section of tooth #11 showing a faint root canal.

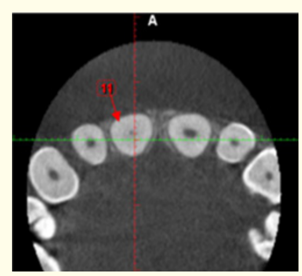

Figure 9: Preoperative CBCT axial section of tooth #11 demonstrating partial canal obliteration.

Figure 10: Tooth structure recreation with CBCT.

Treatment planning

Given the fracture and clinical status, a two-phase treatment plan was formulated:

- **Phase 1:** Endodontic therapy for tooth #11 to treat necrotic pulp
- **Phase 2:** Direct composite restoration of tooth #21 to restore form and function after Ellis Class II fracture.

Phase 1: Endodontic Treatment of Tooth #11

After obtaining informed consent, an initial appointment was scheduled to perform root canal therapy on tooth #11 under lidocaine local anesthesia (2% with adrenaline 1:80000) and rubber dam isolation Figure 11. A dental operating microscope (Labomed Magna surgical microscope, LABO AMERICA INC, USA) was used to enhance visualization during the procedure.

Figure 11: Rubber dam isolation of tooth #11.

Access cavity preparation was carefully done to minimize tooth structure loss. Negotiation of the partially calcified canal was achieved using #6, #8, and #10 K files and D-finders (Mani Inc., Vietnam). The sticky test confirmed canal patency.

Working length was determined using an electronic apex locator and confirmed radiographically at 18 mm (Figure 12). The canal was cleaned and shaped using crown-down technique with rotary instruments up to F2 size (ProTaper Gold, Dentsply Maillefer, Switzerland).

Figure 12: Periapical radiograph of tooth #11 showing working length determination.

Irrigation consisted of 3% sodium hypochlorite (NaOCl) activated ultrasonically (Ultra X, Eighteeth, Orikam, Jiangsu Province, China) to enhance disinfection, followed by 17% EDTA (Anabond Desmear, India) solution for smear layer removal, also ultrasonically activated. Calcium hydroxide (Prevest DenPro Limited, India) was placed using 15k file as an intracanal medicament, and the access cavity was sealed temporarily with Cavit (3MESPE, USA).

The patient was recalled after 7 days for obturation. The Biodentine capsule (Septodont, Saint-Maur-des-Fossés, France) was prepared following the manufacturer's instructions. The material, which exhibited a creamy consistency, was delivered into the root canal using an MTA carrier and compacted with finger pluggers to fill the entire root canal system using the mono-bulk fill obturation technique to promote periapical healing and provide a bioactive seal (Figure 13). Owing to apical root resorption, the obturation was kept 1mm short of the radiographic apex. The orifice was sealed with Ionoseal (VOCO GmbH, Germany) and access cavity was filled with dual-cure composite Paracore (Coltene, Switzerland) as a post-endodontic restoration to restore coronal integrity.

Phase 2: Restoration of Tooth #21

In the next appointment restoration of tooth #21 was initiated. The tooth was cleaned with pumice to remove debris and the frac-

Figure 13: Periapical radiograph of tooth #11 showing obturation with biodentin and post endodontic restoration.

Figure 14: Postoperative intraoral clinical photographs (Frontal view).

Figure 15: Postoperative intraoral clinical photographs (Occlusal view of the maxillary arch).

tured margins were refined with a starburst bevel using red band diamond bur (size FO21, Mani Inc., Vietnam). Shade selection was carried out. Enamel etching involved 37% phosphoric acid (N-Etch gel, Ivoclar Vivadent AG, Liechtenstein) for 20 seconds, rinsed thoroughly and dried, followed by application of a fifth-generation bonding agent (Tetric N-Bond, Ivoclar Vivadent AG, Liechtenstein).

A palatal shelf was reconstructed with composite resin (Tetric N-Ceram, Ivoclar Vivadent AG, Liechtenstein) using a mylar strip. The composite was placed using a brush (Shofu UNI brush 4, Japan) to manipulate increments precisely. Dentin shade composite was layered next, followed by enamel shade composite to mimic natural tooth optical properties. A transparent composite was added at the incisal edge for translucency. Each layer was light-cured (Woodpecker ILED Plus Curing Light, China) at 1200 mW/cm2 power density which was activated for 20 sec at a distance of 1 mm.

Line angles were marked with pencil to guide final contouring. Gross finishing and shaping were performed using a red band diamond bur (size FO21). Sequential polishing was carried out with 4-step Super Snap Rainbow Technique composite polishing discs (Shofu, Japan) from purple colored disc to pink colored disc (coarse to superfine grain), creating a smooth surface. Final surface gloss was enhanced with wet buffing using polishing paste(Figure 14,15).

Discussion

The clinical challenges presented by this patient highlight the complex relationship between dental trauma, orthodontic tooth movement, and subsequent root and pulp pathology [7]. Root resorption following orthodontic treatment is a well-documented phenomenon with a prevalence ranging from 1% to 5% for severe resorption, with maxillary incisors being the most commonly affected teeth due to their root morphology and the forces applied during treatment [6,7]. The risk of root resorption is elevated in teeth that have previously sustained trauma, as seen in this case, where a traumatic event incurred a decade earlier likely contributed to partial canal calcification and heightened vulnerability to resorption during the two-year orthodontic treatment period [8].

Orthodontic forces cause compression and hyalinization of the periodontal ligament, triggering an inflammatory cascade and recruitment of odontoclasts responsible for removing root surface tissues [9]. The crown-down instrumentation technique employed here was effective in addressing the calcified canal, a frequent challenge in traumatized teeth, facilitating thorough cleaning and shaping while preserving as much tooth structure as possible [10]. The use of ultrasonic activation of irrigation solutions like sodium hypochlorite and EDTA improves canal debridement and smear layer removal, aiding in disinfection and better adaptation of obturation materials [11].

The choice of Biodentine as an obturation material aligns with recent advances in bioactive endodontic materials which promote periapical healing through calcium ion release and enhanced sealing properties [12]. Studies have shown Biodentine to be effective in cases of root resorption and periapical pathology due to its encouraging biocompatibility and mechanical characteristics that mimic dentin. Full root canal length obturation with biodentin was chosen for severely resorbed teeth to provide reinforcement and bioactive sealing throughout the canal [13]. One limitation of doing full length obturation with biodentin is the challenge of removing this material if retreatment or intraradicular post placement becomes necessary. In this case the coronal part of the tooth was intact with no fracture lines evident under transillumination or CBCT, so the need for intraradicular post was not anticipated. Biodentine offers certain advantages over MTA; for instance, its consistency is more favorable for clinical application, and unlike MTA, it does not require a two-step obturation procedure due to its quicker setting time of approximately 12 minutes [14].

Management of Ellis Class II fractures via direct composite restorations has gained wide acceptance due to its conservative nature and excellent aesthetic outcomes [15]. The stepwise layering using different shades to replicate dentin, enamel, and incisal translucency, combined with modern adhesive protocols, results in restorations with good marginal integrity and color stability [16]. Creating a palatal shelf aids in restoring tooth strength and functional morphology, vital for anterior teeth subjected to significant occlusal forces [16].

This patient's favorable outcome underscores the importance of early detection through clinical and radiographic examination [17]. Regular monitoring during and after orthodontic treatment is critical to identify root resorption and intervene accordingly [17]. Preservation of pulp vitality where possible, or timely endodontic therapy in necrotic cases, combined with meticulous restorative techniques, ensures longevity and function [12].

Orthodontists and general dentists must collaborate closely when managing patients with history of dental trauma to minimize the risks of adverse sequelae [18]. Comprehensive patient education regarding potential complications and prompt reporting of symptoms can facilitate early interventions, improving prognosis [18].

Conclusion

This case report demonstrates the importance of comprehensive diagnosis and multidisciplinary management in patients presenting with orthodontic complications complicated by trauma history. Root resorption post orthodontics requires close radiographic monitoring, especially in teeth with previous injury.

Partial canal calcifications pose challenges in endodontic treatment that can be overcome with advanced visualization and appropriate instruments. Timely intervention can prevent further periapical damage and maintain tooth function.

Direct composite restoration remains a reliable, esthetic choice for Ellis Class II fractures. Layered resin techniques with careful contouring and polishing improve clinical outcomes.

Clinicians must integrate orthodontic, endodontic, and restorative approaches tailored to individual patient histories for optimized long-term dental health.

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