FROM HOPELESS TO REGENERATED: SUCCESSFUL PRESERVATION OF A TOOTH WITH MASSIVE PERIAPICAL LESION IN AN ADOLESCENT

Begović Adna[1]*, Hasić-Branković Lajla[1], Korać Samra[1], Ljaljević Faruk[2], Pašić Mirna[1], Halilović Mehinović Madžida[1]

[1] Department of Dental Pathology with Endodontics, Faculty of Dentistry with Dental Clinical Center, University of Sarajevo, Bosnia and Herzegovina

[2] Department of Oral surgery, Faculty of Dentistry with Dental Clinical Center, University of Sarajevo, Bosnia and Herzegovina

*Corresponding author

Adna Begović, DMD
Department of Dental Pathology with Endodontics
Faculty of Dentistry with Dental Clinical Center
University of Sarajevo
Bolnička 4a, 71 000 Sarajevo
Bosnia and Herzegovina
Phone: +387 62 485 310
e-mail: adnabegovic@sf.unsa.ba

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ABSTRACT

IB**ackground**: Periapical lesions in adolescents present a particular therapeutic challenge due to age-related anatomical and physiological characteristics, including greater susceptibility to dental trauma, higher caries risk, wide apical foramen and thin dentinal walls. At the same time, high regenerative capacity offers the possibility of successful treatment even in cases with an initially very poor prognosis.

Case Presentation: This report presents a 14-year-old patient with a massive periapical lesion and an iatrogenic root canal perforation of tooth 12. Cone-beam computed tomography (CBCT) imaging revealed an extensive osseous defect with complete perforation of the palatal cortical plate and marked destruction of the vestibular bone. Management included sealing the perforation with MTA under an operative microscope and endodontic treatment followed by apicoectomy with bone graft augmentation and placement of a PRF membrane. After the surgery, the tooth was stabilized with a wire-composite splint until physiologic stability was restored. A four-month follow-up CBCT scan showed complete repair of the osseous defect, homogeneous graft integration, re-established cortical continuity, and preservation of a normal periodontal ligament space. Clinically, stable function and satisfactory esthetics were achieved.

Conclusion: This case demonstrates that even large periapical lesions complicated by iatrogenic perforation with an initially unfavorable prognosis can be successfully managed through a combination of advanced endodontic therapy and surgical intervention. A multidisciplinary approach, precise diagnostics, and the use of bioactive materials enabled preservation of the natural tooth and complete recovery of periapical structures in an adolescent patient.

Keywords: massive periapical lesion, adolescent, endodontic surgery, regenerative dentistry, bioactive materials

Introduction

Periapical lesions in children and adolescents hold particular clinical significance due to anatomical and physiological characteristics, such as increased susceptibility to trauma, high caries risk associated with poor oral hygiene and, in cases of incomplete root development, a wide apical foramen and thin dentinal walls, that can complicate treatment and allow a progressive infection spread [1, 2, 3]. However, young patients' tissues demonstrate enhanced vascularization and high regenerative potential, promoting faster, more effective tissue repair [4]. This report aims to present the therapeutic protocol and clinical outcome of treating a tooth with an extensive periapical lesion in an adolescent patient, emphasizing the importance of comprehensive clinical assessment providing0 tooth preservation despite a poor initial prognosis.

Case report

A 14-year-old patient was referred to the Clinic of Dental Pathology and Endodontics due to persistent symptoms in tooth 12 following unsuccessful long-term repeated endodontic treatment. Medical history revealed a sports-related trauma occurred prior to two years .

Figure 1. Initial periapical radiograph

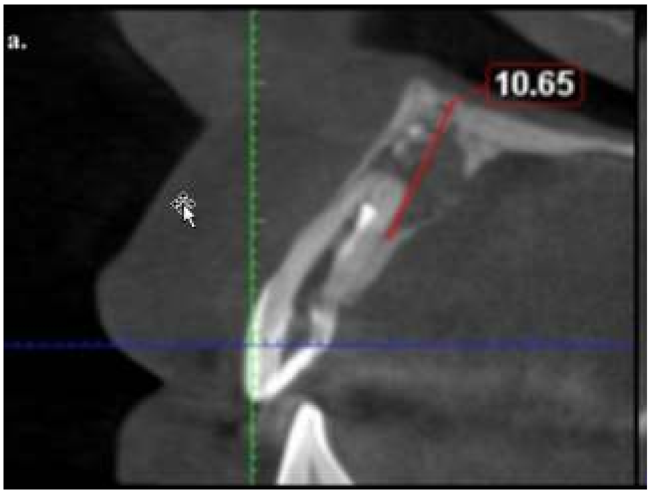

Figure 2a.
Dimensions of the lesion on sagittal CBCT view

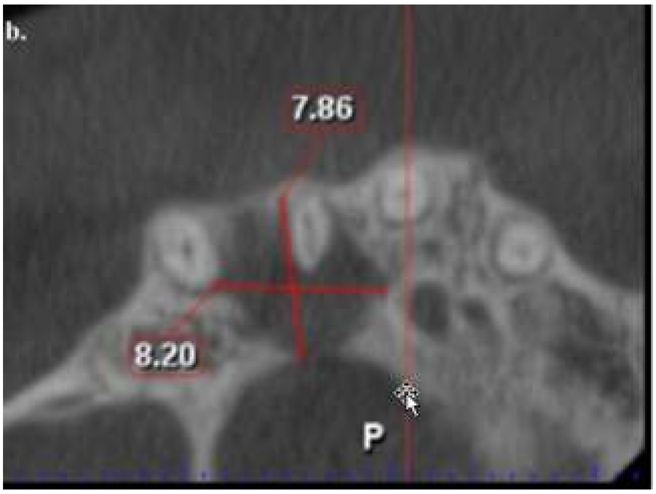

Figure 2b.
Dimensions of the lesion on axial CBCT view

Clinical examination under an operative microscope and radiographic analysis showed a previously initiated endodontic treatment and a *fausse route* in the cervical third of the root. Previous radiographs revealed an extensive periapical radiolucency with residual intracanal medication **(Figure 1)**. The patient was referred for a segmental cone-beam computed tomography (CBCT) scan, which confirmed a significant bone defect measuring 10.65 mm in the apico-coronal, 7.86 mm in the bucco-palatal, and 8.20 mm in the mesic-distal dimensions **(Figure 2)**. The palatal cortical bone was completely perforated, with a significant destruction of the vestibular bone

Figure 3.
Axial CBCT view shows complete perforation of palatal cortex

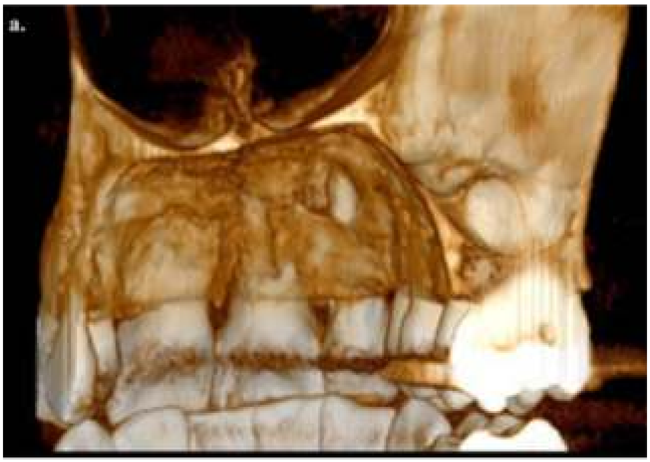

Figure 4a.
Absence of the palatal bone on 3D reconstruction view

Figure 4b.
Vestibular bone defect on 3D reconstruction view

(Figure 3, 4). Communication between the periapical lesion and the root canal through the perforation was observed **(Figure 5)**, creating a pathway for Para radicular spread of infection, which affected approximately three-quarters of the root length.

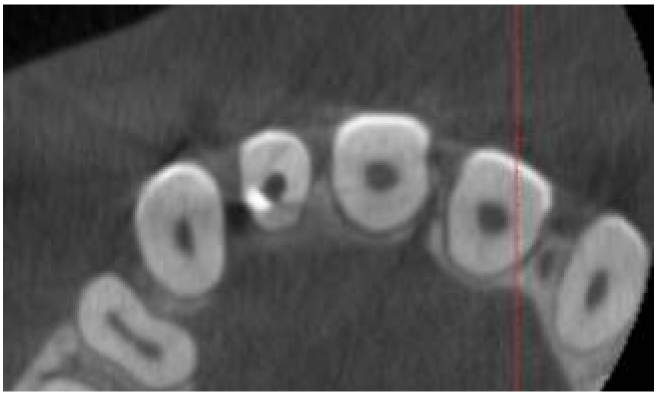

Figure 5. Communication between the perforation and the lesion on an axial CBCT view

Case management

During the first visit, the iatrogenic root canal perforation was sealed using a mineral trioxide aggregate (MTA)-based material under the operative microscope. The canal was then instrumented to a size of 40/.04 with copious irrigation using 2.5% sodium hypochlorite. At the end of the procedure, calcium hydroxide was placed in the canal, along with a gutta-percha cone used as a physical barrier for potential MTA extrusion from the perforation site into the canal, which could compromise future access to the root canal. After 10 days, the canal was obturated with gutta-percha and a bio ceramic sealer using the ultrasonic condensation technique, and the access cavity was restored with a glass-ionomer filling.

Figure 6. Vestibular bone fenestration observed after flap elevation

Figure 7a. The bone defect after the apicoectomy and cystectomy
Figure 7b. Pathological material after enucleation

The treatment plan mandated sequential performance of endodontic and surgical procedures. Therefore, the patient was admitted to the Clinic of Oral Surgery the following day, immediately after the canal filling had set. Four tubes of blood were collected, from which were obtained two platelet-rich fibrin (PRF) membranes and one PRF clot. Sticky bone graft was prepared using synthetic bone material. A mucoperiosteal flap with a distal releasing incision was raised to gain access to the surgical field, revealing the bone defect and the lesion with Para radicular extension **(Figure 6)**. Apicoectomy of tooth 12 was performed along with cystectomy **(Figure 7)**. The bone defect was filled with sticky bone and covered with PRF membranes. The flap was sutured using 5-0 resorbable monofilament sutures.

Figure 8. Control periapical radiograph after the splint placement

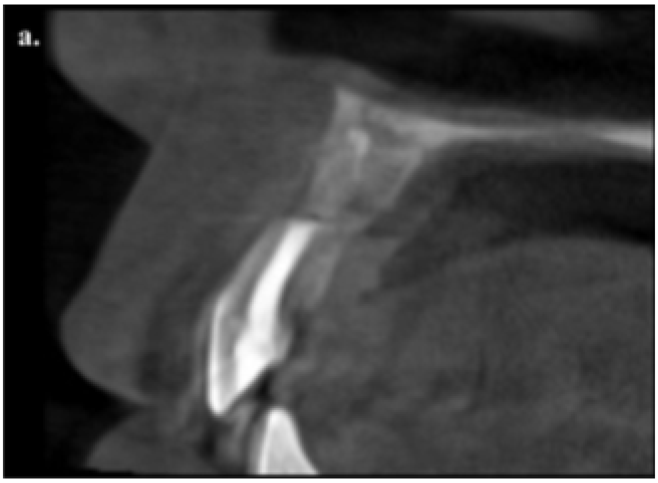

Figure 9a.
Control CBCT scan in sagittal view

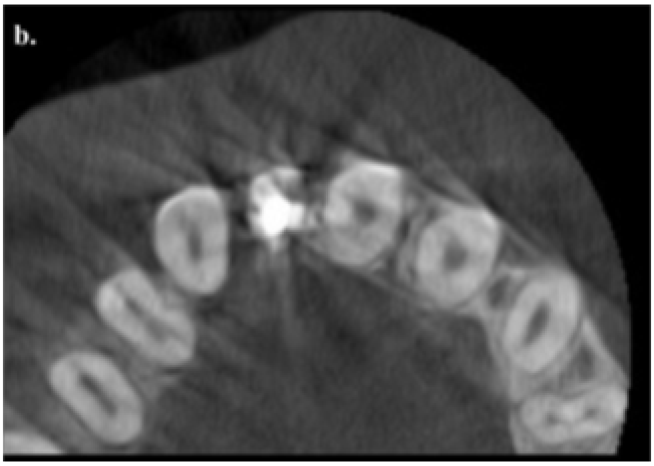

Figure 9b.
Control CBCT scan in axial view

At the follow-up examination 4 days after surgery, due to grade 3 tooth mobility, a wire-composite splint was placed involving teeth 11 to 14 **(Figure 8)**. The patient attended regular follow-ups every 2 weeks. Physiologic tooth stability was achieved after 8 weeks and the splint was removed.

After 4 months, a follow-up CBCT scan showed that the graft was successfully integrated, the bone defect was homogenously filled, with no signs of resorption or pathological cavities, and the cortical continuity had been restored **(Figure 9)**. The tooth was subsequently reconstructed and reshaped with a composite veneer.

Discussion

Periapical lesions in adolescents represent a particular clinical challenge due to specific anatomical and physiological characteristics that increase the risk of rapid infection progression and destruction of surrounding bone structures. In the presented case, the patient exhibited a significant degree of bone destruction, with complete perforation of the palatal cortex and major vestibular resorption which were findings traditionally associated with an extremely poor tooth prognosis. Severe bone resorptions allow progressive spread of infection into surrounding tissues, making microbial elimination via standard endodontic treatment more difficult, thereby increasing the risk of persistent infection and recurrence [5]. Additionally, loss of bony support structurally compromises tooth stability, leading to increased mobility and potential tooth loss. Although the adolescent patients show an immense regenerative capacity due to increased tissue vascularization and numerous active osteoblasts and fibroblasts, such extensive defects rarely undergo spontaneous repair, requiring a multidisciplinary treatment.

Moreover, the presence of an iatrogenic perforation in the cervical third of the root provided a direct pathway for potential infection spread, further complicating the therapeutic approach. Due to the size and radiographic characteristics of the lesion, tooth 12 was managed under an empirical diagnosis of an odontogenic cyst, although a definitive diagnosis can be confirmed only through histopathological analysis. Considering the critically unfavorable prognosis, extraction was initially indicated. However, in an adolescent patient, loss of a tooth in the esthetic zone could significantly affect self-esteem, socialization, and psychological well-being. Hypodontia of tooth 22 contributed to the overall complexity of the case, given that the extraction of tooth 12 would result in challenging functional and esthetic compromises.

While several replacement options were considered, each carried limitations due to the patient's developmental stage, ongoing growth, and high esthetic demands in the anterior region. Adolescents belong to an age group with incomplete craniofacial and jaw development, making conventional fixed prostheses, including bridges and implant-supported restorations, typically contraindicated. A fixed bridge would require preparation of adjacent teeth and the removal of substantial healthy tooth structure. Additionally, fixed prostheses can inhibit premaxillary growth, while the maxilla and alveolar ridge continue to develop. Teeth included in a fixed bridge are rigidly connected and restricted in physiological movement, potentially resulting in disproportion between the prosthetic segment and the surrounding osseous structures, which can manifest clinically as asymmetry or a midline shift [6]. Consequently, occlusal relationships may be altered with masticatory forces distributed unevenly. Vertical sceletal dental growth during adolescence also affects apical migration of the gingiva, which can negatively impact the long-term esthetics of a fixed prosthesis [7].

Although implant-supported rehabilitation provides the most favorable esthetic and functional outcomes in adults, it is usually contraindicated in adolescents. The implant, once integrated into bone, remains in a fixed position and cannot follow maxillary growth or vertical changes of the gingiva and alveolar ridge. Thus, the implant remains in an apical position, leading to infraocclusion of the superstructure in reference to the adjacent teeth, which is unacceptable in a highly esthetic zone such as tooth 12 [6].

Therefore, the only optimal temporary therapeutic option was a partial denture (flipper). While minimally invasive, continuous growth and movement of adjacent teeth may affect the stability and retention of the prosthesis, reducing functional performance and patient comfort. Long-term complications may include soft-tissue irritation, alveolar ridge changes, and altered distribution of masticatory forces [8]. This type of prosthesis serves only as a temporary solution until the patient becomes a candidate for more definitive restorations after craniofacial growth is complete.

The decision to pursue combined endodontic-surgical treatment was driven by the goal of preserving the natural tooth in a highly esthetic region despite a very poor prognosis, in light of the patient's psychological and social well-being.

The primary objective of treatment was to achieve thorough disinfection of the root canal system and homogenous obturation via orthograde endodontic therapy. The use of an operative microscope enabled precise localization of the existing cervical root perforation and improved control during MTA application, contributing to the effective repair of the *fausse route* [9].

MTA provides not only mechanical sealing but also shows bioactive properties, promoting mineralized tissue formation [10]. Its highly alkaline pH provides antibacterial features, contributing to infection control at the perforation site [11]. Additionally, MTA demonstrates high biocompatibility and minimal cytotoxicity to surrounding tissues, supporting the regeneration of periradicular and periodontal structures without significant inflammatory response [12]. Upon hydration, MTA initially forms calcium hydroxide and releases calcium ions, which are essential for adhesion, proliferation, and functional activity of reparative cells [13]. The release of calcium ions induces the expression of Bone Morphogenetic Protein 2 (BMP-2), which stimulates periodontal ligament progenitor cells to produce mineralized matrix locally. This process promotes their differentiation into osteoblasts and cement oblasts, ultimately supporting the formation of robust mineralized tissue in the peri radicular region [14]. Moreover, MTA modulates cytokine production by suppressing proinflammatory while stimulating reparative cytokines, thereby maintaining a regulated and balanced inflammatory response [15]. Finally, hydroxyapatite or carbonate apatite forms on the surface of MTA, establishing a stable biological seal and ensu-ring long-term hermetic closure of the perforation [10].

The perforation was closed during the initial visit because the interval between perforation's occurrence and its sealing is critical for minimizing microbial contamination and preventing localized periodontal ligament inflammation, which ultimately improves treatment prognosis [16, 17].

The root canal was instrumented to size 40/.04 with abundant irrigation using 2.5% sodium hypochlorite. At the end of the first visit, a calcium hydroxide-based intracanal medicament was placed along with gutta-percha. Although the perforation had already been sealed with MTA, the perforation site remained biologically active and sensitive to pH fluctuations, minor material displacement, and microleakage. Freshly mixed MTA has an initial pH of approximately 10–10.2, which gradually increases during hydration and setting to approximately 12.5 over 24–72 hours as the material fully sets [18, 19]. In contrast, the pH of calcium hydroxide immediately upon application is approximately 12.5–12.8 [20].

During the initial setting phase, the MTA surface is relatively sensitive to strong alkaline substances. Contact with calcium hydroxide could potentially destabilize the surface layer of MTA, compromising hermetic sealing. Gutta-percha, placed between the calcium hydroxide and MTA, acts as a physical barrier protecting MTA during early setting, while allowing the antibacterial action of calcium hydroxide in the rest of the canal. Also, it stabilizes the filling, thereby reducing microleakage and micromovements of the material [21].

After 10 days, the canal was obturated with gutta-percha and a bio ceramic sealer using ultrasonic condensation technique. Considering the morphological irregularities of the canal due to prolonged previous treatment, including uneven canal diameters along its length, ultrasonic condensation was selected as the most favorable method, as it provides superior gutta-percha adaptation to canal walls and efficient filling of irregularities, minimizing voids and ensuring three-dimensional hermetic sealing [22, 23].

The selection of a bio ceramic sealer was based on its biocompatibility, bioactivity, and dimensional stability. Calcium silicate-based sealers release hydroxyl and calcium ions during setting, which react with phosphate ions from dentinal fluid to form hydroxyapatite. Hydroxyapatite deposition creates a mineral infiltration zone between the sealer and dentin, providing chemical bonding, while the diffusion of sealer particles into intertubular dentin creates mechanical interlocking with the canal walls. This ensures improved adaptation and sealing, as well as the promotion of mineralization of surrounding tissues (dentin, cementum, periapical bone) [24, 25]. Studies show that calcium silicate sealers promote osteoblastic differentiation and hydroxyapatite deposition in an osteoblastic cell line while reducing proinflammatory cytokine expression in macrophages, further supporting periapical healing [26]. Given that the root perforation had been previously sealed with MTA, the sealer's bioactivity and compatibility with MTA were pivotal. Furthermore, bio ceramic sealers exhibit minimal shrinkage upon setting, reducing the risk of microleakage [27].

Due to the bio ceramic sealer's setting time, which is approximately 4 hours or even prolonged depending on environmental conditions [24], the surgical intervention was performed the day after the obturation. Apicoectomy and cystectomy were performed, and the bony defect was filled with a sticky bone, which is a combination of PRF and bone substitute material. This combination provides greater Oste inductive and osteoconductive support compared to the use of either bone substitute or PRF alone [28]. The fibrin network of PRF stabilizes the graft particles, allowing efficient three-dimensional filling of irregular defects, while growth factors contained within PRF, such as transforming growth factor β1 (TGF-β1), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), and insulin-like growth factor (IGF), stimulate angiogenesis, osteogenesis, and fibroblast proliferation [29]. This accelerates healing and improves the quality of newly formed bone [30]. Furthermore, sticky bone offers superior stability compared to conventional bone granules, reducing graft migration and facilitating easier shaping and placement into the defect. The autologous nature of PRF minimizes immunologic reactions and lowers the risk of graft rejection [29].

Due to severe postoperative tooth mobility, immobilization using a wire-composite splint allowed physiologic stability of the tooth during the regenerative process, as confirmed by follow-up evaluation at 8 weeks. Although there was concern regarding potential ankylosis, the degree of mobility required prolonged splinting with mandatory frequent monitoring. Ultimately, the tooth achieved stable alveolar fixation, maintaining physiologic mobility and radiographically preserved periodontal ligament space.

A follow-up CBCT scan at four months showed complete healing of the bone defect with homogeneous integration of the graft. There was an evident reduction of the radiolucent area, formation of new bone at the graft site, trabecular homogenization, and reestablishment of cortical continuity, indicating successful repair and regeneration of periapical tissue.

Conclusion

Teeth with large periapical lesions in adolescent patients, including those initially deemed hopeless and indicated for extraction, can achieve successful therapeutic outcomes. Although the procedure is technically demanding and requires a high level of expertise and meticulous planning, the expected benefits exceed the risks associated with extraction and early prosthetic rehabilitation. Thanks to the biological characteristics of a young patient, significant lesion regression can be achieved, preserving both tooth function and esthetics. The tooth's long-term prognosis depends on the success of endodontic and surgical procedures and their coordination, the maintenance of proper oral hygiene, and participation in regular follow-up assessments.

Declaration of Interest:

Authors declare NO conflict of interest.

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