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MANAGEMENT OF A COMBINED INTRUSION AND COMPLICATED CROWN FRACTURE OF THE MAXILLARY CENTRAL INCISORS IN A CHILD

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ABSTRACT

Intrusion represents the most severe form of dental trauma, resulting in significant damage to the periodontal ligament-pulp fibres. This report details the treatment of external root resorption with intrusion and complicated crown fractures of maxillary central incisors.

CBCT scans revealed oblique fractures in teeth 11-12, extending 4 mm into the gingival line and involving the pulp. The intrusion severity was classified as "severe" (8 mm). The teeth were repositioned under sedation by surgical extrusion and stabilised. Root canals were cleaned and filled with calcium hydroxide within thirty days. Permanent restoration of the fractured areas occurred after confirming tooth positions. At the 12-month follow-up, severe external resorption was observed. Remaining gutta-percha was removed, and calcium hydroxide was applied for three weeks. At the second visit, the canal lengths were assessed, and MTA was placed in all resorbed areas and root canals. Throughout the subsequent 12-month follow-up, the teeth functioned normally without symptoms.

The stage of root development, patient age, and degree of intrusion are critical factors influencing prognosis. According to IADT guidelines, complete root development and intrusion exceeding 7 mm justified surgical repositioning. The literature lacks definitive evidence comparing orthodontic versus surgical approaches. Some authors advocate immediate surgical extrusion to enhance endodontic access and aesthetics, though caution is warranted due to potential mechanical damage and root resorption. Surgical repositioning may have contributed to post-endodontic root resorption. Nonetheless, the multidisciplinary approach effectively restored function and aesthetics in this case. After two years, clinical restoration parameters remained satisfactory, alongside periodontal and periapical conditions.

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Keywords: Dental Trauma, External Root Resorption, Intrusion.

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INTRODUCTION

Dental trauma is considered a public health problem, affecting 4-33% of the world's population.[1] Intrusions, which account for 0.5% to 1.9% of all cases, are the most severe type of dental trauma. Because they cause significant damage to the periodontal ligament and pulp fibres, resulting in the worst prognosis.[2] Intrusion refers to the apical displacement of a tooth into the bone. This type of injury damages all the supporting tissues of the tooth, including the gingiva, periodontal ligament, alveolar bone, cementum, and pulp.[3] For intrusion treatment to be considered successful, the tooth must be restored to its proper position without loss of periodontal tissue while maintaining its vitality.[2,3] However, due to the complex nature of the intrusion, complications such as pulp necrosis and root resorption are often unavoidable. The severity of these complications pertains to both pre-trauma factors (stage of root development and patient age) and trauma-related factors (severity of intrusion, presence of additional injuries, and treatment approaches).[4,5] Previous studies have reported that immature teeth have a better prognosis than teeth with completed root formation and that mild intrusion cases have a better prognosis than severe intrusion cases.[4-7] It has been observed that potential complications are more prevalent in cases of intrusion accompanied by other types of injury.[8,9] This, in turns, calls for a more comprehensive treatment protocol. In cases with concomitant injuries, treatment planning relies on clinical judgment. Thus, accurate diagnosis and the establishment of treatment objectives are crucial. Furthermore, managing these injuries necessitates vigilant monitoring and a multidisciplinary strategy to avoid possible complications.[10]

This case report presents the treatment and subsequent repair of external root resorption in a child with concomitant intrusion and complicated crown fractures of the maxillary permanent central incisors. The two-year treatment and follow-up process entailed a multidisciplinary approach, including endodontics, pedodontics, orthodontics, and surgery.

Case Description

History

A 14-year-old male patient presented to the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Marmara University, three days after a traumatic injury to his maxillary anterior teeth and upper lip. A clinical examination revealed severe intrusion of teeth numbers 11 and 21 (Figures 1a-b).

Diagnosis

A clinical examination revealed that the maxillary anterior teeth exhibited sensitivity to percussion and palpation. Segmental mobility was evaluated in the affected area, and no evidence of alveolar fracture was found. Laceration and swelling of the soft tissues were observed. As the central incisors were not visible in the oral cavity, only the lateral teeth underwent electric pulp testing. Panoramic radiographs (OPGT) and cone beam computed tomography (CBCT) were selected for radiological evaluation. The imaging techniques, performed at the time of presentation, showed fully developed roots with wide apical foramina (Figures 2a-c). Radiographs revealed oblique fracture lines extending approximately 4 mm toward the gingival margin in both teeth, involving the pulp (Figure 3). The degree of intrusion for teeth 11 and 21 was classified as "severe." The

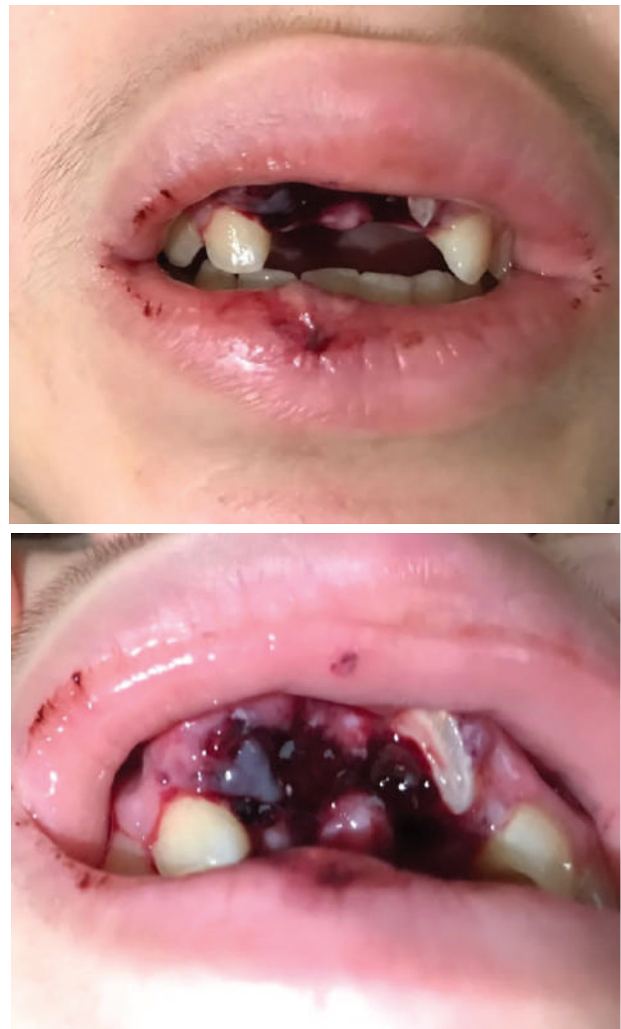


Figure 1a-1b. Initial extraoral photographs of the patient

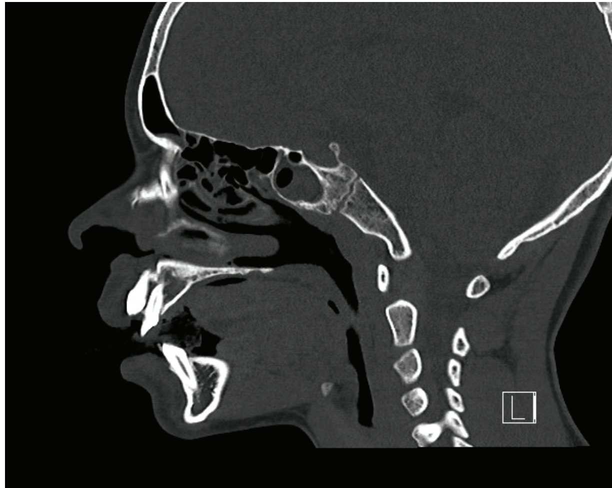


Figure 2a. Sagittal CBCT views showing the position of the maxillary central incisors

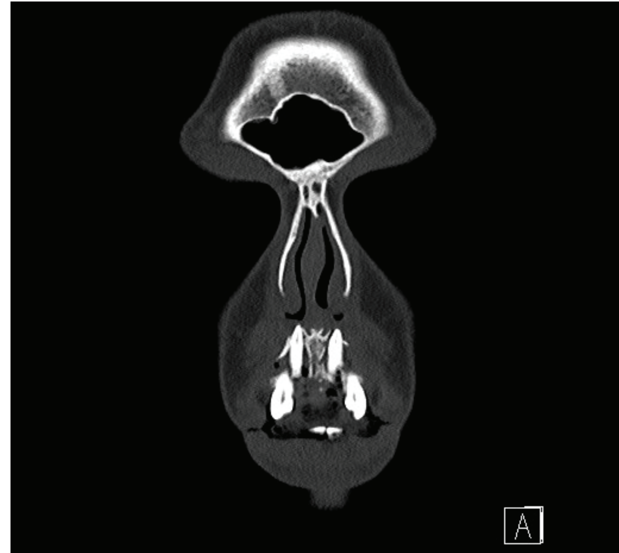


Figure 2c. Coronal CBCT views showing the position of the maxillary central incisors

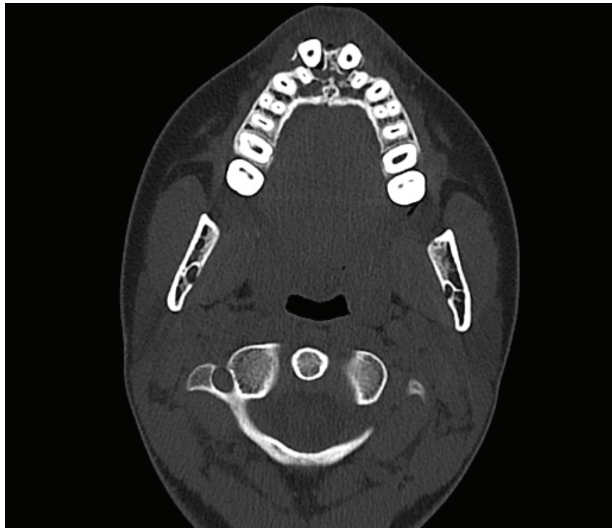


Figure 2b. Axial CBCT views showing the position of the maxillary central incisors

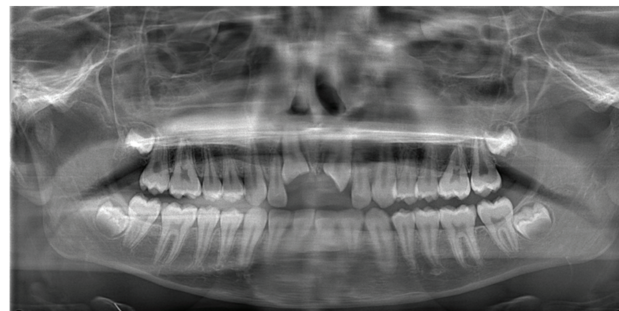


Figure 3. Panoramic radiographs of the patient at initial presentation

CBCT imaging indicated that the buccal and palatal bone plates remained intact.

Treatment Planning

The patient was administered anaesthesia via sedation. A local anaesthetic, comprising 4 cc of articaine, was administered buccally and palatally between the canine incisors. Subperiosteal and vertical incisions were made in the canine-canine area. A full-thickness subperiosteal flap was then elevated. The inflamed periosteal tissues in the buccal region of the central teeth were debrided. A vertical incision was made from the distal region of the central teeth using piezosurgery, which facilitated the repositioning of the intruded teeth. Subsequently, the buccal tissues of the central teeth were mobilised with osteotomes, and the teeth were repositioned in the palatal and coronal directions. To stabilise the position of the central incisors, bonding brackets were placed in the buccal region, and an archwire was applied during the operation (Figure 4). The surgical area was then sutured with 4/0 vicryl sutures. A course of antibiotics (amoxicillin 500 mg tablets, administered every 8 hours for 7 days) was prescribed.

Immediately following the procedure, the root canals were cleaned and shaped using rotary files (EndoArt, Inci Dental, Turkey) attached to the endomotor (DualMove, MicroMega, Coltene, France). The root canals were prepared to an apical size of 40 with a taper of 0.4. Subsequently, calcium hydroxide (Vision, WP Dental, Germany) was applied to the canals. Thirty days later, the canals were filled with

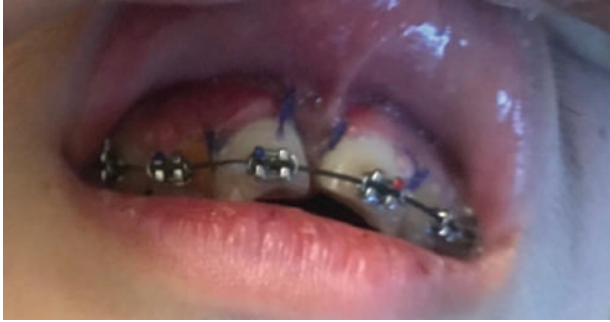


Figure 4. Post-operative stabilisation of the repositioned teeth with brackets and sutures

gutta-percha and a resin-based root canal sealer (AH Plus, Dentsply Sirona, USA) (Figure 5). Six weeks after bracket placement, the teeth had stabilised sufficiently to allow for the permanent restoration of the fractured areas at the incisal edge following bracket removal. Clinical and radiological examinations were conducted on a weekly basis for the initial two months, after which they were performed every three months.

Follow up

No clinical or radiographic evidence of complications was observed until the 12-month follow-up (Figures 6a-b). However, at the 12-month follow-up, the patient reported mild percussion sensitivity in the central incisors and associated gingival tenderness. Radiographs demonstrated external root resorption on both roots, with the gutta-percha located 2-3 mm outside the root due to resorption (Figure 7). Given the extent of external root resorption, it was deemed necessary to repeat the root canal treatment.

Maintenance

As the patient habitually breathed through their mouth, rubber dam isolation was not an option. Following the opening of the access cavity, the canal filling in the coronal and middle thirds was removed with EndoArt retreatment files (400 rpm speed and 2.5 Ncm torque), while the apical third was removed with stainless steel hand H-files (DiaDent, California, USA). The remaining gutta-percha outside the resorption area was removed by spiralling and pulling with two hand files under x6.5 magnification (Ergo Loupe, Admetec, Tuttlingen, Germany) (Figures 8a-c).

The working length was determined using an electronic apex locator (MicroMega, Coltene, Switzerland). The root canals were then irrigated with a solution of 2.5% sodium hypochlorite (NaOCl) (Microvem, Altun Sterilization &

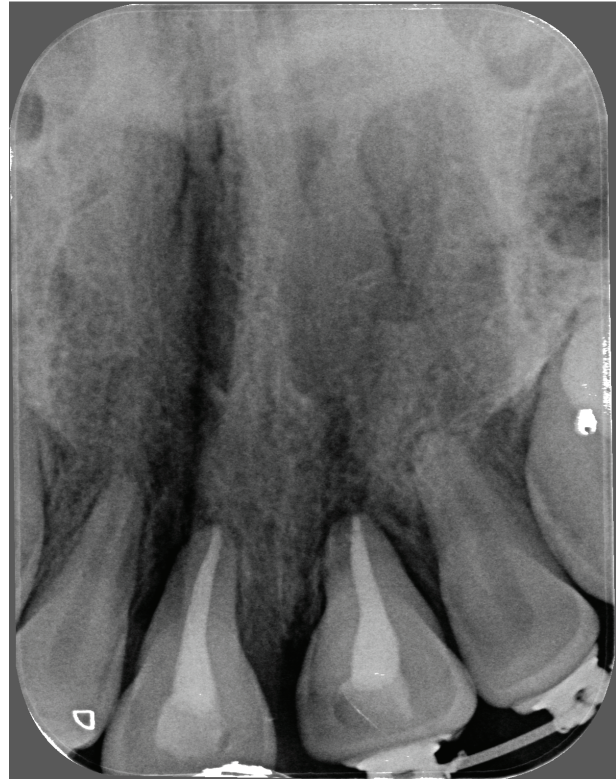


Figure 5. Completion of root canal treatment of teeth #11 and #21

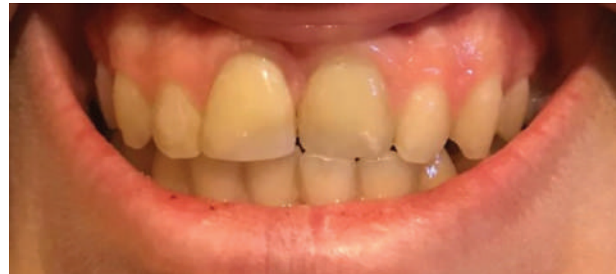


Figure 6a. 6 months follow-up clinical examination

Medical, Turkey) and NiTi rotary files (EndoArt, Inci Dental, Turkey) to remove any remaining debris from the root walls. Following the drying of the canals, calcium hydroxide was placed within them, and the patient was scheduled for a follow-up appointment three weeks later (Figure 9).

By the second appointment, the patient's symptoms had completely disappeared. Consequently, it was determined that the root canal treatment should be completed. Subsequently, the access cavity was opened, and the calcium hydroxide residue was sequentially washed with 2.5% NaOCl, saline, and 17% ethylenediaminetetraacetic acid (EDTA) (Microvem, Altun Sterilization & Medical, Turkey)

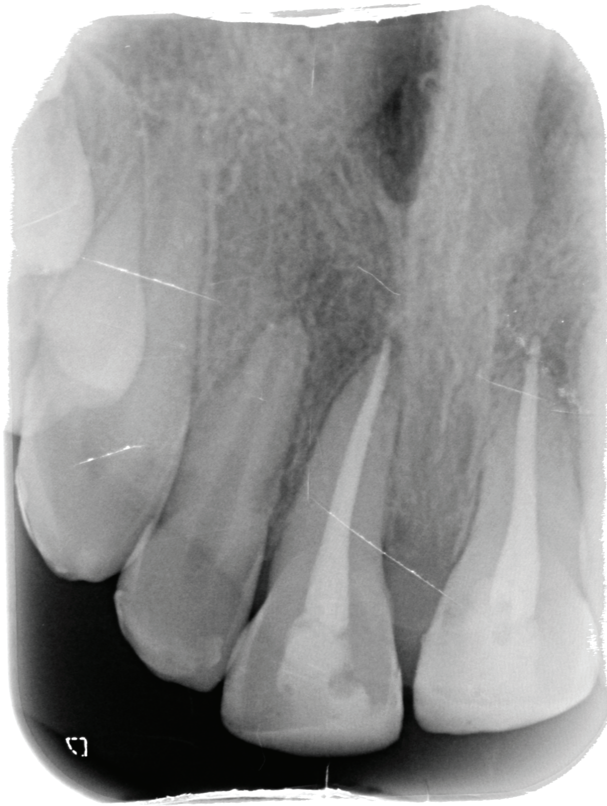


Figure 6b. 6 months follow-up radiograph

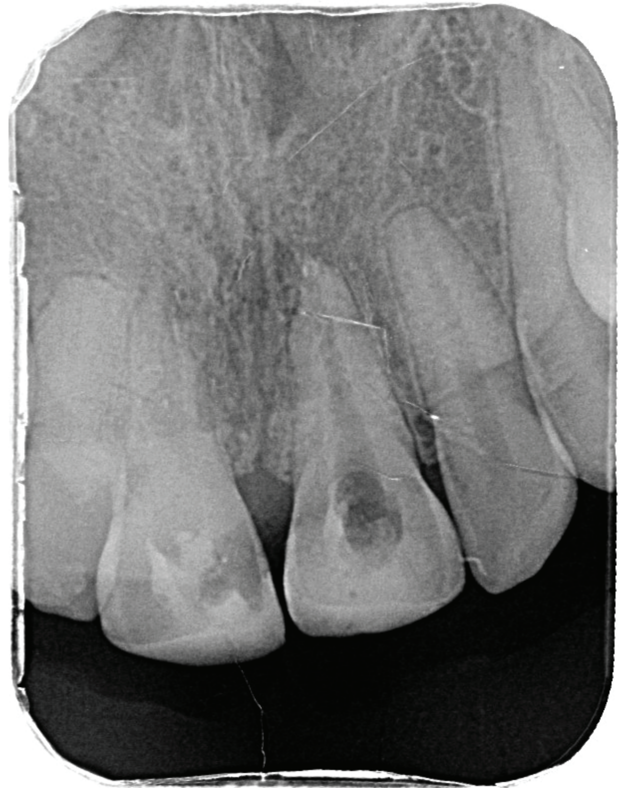


Figure 8a. Removal of excess gutta-percha from tooth #21

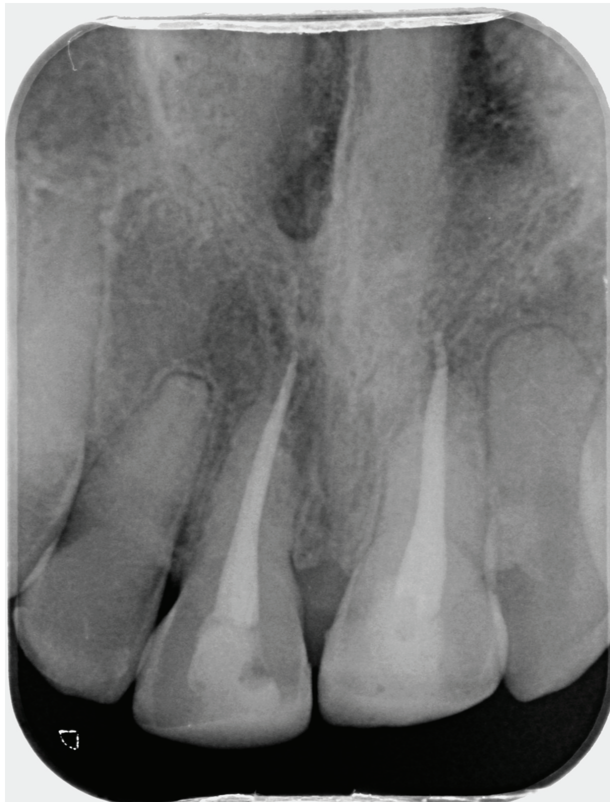


Figure 7. 12 months follow-up radiograph

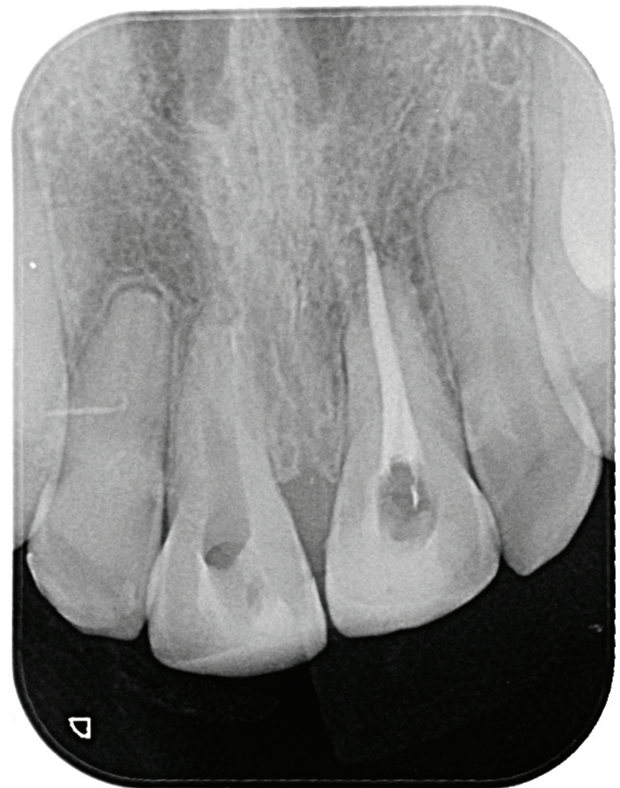


Figure 8b. Removal of excess gutta-percha from tooth #11

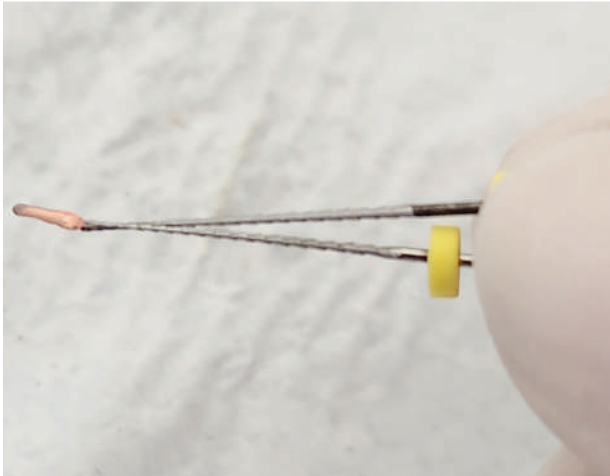


Figure 8c. Removal of the guttapercha extending from the apical

Figure 9. Identification of areas of resorption on the root walls

solution under sonic activation (EDDY, VDW, Germany). The canals were dried using paper points. The powder and liquid of mineral trioxide aggregate (MTA) (BioMTA, Cerkamed, Poland) were combined in accordance with the manufacturer's instructions. Subsequently, an initial layer of MTA was placed using an MTA carrier and condensed with a hand plugger. Given the relatively short length of the canals, it was deemed appropriate to fill the entire canal with MTA, rather than creating an apical plug. The procedure was repeated, with MTA being placed until it reached a depth of 2 mm below the cementoenamel junction. The canals were completely filled with MTA, with the final filling extending 2 mm below the cementoenamel junction (Figure 10). A moist cotton pellet was placed over the MTA, and the patient was recalled 24 hours later for assessment. Following a 24-hour interval, the moist cotton pellet was removed, and the final restoration of the access cavity was completed. The patient was scheduled for regular follow-up visits.

At the six-month and 12-month follow-up visits, the teeth were clinically asymptomatic and functional (Figures 11). Radiographs demonstrated the absence of pathological or resorptive processes (Figure 12). Vitality tests were conducted on teeth #12 and #22. As the teeth were found to be vital, it was determined that no additional treatment was necessary.

DISCUSSION

The treatment of a traumatised tooth necessitates a multidisciplinary approach due to the high incidence of aesthetic, pulpal, and periodontal complications following traumatic injury.[4] When trauma occurs, it is necessary to initiate the treatment as soon as possible so as to minimise and prevent potential complications.[10] The most common outcomes of intrusion are pulp necrosis and both progressive and replacement inflammatory resorption in permanent teeth with complete root formation.[11,12] Several studies in the literature have assessed the prevalence of external inflammatory resorption in different types of trauma. Intrusive dislocation has been found to have the highest incidence (25%). Hecova et al.[4] reported a prevalence of 33.3% for external inflammatory resorption in cases of closed apex intrusion. The high frequency of these post-traumatic complications can be attributed to significant damage to the periodontal ligament and pulp.[13] In this case, the patient presented to our clinic immediately after the trauma, and treatment was initiated as soon as possible. It has been observed that in traumatised teeth, even if the crown is intact, bacteria can infect the pulp through dentin tubules. Furthermore, if this infection is not treated, it has been demonstrated that bacteria and their toxins can lead to external resorption.[14] In this case, the presence of a complex crown fracture is evident. The development of pulpal necrosis can be posited to be an anticipated outcome. Nevertheless, the severe external resorption observed in both teeth was an unexpected occurrence despite the administration of prompt and appropriate treatment. Nonetheless, regular follow-up appointments enabled the external resorption to be managed.

As posited by Andreasen et al.,[12] the prognosis of intruded

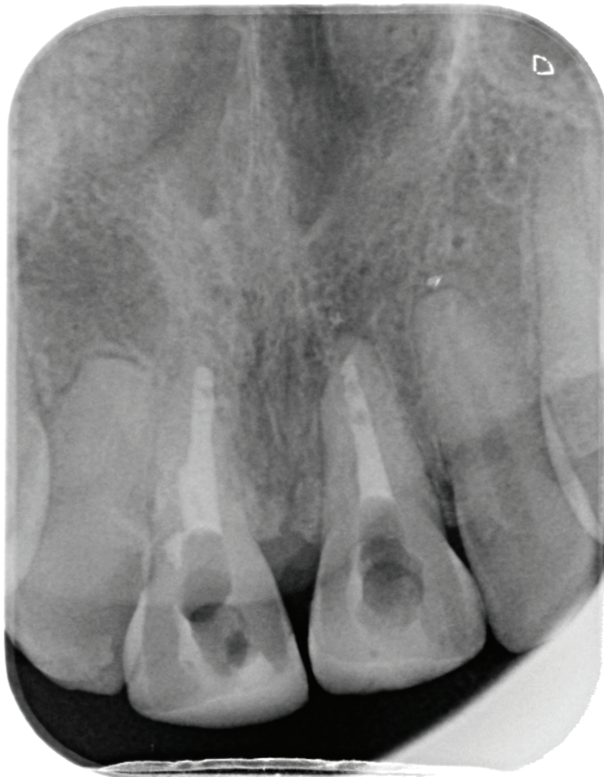


Figure 10. Root canal filling with MTA

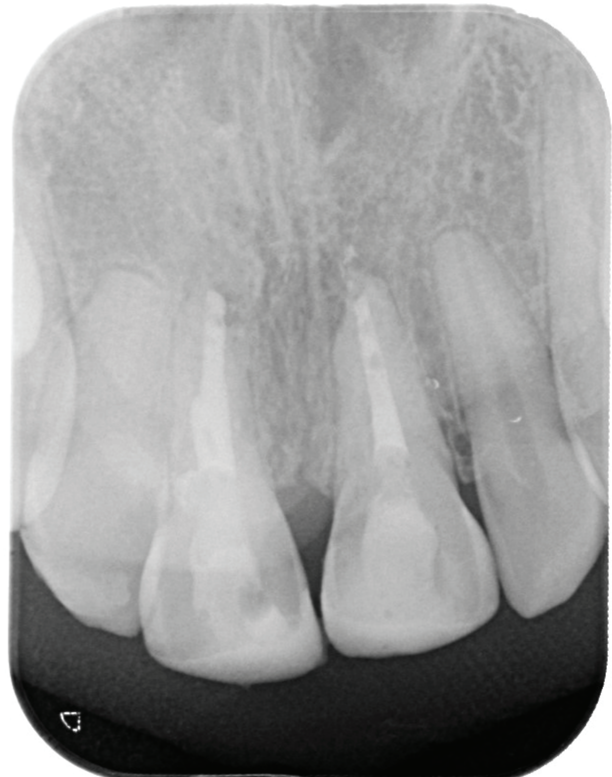
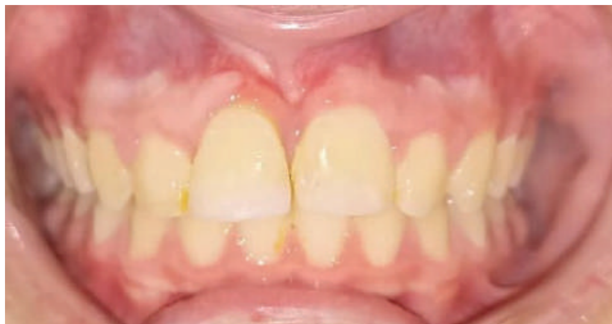


Figure 12. 12 months follow-up radiographs after retreatment



Figures 11. 12 months clinical follow-up

teeth is contingent upon three factors: the stage of root development, the age of the patient, and the degree of intrusion. In this case, the traumatised teeth had undergone complete root development, the patient was 14 years of age, and the degree of intrusion of the upper central incisors was in excess of 7 mm. In accordance with the recommendations of the International Association of Dental Traumatology (IADT),[15] which advocate surgical repositioning of teeth with complete root formation, the procedure was conducted in the prescribed manner.

To prevent external root resorption due to potential infection, the guideline specifies that root canal treatment and the application of calcium hydroxide should commence within two weeks or as soon as the condition of the tooth allows.[15] In this scenario, the root canal treatment started one week after the surgical procedure. Meanwhile, calcium hydroxide was applied for 30 days. Even though the guideline recommends the splint's removal at the four-week follow-up, minimal mobility was observed in the teeth during the session when the root canal treatment was completed, and the splint duration was extended by an additional two weeks. The literature indicates that in cases of orthodontic extrusion, the duration of the splint may be extended to 8-12 weeks to allow for bone remodeling.[16,17] Consequently, the splint duration was extended by two weeks to achieve the desired stabilization following surgical extrusion.

The current IADT guidelines recommend follow-ups at least at 2, 4, and 6-8 weeks, then at 3, 6 months, 1 year after trauma, and annually for 5 years post-trauma.[15] In the event of uncertainty, shorter intervals should be employed. In this case, clinical and radiological examinations were conducted every week for the initial two months, after which they were performed every three months. Due to the development of external resorption at the 12-month mark, a retreatment

was administered, with the new treatment followed up at 6 and 12 months.

There is no consensus in studies evaluating orthodontic and surgical repositioning procedures. A systematic review by Al-Khalifa and Al Azemi[18] revealed an absence of evidence that is capable of facilitating a comparison of the outcomes of orthodontic and surgical interventions. On the other hand, Tsilingaridis et al.[19] opined that immediate surgical extrusion facilitates endodontic access, reduces treatment cost and duration, and improves patient aesthetics. Koongi Sonoda et al.[17] posited that in cases of severe intrusion, immediate surgical repositioning may yield expedient results; however, it could also lead to additional mechanical damage and promote root resorption. The researchers observed that there was no evidence of root surface damage or a reduction in the incidence of ankylosis with the use of orthodontic forces for extrusion.

In this case, the root resorption that developed after endodontic treatment may be attributed to the surgical repositioning. Under the guidelines of IADT,[15] cases of dental intrusion are considered to be at high risk of external root resorption. It is therefore essential that these cases be monitored over time to detect the onset of resorption and provide timely treatment. In this case, the external root resorption that developed subsequent to surgical extrusion and canal treatment was promptly identified. The utilisation of MTA for preventive endodontic treatment yielded favourable outcomes.

Despite the extensive use of MTA due to its advantageous attributes, including biocompatibility, bioactivity, hydrophilicity, and sealing ability, it is not devoid of drawbacks. These include a prolonged setting time, the potential for tooth discolouration, a mud-like consistency, and suboptimal handling characteristics.[20] Nearly 60% of cases have reported tooth discolouration among pulpotomy procedures involving the coronal region.[21,22] It has been posited that 22.7% of apical plugs made with MTA may result in discolouration of the coronal portion of the tooth, thereby compromising aesthetic appeal.[23] Nevertheless, a study by Krug et al.[24] demonstrated that when MTA placement is correctly adjusted at a distance from the cementoenamel junction, no coronal discolouration took place even after two years.

In this case, the orthograde method was chosen for the placement of MTA. Because the root lengths were shortened due to external resorption, the entire canal was filled with MTA up to 3 mm below the cementoenamel junction following the application of an apical plug. At the one-year follow-up, there were no aesthetic complaints, aligning with findings in the literature.[24]

A two-year follow-up indicated that the restorations' clinical parameters, along with the periodontal and periapical conditions, were satisfactory. The relatively brief follow-up period, as per current guidelines, presents a possible limitation of this case report. Nonetheless, despite these limitations, effective results were achieved through a multidisciplinary approach in this case. Drawing from the findings presented here, clinicians handling trauma cases with comparable diagnoses can consider the following recommendations:

- The application of treatment approaches should be guided by the principles of scientific evidence, and due consideration must be given to the distinctive characteristics of each case.
- It is imperative to recognise the necessity for timely diagnosis in the context of dental trauma treatments. Thus, it is crucial to ensure that follow-up procedures are not neglected.
- In the event of complications, the clinician should be conversant with alternative treatments to ensure effective management.

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