

Long-term interdisciplinary management of severe post-traumatic external inflammatory root resorption in an adolescent: A 10-year follow-up case report

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Highlights

Proper avulsion management and follow-up are vital, as rapid root resorption in children may cause early tooth loss and restrict restorative options in adolescence.

A multidisciplinary approach sustained a post-avulsed tooth with advanced resorption, preserving dentoalveolar integrity until implant restoration was possible.

Tooth preservation should be comprehensive in pediatric patients, even with uncertain prognosis, as it supports long-term outcomes beyond function or esthetics.

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Abstract

External inflammatory root resorption is a pathologic process that commonly develops following mechanical damage to the cementum during traumatic dental injury. This case report presents the long-term interdisciplinary management of an avulsed immature maxillary central incisor complicated by severe external inflammatory root resorption. A 10-year-old patient presented with bleeding gingival tissue adjacent to the maxillary right central incisor. The medical history revealed that three years earlier, the patient had sustained an avulsion of tooth #11, which had been subsequently replanted. Clinical and radiographic examinations confirmed severe external inflammatory root resorption. Initial treatment consisted of root canal obturation with mineral trioxide aggregate followed by composite crown restoration. However, after nineteen months, the resorption progressed rapidly, resulting in crown fracture. Consequently, a decoronation procedure was performed. A removable orthodontic appliance was then used to preserve the alveolar bone space for nine years. At the age of 20, the patient underwent dental implant placement and restoration with a zirconia crown. This interdisciplinary and staged treatment approach ensured both functional stability and satisfactory aesthetic outcomes throughout all phases of management.

Keywords: Adolescent; Pediatric Dentistry; Root Resorption; Tooth Avulsion

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INTRODUCTION

Dental avulsion causes severe damage to the periodontal ligament and is considered one of the most significant forms of dental trauma.¹ The most critical complication following replantation is external inflammatory root resorption (EIRR).¹ This condition develops as a result of a necrotic and infected pulp, together with trauma-induced injuries to the periodontal ligament and root surface.¹ The resorptive process persists as long as the root canal system remains infected, ultimately leading to complete root resorption and potential tooth loss.^{2,3}

The severity of EIRR depends on the patient's age, with adolescent teeth progressing more rapidly compared to older patients.⁴ This is due to the wider dentinal tubules in young individuals, which facilitate the spread of microorganisms and accelerate resorption.⁴ The appearance of EIRR can vary from weeks to years, underscoring the importance of regular follow-up as recommended by the International Association of Dental Traumatology (IADT) guidelines.⁵ Teeth with EIRR can be asymptomatic, especially in the early stages, so careful clinical and radiological evaluation is essential.⁶ Timely treatment is crucial in stopping the progression of EIRR and promoting the repair of the tooth's hard tissues.

The long-term prognosis for post-traumatic EIRR depends on the size and severity of its expansion.³ Since small initial lesions of EIRR may not be visible on periapical radiographs, the pathology may be missed in the early stages and only diagnosed when it has become highly advanced. Consequently, the prognosis for most teeth affected by EIRR remains uncertain.

Dental traumatic injuries are most common in children during the crucial period of teeth and jaw development.⁷ The loss of teeth in children and adolescents can negatively impact craniofacial development.⁸ Even a single tooth extraction can significantly reduce the buccolingual alveolar

dimension, causing disruptions in the movement of posterior teeth and alterations in the dental arch perimeter.⁹ To prevent undesirable outcomes, clinicians should consider the long-term consequences of their treatment choices. Collaboration among interdisciplinary dental specialists ensures a comprehensive understanding of the dentoalveolar system's integrity and positively influences prognosis. This case report presents an interdisciplinary approach to managing EIRR in a young patient with avulsion of the maxillary central incisor, followed over a 10-year period.

CASE REPORT

This case report was prepared in accordance with the PRICE 2020 guidelines.¹⁰ A 10-year-old female patient was referred to an endodontist in private practice in Kaunas, Lithuania, on April 15, 2014. The patient expressed concern about "the bleeding gumball" adjacent to the right maxillary central incisor (#11) (Figure 1). Written informed consent was obtained to investigate the patient's complaint and to use intraoral and radiographic images for research and publication purposes. The medical history revealed that tooth #11 had been avulsed three and a half years earlier. According to the patient's mother, the avulsed tooth was promptly placed in a container with milk and replanted within two hours; however, no follow-up was conducted.

At the first appointment, clinical examination revealed localized proliferative inflammatory gingival tissue in the region of tooth #11. No sinus tract was detected, and the adjacent teeth showed no pathological changes. Probing of tooth #11 elicited bleeding and revealed an expanded defect with sharp, irregular edges. Pulp sensitivity tests (cold and electroodontometric) yielded negative responses. The tooth was not sensitive to percussion or palpation and exhibited no mobility.

A periapical radiograph demonstrated an extensive radiolucent area on the external root surface (Figure 2).



Figure 1. Baseline intraoral photograph showing bleeding gingival tissue adjacent to tooth #11, corresponding to the patient's chief complaint



Figure 2. Baseline periapical radiograph revealing extensive external inflammatory root resorption

Based on these clinical and radiographic findings, a diagnosis of severe external inflammatory root resorption (EIRR) of tooth #11 was established. Given the widespread nature of the resorption, the prognosis was considered questionable. Nevertheless, root canal treatment with long-term intracanal calcium hydroxide therapy and regular follow-up was initiated to maintain the tooth in the arch for as long as possible. This approach was selected to preserve the tooth during childhood, as dental implantation is not feasible until adulthood.

Root canal treatment was performed under local anesthesia with 1.7 mL of 4% articaine (Ubistesin Forte, 3M ESPE Dental AG, Seefeld, Germany), using a dental microscope (OPMI pico, Carl Zeiss Meditec AG, Jena, Germany) and rubber dam isolation. An endodontic access cavity was prepared with a round diamond high-speed bur under water cooling. Endodontic examination under the microscope revealed necrotic pulp tissue and resorption of the distal root wall extending into the periodontal tissues. The root canal was irrigated with 2.5% sodium hypochlorite with passive ultrasonic activation, followed by placement of an intracanal medication of calcium hydroxide (Hydrocal, P.P.H. CerkaMed, Stalowa Wola, Poland).

The calcium hydroxide dressing was replaced every two weeks over a four-month period. Subsequently, the tooth was reopened, and final irrigation was performed with 5 mL of 17% ethylenediaminetetraacetic acid (EDTA). After drying with paper points, the root canal was obturated with a tooth-colored mineral trioxide aggregate (ProRoot® MTA, Dentsply Sirona, Charlotte, North Carolina, USA) (Figure 3). The access cavity was sealed with composite resin.



Figure 3. Postoperative periapical radiograph following completion of root canal treatment for tooth #11

The patient underwent regular clinical and radiographic examination (Figures 4A–C) and remained free of complaints or symptoms. Radiographic evaluation showed no detectable progression of EIRR. Tooth #11 responded negatively to percussion and palpation tests, and the surrounding soft tissues exhibited no pathological changes. However, after nineteen months, periapical radiographs demonstrated rapid resorption progression, resulting in crown fracture of tooth #11 (Figure 4D). Following consultation with an endodontist, orthodontist, and oral surgeon, an interdisciplinary treatment plan was considered, which included a combination of endodontic surgical intervention and orthodontic therapy.

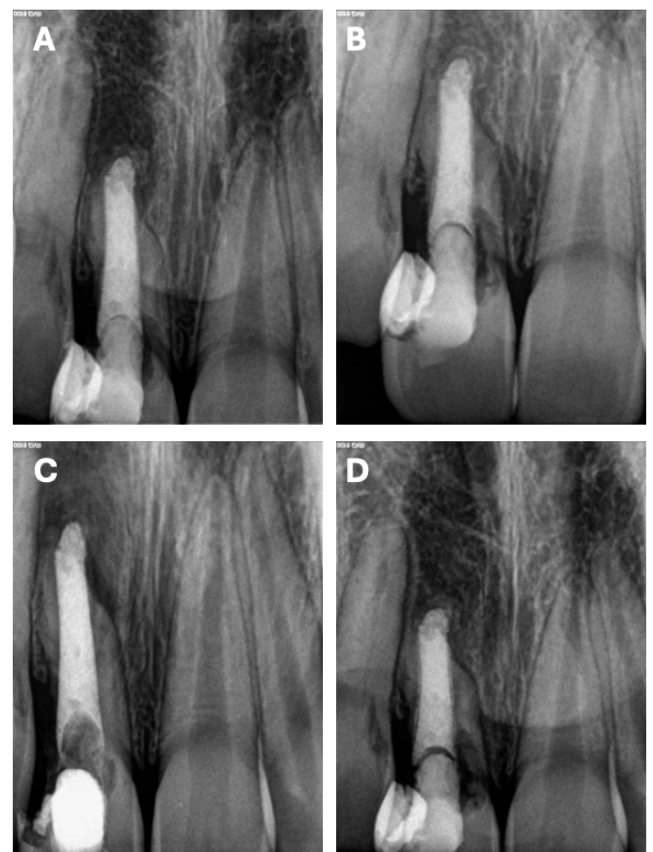


Figure 4. Clinical history of tooth #11. A: Postoperative periapical radiograph at 3 months after root canal treatment; B: Postoperative periapical radiograph at 8 months; C: Postoperative periapical radiograph at 10 months; D: Postoperative periapical radiograph at 14 months showing progression of EIRR and crown fracture

A decoronation procedure was performed by an endodontist in cooperation with an oral surgeon. The objective was to preserve the tooth root within the dental arch while maintaining alveolar bone height and width (Figure 5A, B). The procedure involved removal of the crown with a diamond bur under saline irrigation, filling of the root canal with mineral trioxide aggregate (MTA), and reduction of the root surface to 2 mm below the crestal bone level. The gingiva was sutured, and a removable customized orthodontic appliance was fabricated to maintain the space. This appliance also provided both esthetic and functional benefits (Figure 6).

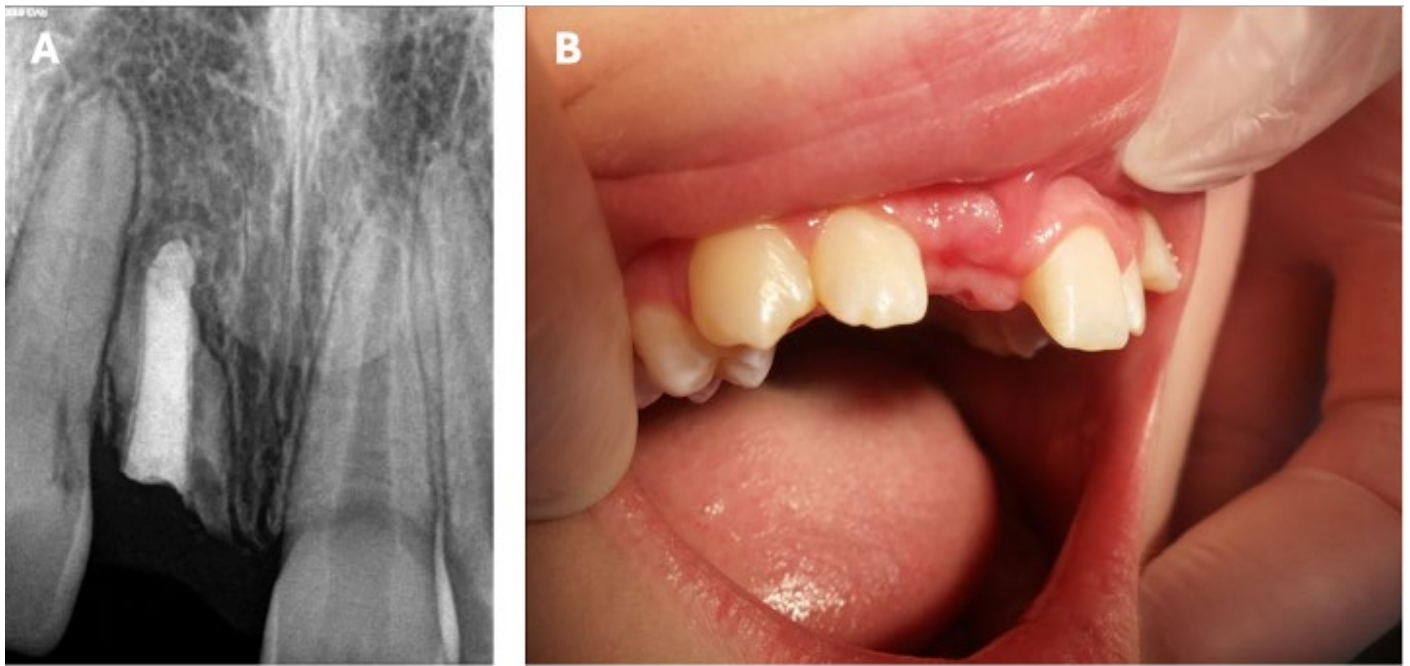


Figure 5. Tooth #11 following decoronation. A: Periapical radiograph showing the retained root filled with mineral trioxide aggregate and reduced 2 mm below the crestal bone level; B: Intraoral photograph demonstrating the surgical site after crown removal and soft tissue closure



Figure 6. Removable orthodontic appliance fabricated after decoronation, serving to maintain alveolar space and provide both esthetic and functional rehabilitation within the dental arch

Subsequent follow-up appointments after the decoronation procedure and during the period of removable orthodontic appliance use revealed no pathological changes.

At the age of 20, the patient underwent dental implant placement at the site of tooth #11, which was subsequently restored with a zirconia crown (Figures 7 and 8).

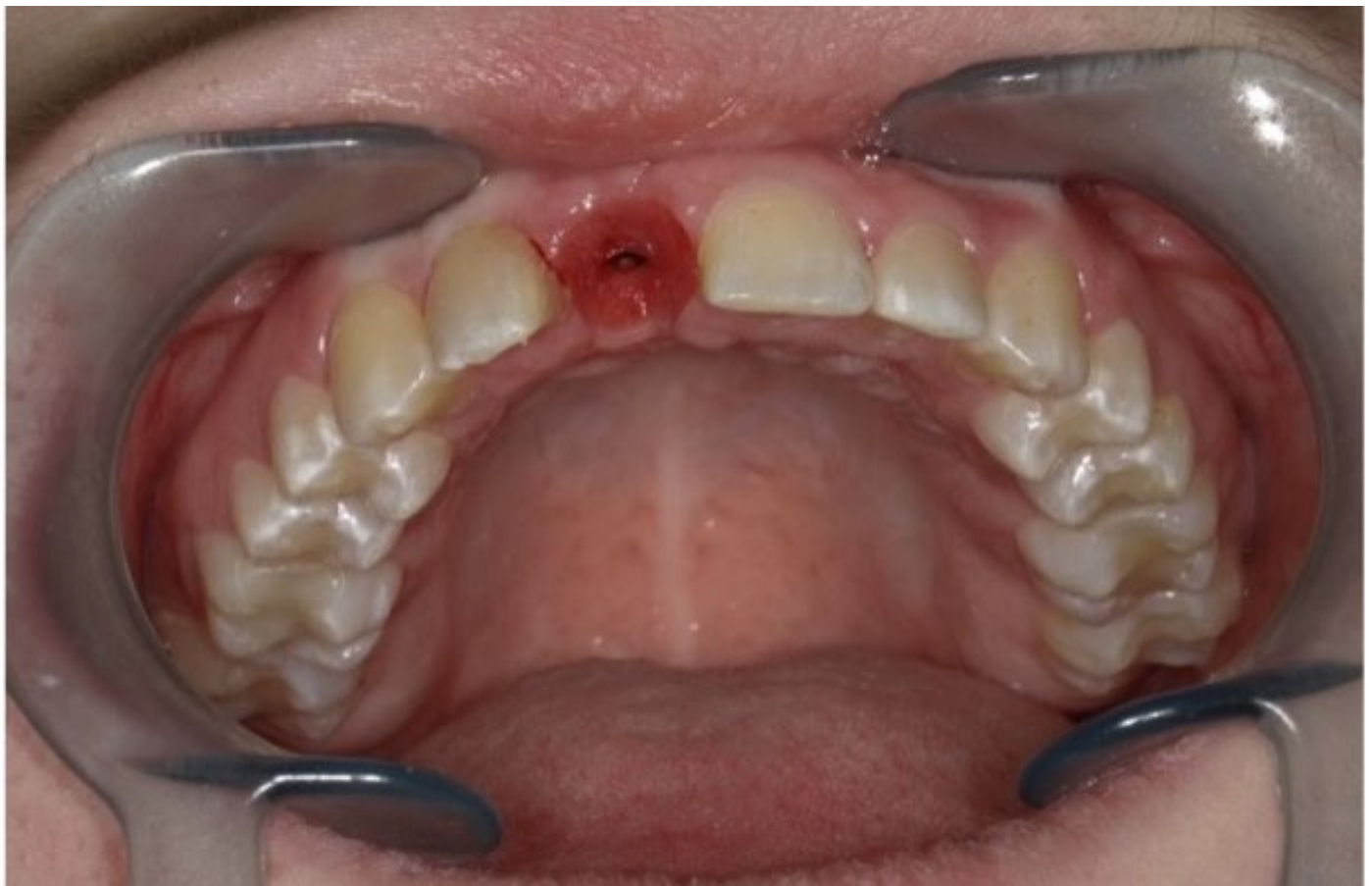


Figure 7. Intraoral photograph during dental implantation procedure



Figure 8. Intraoral photograph after zirconium crown restoration placement

DISCUSSION

The treatment of immature teeth after avulsion remains a significant clinical challenge. EIRR may occur shortly after trauma or present later, ranging from several weeks to years post-injury. Depending on the condition of the tooth and surrounding tissues, EIRR may remain asymptomatic and be detected only through radiographic changes.³ Although periapical radiographs are widely used for diagnosis, studies have demonstrated that lesions less than 0.3 mm in depth may not be detectable with conventional two-dimensional radiography.¹¹ Thus, periapical radiographs may fail to identify EIRR during the initial stages of its progression. When evaluating the risk of post-traumatic EIRR, clinicians should consider two key factors: the likelihood of infection in the root canal system and the extent of external root surface damage.³ In cases with a high risk of EIRR, additional imaging modalities such as cone-beam computed tomography (CBCT) should be considered. Timely treatment is crucial, as it can arrest the progression of EIRR and promote repair of the tooth's hard tissues.³

Regular follow-up visits are essential for traumatized teeth to allow early identification and management of pathological changes. However, in this case, follow-up was not maintained. This may have resulted from the dentist's lack of knowledge or failure to inform the patient's mother about the importance of ongoing monitoring for a favorable outcome. Recent research has shown that dentists' knowledge of dental trauma management is significantly associated with the number of trauma cases treated.¹² This suggests that the primary learning source for many clinicians is their own clinical experience. Such findings highlight a lack of formal education on dental trauma management, which may contribute to limited awareness and unfavorable outcomes. Consequently, in the present case, EIRR was not detected until it had progressed considerably. Despite this challenge, this case report

demonstrates an interdisciplinary approach to the management of severe EIRR in a young patient's maxillary central incisor. Treatment included decoronation with preservation of alveolar bone height and width until adulthood, ultimately resulting in patient satisfaction with both esthetic and functional outcomes throughout the treatment process.

Despite the extensive presence of EIRR, the decision was made to retain the tooth in the dental arch for as long as possible. This approach was primarily chosen because dental implants are contraindicated in very young patients. Recent research suggests that implant therapy may be considered in younger individuals.¹³ However, age-related limitations remain due to ongoing changes in alveolar bone dimensions. It is advisable to delay implant placement until at least 10 years of age to minimize complications associated with structural and growth factors. Nevertheless, implants pose challenges because they cannot adapt to the dynamic changes of growing tissues, leading to risks such as submergence relative to adjacent teeth and the dentoalveolar process.¹⁴ The likelihood of complications decreases in patients aged 15 years and older.¹³ Therefore, preserving natural teeth during adolescence is essential, as tooth loss results in decreased arch space and alveolar bone resorption. Rodd et al.⁹ highlighted the importance of prosthetic replacement for a lost incisor to prevent extensive resorption. Based on these findings, intentional retention of the root of the maxillary permanent incisor is recommended as a means to preserve alveolar bone, as demonstrated in this case.

To arrest EIRR and encourage the repair of periodontal ligament cells, interceptive treatment is recommended.³ This approach involves elimination of infection in the root canal through chemo-mechanical debridement, followed by placement of an intracanal calcium hydroxide dressing before final obturation. In the present case, consistent with standard EIRR management

protocols, root canal treatment with long-term calcium hydroxide therapy was performed to arrest the resorptive process. Calcium hydroxide inhibits clastic cell activity and prevents inflammatory resorption¹⁵. Successful root canal treatment can promote repair of hard tissues in areas affected by EIRR.¹⁶ Despite irreversible destruction of the root canal wall, hermetic obturation with mineral trioxide aggregate (MTA) stabilized the tooth root, which remained in the alveolar socket for 10 years. Although radiographic examination showed no change in the EIRR area during the first year after obturation, progression was observed 19 months later when a crown fracture occurred.

The traditional indication for the decoronation procedure is tooth ankylosis.¹⁷ However, given its primary purpose of preserving alveolar bone volume, decoronation may also be considered in other pathological conditions. In the present case, the procedure was performed to maintain alveolar bone height and width until implant placement. Contrary to the conventional protocol¹⁷, which recommends removal of the root canal filling, mineral trioxide aggregate (MTA) was intentionally left in the canal due to its favorable biological properties, including sealing ability, biocompatibility, and bone induction potential.¹⁸

Despite advanced external root resorption, the root of an avulsed tooth was successfully preserved for 10 years following trauma. In combination with a removable orthodontic appliance, this approach not only maintained the dimensions of the alveolar ridge and supported natural expansion of the dental arch, but also had no adverse effect on craniofacial development. The primary objective in this case was not merely to preserve the tooth for functional, esthetic, and social reasons, which are particularly important during adolescence, but also to maintain the overall integrity of the dentoalveolar system until the patient reached an appropriate age for dental implantation.

CONCLUSIONS

Despite severe post-avulsion external inflammatory root resorption and poor prognosis, tooth preservation was pursued as a long-term interdisciplinary option to maintain dentoalveolar integrity until an appropriate age for implant placement.

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