Healing with Precision: Case Reports on Microsurgical Approach to Endodontics

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Abstract

Trauma-induced periapical granulomas and cysts are relatively common but cause significant complications in endodontic practice, often resulting from chronic infection following dental trauma. These lesions can lead to persistent pain, swelling, and potential tooth loss if not properly managed. Conventional endodontic treatment may not always address the underlying pathology, necessitating more invasive surgical interventions. Surgical removal of these lesions combined with apicectomy is a well-established approach to treat, as it not only eliminates the lesion but also addresses any infection present at the root apex, thereby improving the prognosis for tooth retention. In these case reports, trauma-related periapical granuloma and cyst was successfully managed by a combination of surgical removal and apicectomy. Through these interventions, the affected teeth were preserved, and the patient's symptoms were resolved, highlighting the effectiveness of the combined treatment strategy in managing complex endodontic pathology.

Keywords

- apicectomy
- MTA
- periapical cyst
- root canal treatment
- traumatic bone cyst

Introduction

Dental trauma, particularly when it involves the loss or injury to a tooth's vitality, can result in a variety of complications, one of the more concerning being the formation of periapical granulomas and cysts. These cysts are often associated with chronic infections that arise from untreated or inadequately treated traumatic injuries. Periapical cysts, although rare, can lead to persistent symptoms such as pain, swelling, and radiographic evidence of bone destruction, threatening the survival of the affected tooth.[1] Conventional endodontic treatments may be insufficient in these cases, especially when a cystic lesion is present, necessitating more advanced surgical intervention.[2] Cyst enucleation, combined with apicectomy, offers an effective approach to treating trauma-induced periapical cysts.[3] This dual procedure addresses both the cystic lesion and any potential infection at the root apex, thus eliminating the source of pathology while promoting the preservation of he tooth. An apicectomy involves surgically removing the infected root tip and sealing the root canal system with a retrograde filling, effectively preventing reinfection.[4] The main objective of documenting these case reports is to demonstrate the management of a periapical lesions associated with dental trauma using surgical intervention and apicectomy.[5] Through these reports, we aim to highlight the clinical decision-making process, the surgical technique employed, and the favorable outcome achieved. These cases also reinforce the importance of timely intervention and a comprehensive treatment approach when managing complex endodontic cases, particularly those involving trauma-induced granuloma and cyst formation.[6] By documenting these cases, we emphasize the importance of combining both surgical techniques to not only address the

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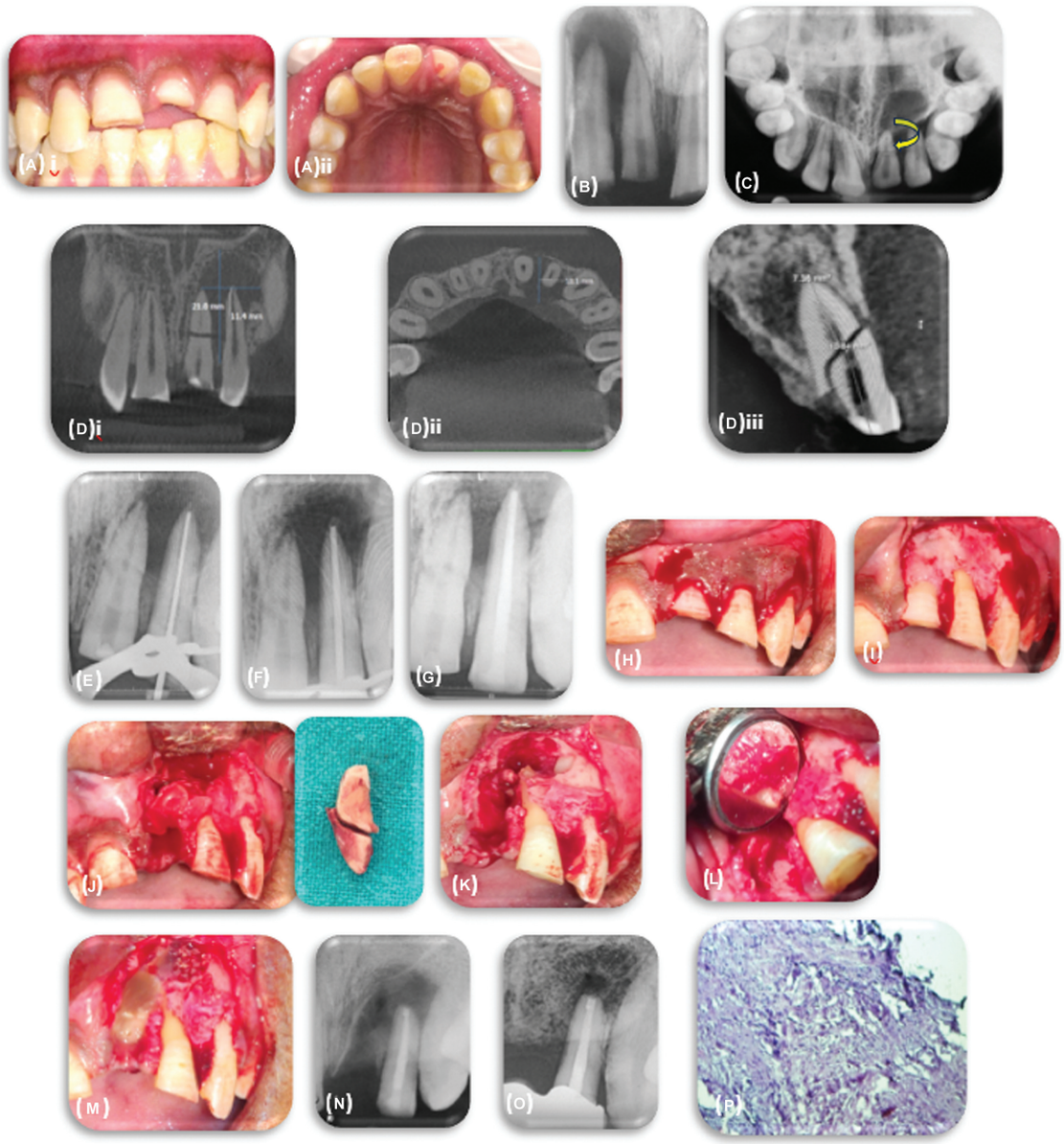

Fig. 1 (**A**) Preoperative photograph, (**B**) preoperative radiovisiography (RVG), (**C**) preoperative occlusal radiograph, (**D**) (i) cone-beam computed tomography (CBCT) sagittal view, (ii) CBCT axial view, (iii) CBCT coronal view, (**E**) working length RVG (22), (**F**) master cone RVG (22), (**G**) obturation RVG (22), (**H**) incisions, (**I**) full-thickness flap raised, (**J**) extraction done of 21, (**K**) lateral and apical bone defect in 22, (**L**) clinical view of retrofilled mineral trioxide aggregate (MTA), (**M**) bone graft and platelet-rich fibrin (PRF) placed in the bony defect, (**N**) postoperative RVG, (**O**) 6 months' follow-up, and (**P**) histopathological examination—granulation tissue.

infection but also retain the tooth and its function in the long term, showcasing the positive impact of such interventions in modern endodontics.

Case Report 1

A 20-year-old male patient visited to the department of conservative dentistry and endodontics with a primary complaint of a fractured upper front tooth, persisting for the past 1.5 year. The patient had a history of trauma to the same tooth due to a fall approximately 1 year ago. His medical history was noncontributory. On clinical examination, permanent maxillary left central incisor had Ellis class III fracture and grade 1 mobility. The lateral incisor did not demonstrate abnormal mobility (►**Fig. 1A**). No response was elicited on both cold and electric sensibility tests with respect to 21 and 22. Periapical radiograph revealed a large periapical lesion with respect to 21 and 22 (►**Fig. 1B**). An occlusal radiograph was done to check for the fracture line in 21 (►**Fig. 1C**). A cone-beam computed tomography (CBCT) scan was further done to check for the extent of the fracture. CBCT scan revealed round to oval radiolucency with no

distinct borders in relation to 21 and 22 and an oblique fracture line in 2 (►**Fig. 1D**).

Endodontic therapy with respect to 22, followed by apicectomy and retrograde mineral trioxide aggregate (MTA) filling, was planned as the preferred treatment and extraction of tooth 21. After isolating the area with a rubber dam, tooth 22 was accessed, and the working length was determined using an electronic apex locator (Root ZX Mini, J Morita) and radiographic confirmation was done (►**Fig. 1E**).

Copious irrigation of the canal was done with normal saline, and root canal preparation was performed using (ISO) 80 K-file (Dentsply Maillefer, Switzerland) with a circumferential filing motion. Thorough debridement was achieved through alternating irrigation with a copious amount of 2.5% sodium hypochlorite and normal saline. Smear layer was also eliminated using 3 mL of 17% ethylenediaminetetraacetic acid (EDTA) solution (Waldent, India). Calcium hydroxide was given as an intracanal medicament, and the access cavity was sealed with Cavit. The patient was scheduled for a follow-up after 5 days.

At the next appointment, the tooth was reisolated using a rubber dam, and the root canal was irrigated with 2.5% sodium hypochlorite (Prevest Dentpro, India) with sonic activation to remove any remaining calcium hydroxide and achieve thorough disinfection. A triple antibiotic paste (TAP) containing equal amounts of ciprofloxacin, metronidazole, and minocycline was then applied as an intracanal medicament for 10 days.

Upon recall, the canal was irrigated, dried using absorbent paper points (Meta BioMed, Korea), and obturated with Sealapex root canal sealer (Kerr Dental, South Korea). A postobturation restoration was then completed using composite resin (3M Composites, United States) (►**Fig. 1F** and **G**).

Surgical Phase

Blood tests were performed to confirm the absence of any underlying pathology. Local anesthesia (LA) was administered using 2% lidocaine via infiltration. To access the surgical site, a full-thickness mucoperiosteal flap was raised by making two vertical releasing incisions along with a crevicular incision (►**Fig. 1H** and **I**). A trapezoidal flap was raised, and tooth 21 was extracted (►**Fig. 1J**).

Upon identifying the bone defect, a window larger than 1×1 cm was made using a straight micromotor handpiece and bone-cutting burs with copious water irrigation (►**Fig. 1K**). Note that 3 mm of root-end resection was performed, and curettes were used to remove the entire granulation tissue. The excised tissue was preserved in 10% formalin for histopathological analysis. MTA was then used as a retrograde filling bioceramic material (►**Fig. 1L**), and the bone defect was managed by placing platelet-rich fibrin (PRF) along with a bone graft (►**Fig. 1M**).

A postoperative intraoral periapical radiograph (IOPA) was taken to confirm proper root-end restoration (►**Fig. 1N**). Suture removal was done after 10 days and follow-up of the patient after 6 months (►**Fig. 1O**). The histopathological biopsy report confirmed the presence of granulation tissue (►**Fig. 1P**).

Case Report 2

A 28-year-old male reported to the department of conservative dentistry and endodontics with a primary complaint of buccal swelling in the upper right front region from past 3 months. The patient had a history of trauma from a fall approximately 2 years back. Medical history of the patient was noncontributory.

On clinical examination, a sinus tract was found associated with tooth number 12, which displayed grade 1 mobility. Tooth 11 was missing, and a fixed prosthesis extended across teeth 12, 11, and 21 (►**Fig. 2A**). After the removal of the fixed prosthesis, both cold and electric pulp sensibility tests were performed on tooth 12, but no response was elicited (►**Fig. 2B** and **C**).

A periapical radiograph revealed a large radiolucency associated with tooth number 12, and a sinus tract tracing was performed using the gutta-percha point (►**Fig. 2D**). A CBCT scan was conducted for improved diagnosis, revealing a well-defined, round radiolucency with a perforation in the buccal cortical plate (►**Fig. 2E**).

The planned treatment involved root canal therapy for tooth 12, followed by apicectomy and retrograde MTA filling. After achieving rubber dam isolation, access to tooth 12 was done, and the working length determination was done using an electronic apex locator (Root ZX Mini, J Morita). Root canal irrigation was done initially with normal saline.

Root canal preparation was performed using an (ISO) size 70 K-file (Dentsply Maillefer, Switzerland) with a circumferential filing motion. Copious irrigation with 2.5% sodium hypochlorite (NaOCl), alternated with normal saline, was done for thorough debridement. For smear layer removal, 3 mL of 17% EDTA solution (Waldent, India) was used. Calcium hydroxide was given as an intracanal medicament followed by placement of Cavit. The patient was recalled after 5 days.

On the second visit, isolation was done using rubber dam. The root canal was irrigated with 2.5% NaOCl (Prevest Dentpro, India) and activated sonically to enhance disinfection. TAP containing equal amounts of ciprofloxacin, metronidazole, and minocycline was then given as an intracanal medicament for 10 days.

During the next recall, the root canal was thoroughly irrigated, absorbent paper points (Meta BioMed) were used to dry the canal, and obturation was completed with Sealapex root canal sealer (Kerr Dental, Meta BioMed). The procedure was completed with a postobturation restoration using composite resin (3M Composites) (►**Fig. 1F** and **G**).

Surgical Phase

Blood tests were performed to ascertain the absence of any underlying hematological pathology. LA was administered via infiltration using 2% lidocaine to ensure adequate pain control. Full-thickness mucoperiosteal flap was raised by giving two vertical releasing incisions along and crevicular incision (►**Fig. 2H**). A trapezoidal flap was reflected, exposing the underlying bone defect. A bony window was then created using a straight micromotor handpiece and bone-

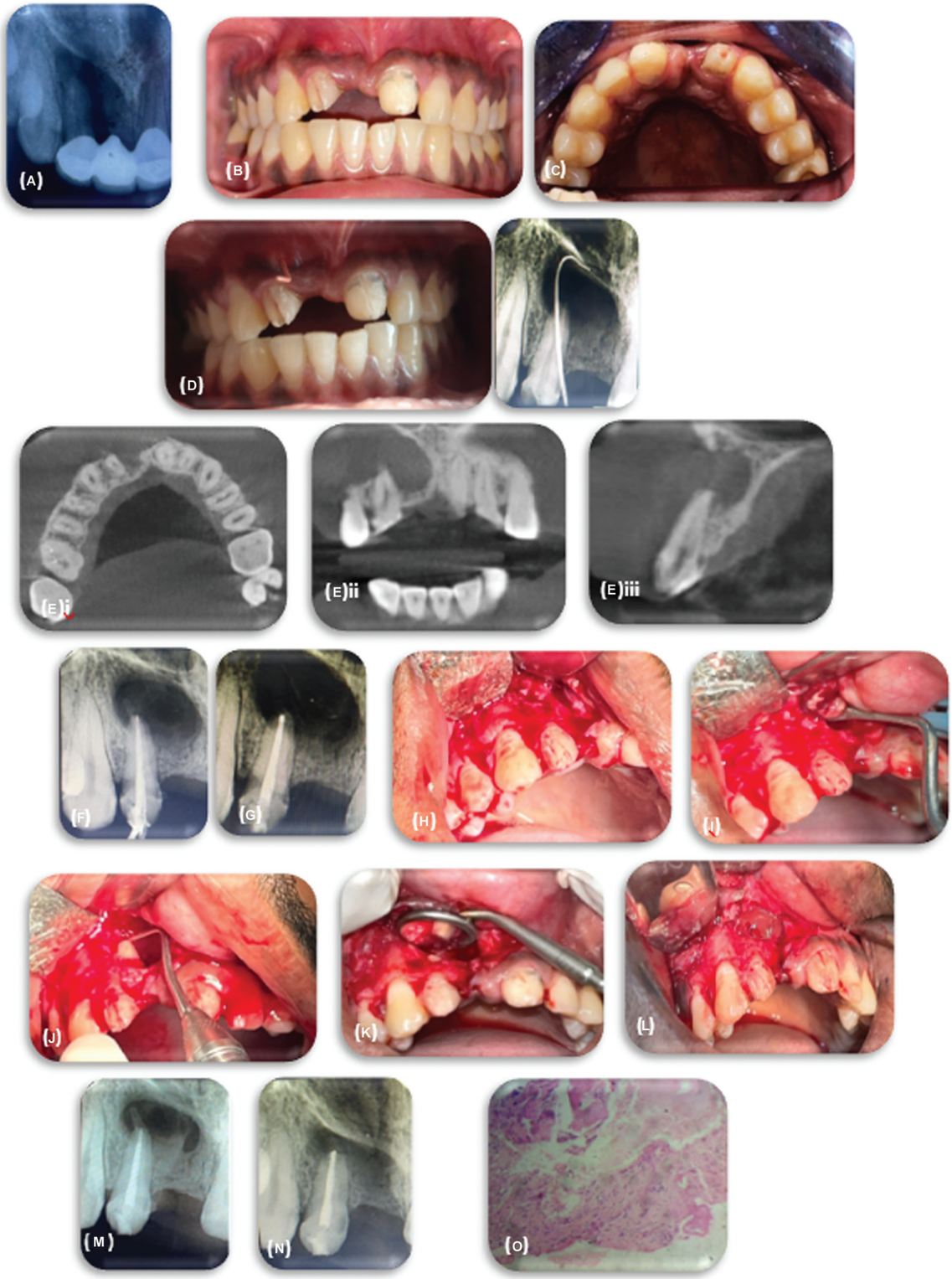

Fig. 2 (**A**) Preoperative radiovisiography (RVG), (**B** and **C**) preoperative photograph, (**D**) sinus tracing, (**E**) (i) cone-beam computed tomography (CBCT) axial view, (ii) CBCT sagittal view, (iii) CBCT coronal view, (**F**) master cone RVG (12), (**G**) obturation RVG (12), (**H**) full-thickness flap raised, (**I**) apical bone defect in 12, (**J**) exposing the root of 12, (**K**) clinical view of retrofilled mineral trioxide aggregate (MTA), (**L**) platelet-rich fibrin (PRF) placed in the bony defect, (**M**) postoperative RVG, (**N**) 6 months' follow-up, and (**O**) histopathological examination—traumatic bone cyst.

cutting burs under continuous sterile saline irrigation (►**Fig. 2I**).

A root-end resection of approximately 3 mm was performed (►**Fig. 2J**). Granulation tissue within the defect was thoroughly debrided using curettes, and the excised tissue was placed in 10% formalin for the histopathological analysis. A retrograde cavity was then prepared and filled with MTA (►**Fig. 2K**). To facilitate healing, PRF was placed within the bone defect (►**Fig. 2L**).

A postoperative IOPA was obtained to confirm the adequacy of the root-end restoration (►**Fig. 2M**). The patient was recalled after 10 days for suture removal and subsequently reviewed at 6 months, during which he remained asymptomatic (►**Fig. 2N**). Histopathological examination of the biopsy specimen confirmed the diagnosis of a traumatic bone cyst (►**Fig. 2O**).

Discussion

Endodontic surgery involves the removal of diseased periapical tissue to facilitate healing, encourage tissue regeneration, and restore the structural integrity of the tooth.

The success of primary endodontic surgery ranges between 78 and 91%.[7] From a pathological standpoint, the precise histological nature of a periapical lesion that appears as a radiolucency on a radiograph is often uncertain at the time of treatment. Approximately 10% of all periapical lesions require surgical intervention alongside the conventional endodontic therapy.[2]

Trauma-induced periapical pathology poses a unique challenge in endodontic treatment, often necessitating a multidisciplinary approach to achieve long-term success.[8] In clinical scenarios where conventional root canal therapy fails due to persistent periapical infection, apical pathology, or anatomical complexities, apicectomy serves as a reliable treatment option.[9] These cases underscore the significance of periapical surgery in managing trauma-related endodontic complications and highlight the critical role of modern surgical techniques and biomaterials in improving treatment outcomes. Trauma to the dentition, particularly luxation injuries or crown-root fractures, can disrupt the apical vasculature, leading to pulpal necrosis and subsequent periapical pathology.[10] Bacterial invasion through exposed dentinal tubules, microcracks, or a compromised root canal system can exacerbate inflammatory responses, culminating in periapical lesion formation. If left untreated, these lesions may progress to periapical cysts, abscesses, or even osteolytic bone defects, requiring surgical intervention.[11]

A compromised apical seal, which permits the escape of bacteria and their byproducts, is the main cause of periapical lesions. Periradicular curettage of the affected periapical tissue removes only the effects of the leakage but does not address the underlying issue. If the root end is not resected, there remains a risk of lesion recurrence after tissue removal.[12]

A 3-mm root-end resection effectively eliminates all lateral canals and apical ramifications, which significantly reduces the chances of reinfection and treatment failure.[13]

MTA was used as the root-end filling bioceramic material due to its superior sealing ability, biocompatibility, and ability to promote cementogenesis. Studies have demonstrated that MTA facilitates apical healing and periodontal regeneration, making it the material of choice for periapical surgeries. Furthermore, the placement of PRF within the bony defect enhanced healing by stimulating osteoblastic activity and soft tissue repair.[14]

Studies indicate that resecting 3 mm apical root-end and preparing a 3-mm root-end during periapical surgery eliminates 93% of lateral canals and 98% of apical ramifications.[15] Postoperatively, the patient was instructed to avoid eating for at least 4 hours, as studies show that MTA sets and hardens into a solid structure within approximately 4 hours in a humid environment.[16] Postoperative follow-up at 3 and 6 months confirmed progressive healing, with radiographic evidence of periapical bone regeneration. The patient remained asymptomatic, indicating successful eradication of infection and periapical healing.

Conclusion

These case demonstrate that apicectomy, combined with advanced biomaterials and microsurgical techniques, is a highly effective treatment modality for managing trauma-induced periapical lesions. A meticulous surgical approach, proper case selection, and long-term follow-up are critical to ensuring optimal healing and treatment success.

Conflict of Interest
None declared.

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