



Apicoectomy: Successful Healing After Failed Root Canal Treatment In An Adolescent – A Case Report

¹Dr.Qurathul Ayn Fathima, ²Dr.Arjun Thomas, ³Dr.Rangeeth Bollam Nammalwar, ⁴Dr.Kavya

¹Postgraduate Scholar, ²Associate Professor, ³Professor and Head, ⁴Postgraduate Scholar

¹Department of Pediatric Dentistry,

¹Thai Moogambigai Dental College and Hospital, Dr. M.G.R. Educational and Research Institute (Deemed to be University) Chennai, Tamil Nadu, India.

Abstract: Background: Successful endodontic treatment depends on complete disinfection of the root canal system and an adequate three-dimensional seal. Persistent periapical pathology following root canal treatment may result from inadequate debridement, deficient obturation, or persistent microbial infection. In such cases, surgical endodontic intervention serves as an effective alternative when nonsurgical retreatment is unlikely to achieve complete resolution. **Case Presentation:** A 14-year-old female presented for replacement of a temporary crown in maxillary right central incisor, which had previously undergone root canal treatment. Radiographic examination revealed inadequate obturation with multiple voids and a well-defined periapical radiolucency, indicating persistent periapical disease. Following initial nonsurgical management, periapical surgery was performed. The procedure included apicoectomy through a semilunar flap approach, peri radicular curettage, root-end resection, retrograde cavity preparation, and retrograde filling with mineral trioxide aggregate (MTA) followed by obturation of 11 using a modified cone technique with bioceramic sealer. Postoperative follow-up demonstrated uneventful healing with satisfactory clinical and radiographic outcomes. **Conclusion:** Apicoectomy is a predictable tooth-preserving treatment for persistent periapical lesions when conventional endodontic therapy is unsuccessful. Careful diagnosis, appropriate case selection, meticulous surgical technique, and the use of bioactive materials such as MTA are essential for achieving favourable treatment outcomes.

Index Terms. Apicoectomy, Endodontic Microsurgery, Mineral Trioxide Aggregate, Persistent Periapical Lesion, Root-End Resection, Retrograde Filling, Pediatric Dentistry.

I. INTRODUCTION

Successful root canal treatment aims to eliminate microorganisms from the root canal system, prevent reinfection by achieving complete obturation with an impervious apical and coronal seal, and promote healing of the periapical tissues. Despite significant advances in endodontic instruments, irrigation protocols, magnification, and obturation materials, post-treatment apical periodontitis continues to occur in a proportion of treated teeth. Persistent intra radicular infection, extra radicular biofilms, complex root canal anatomy, inadequate canal disinfection, missed canals, procedural errors, and coronal microleakage remain the principal causes of endodontic failure. ¹⁻³ Nonsurgical root canal retreatment is considered the treatment of choice whenever the root canal system can be predictably re-accessed and disinfected. However, retreatment may not always be feasible or may offer a poor prognosis because of factors such as posts and cores, complex restorations, canal obstruction, separated instruments, or persistent periapical pathology that cannot be resolved by conventional means. In such situations, endodontic surgery provides a conservative alternative that enables preservation of the natural tooth while directly eliminating the periapical source of infection. ²⁻⁴

Apicoectomy is an endodontic microsurgical procedure which involves surgical exposure of the root apex, curettage of pathological periapical tissue, resection of the apical portion of the root, preparation of a root-end cavity, and placement of a biocompatible retrograde filling material to achieve an effective apical seal. The introduction of dental operating microscopes, ultrasonic retro preparation, cone-beam computed tomography (CBCT), microsurgical instruments, and bioactive calcium silicate-based materials has markedly improved the precision and predictability of the procedure, with contemporary studies reporting success rates exceeding 90% in appropriately selected cases.^{2, 4, 5} Mineral trioxide aggregate (MTA) is regarded as one of the most reliable root-end filling materials because of its excellent sealing ability, biocompatibility, bioactivity, and capacity to promote hard tissue formation and periapical healing. Consequently, MTA continues to be standard option for retrograde root-end filling in endodontic surgery.^{2,5}

The present case report describes the successful management of a persistent periapical lesion associated with a previously endodontically treated maxillary central incisor through apicoectomy followed by retrograde root-end filling with mineral trioxide aggregate (MTA) highlighting the importance of surgical endodontic intervention as a predictable treatment modality for preserving natural teeth when conventional nonsurgical root canal therapy has failed to achieve complete periapical healing.

II. CASE REPORT:

A 14-year-old female presented to the Department of Pediatric Dentistry with the chief complaint of replacement of a discoloured temporary crown in relation to the maxillary right central incisor. The patient had undergone root canal treatment approximately two years earlier, followed by placement of a temporary acrylic crown. Her medical and family histories were non-contributory. Clinical examination revealed a well-retained but discoloured temporary crown on tooth 11. The surrounding soft tissues appeared healthy, and the tooth was asymptomatic with no evidence of swelling, sinus tract, increased mobility, or tenderness to percussion and palpation. Radiographic examination using an intraoral periapical radiograph revealed inadequate root canal obturation characterized by multiple voids and poor adaptation of the obturating material to the canal walls. A well-defined periapical radiolucency, widening of the periodontal ligament space, discontinuity of the lamina dura, and loss of normal periapical trabecular architecture were observed, suggestive of persistent apical periodontitis associated with a previously treated tooth as shown in Figure 1 (A) Based on the clinical and radiographic findings, a diagnosis of persistent apical periodontitis associated with a previously endodontically treated maxillary right central incisor was established.

After discussing the treatment options with the patient and her parents, written informed consent was obtained. Considering the patient's age and the strategic importance of preserving the natural tooth, nonsurgical endodontic retreatment was initiated as the first phase of treatment. The existing root canal filling material was carefully removed, as shown in Figure 1 (B) and the working length was re-established using an electronic apex locator and confirmed radiographically, as shown in Figure 1 (C). Chemo mechanical preparation was performed with copious irrigation using sodium hypochlorite and normal saline to enhance canal disinfection. Following complete canal preparation, triple antibiotic paste consisting of ciprofloxacin, metronidazole, and doxycycline mixed in a 1:1:1 ratio was placed as an intracanal medicament. The access cavity was sealed with a temporary restoration, and the existing acrylic temporary crown was recemented, as shown in Figure 1 (D) The patient was recalled after three weeks, during which she remained asymptomatic. Despite adequate nonsurgical retreatment and intracanal disinfection, the periapical lesion persisted and compromised apical seal necessitated surgical endodontic intervention.

The surgical procedure was performed under local anaesthesia using an anterior superior alveolar nerve block with approximately 0.5–1.0 mL of local anaesthetic solution administered in the mucobuccal fold superior to the maxillary first premolar, directing the needle towards the infraorbital foramen. After achieving profound anaesthesia, the surgical site was disinfected, reference markings were made to facilitate accurate positioning and a semilunar flap was designed with a single curved incision extending from the alveolar mucosa, curving coronally into the attached gingiva, and returning to the alveolar mucosa, as shown in Figure 2 (A) The flap was carefully reflected using a periosteal elevator to expose the periapical region, as shown in Figure 2 (B).

A conservative osteotomy was performed using a surgical-length No. 2 round bur under continuous sterile saline irrigation with light brushing strokes to prevent overheating of the surrounding bone as shown in

Figure 2(C). Complete peri radicular curettage was carried out, and the pathological soft tissue was removed for thorough debridement of the lesion as shown in Figure 2(D). The root apex was identified by inserting a sterile endodontic file into the canal to confirm its position and verify the working length. Approximately 3 mm of the apical root end was resected to eliminate the majority of apical ramifications and lateral canals while preserving maximum root length and minimizing dentinal tubule exposure by using a surgical fissure bur perpendicular to the long axis of the root (0° bevel) under copious irrigation.

A 3-mm deep root-end cavity was prepared ultrasonically along the long axis of the canal and retrogradely filled with mineral trioxide aggregate (MTA) putty to establish a hermetic apical seal as shown in Figures 2(E) and 2(F). The surgical site was thoroughly irrigated with sterile saline followed by diluted povidone-iodine solution. The flap was repositioned in its original position and secured using simple interrupted 4-0 vicryl sutures as shown in Figure 2(G). Postoperative instructions regarding oral hygiene, diet, medications, and maintenance of the surgical site were given. Healing was uneventful, with satisfactory soft tissue healing observed at the one-week follow-up and continued healing was confirmed at the three-week review. Serial radiographic evaluations demonstrated progressive reduction of the periapical radiolucency with evidence of new bone formation.

Following satisfactory periapical healing at the three-month follow-up, definitive root canal obturation was planned. Owing to the relatively wide canal, the master gutta-percha cone was customized using the rolling technique to achieve optimal adaptation before obturation as shown in Figure 3(A) and 3 (B) and obturation was completed using a bio ceramic sealer as shown in Figure 3(C). The tooth was subsequently restored with a three-dimensional (3D)-printed temporary crown to re-establish aesthetics and function as shown in Figures 3(D) and 3(E), while awaiting placement of the definitive permanent restoration.

III. Discussion

Endodontic microsurgery has evolved considerably over the past few decades, with improvements in surgical techniques and biomaterials leading to predictable clinical outcomes. When apical periodontitis persists after initial treatment, it is typically driven by lingering intra-radicular pathogens, incomplete chemo-mechanical debridement, inadequate obturation, unaddressed anatomical variations, or coronal fluid leakage.⁵ In the present case, radiographic examination demonstrated multiple voids and a persistent periapical radiolucency, indicating failure of the previous endodontic treatment. Consistent with contemporary endodontic recommendations, nonsurgical retreatment was initially performed because it remains the preferred treatment option whenever the root canal system can be predictably disinfected and retreated.^{6,7,8} Contemporary evidence suggests that orthograde retreatment should always be considered before surgical intervention, as it addresses the primary source of infection while preserving the natural tooth whenever possible.^{9,10} Despite meticulous retreatment, surgical intervention was indicated because of the persistent periapical pathology and the need to establish a predictable apical seal. Apicoectomy permits direct removal of infected periapical tissues together with resection of the apical portion of the root, where anatomical complexities such as accessory canals, apical ramifications, and persistent microbial biofilms are frequently present.^{11,12} Root-end cavity preparation followed by retrograde sealing further minimizes bacterial leakage and enhances periapical healing.¹³ Mineral trioxide aggregate (MTA) was selected as the retrograde filling material because of its excellent sealing ability, superior biocompatibility, dimensional stability, alkaline pH, bioactivity, and ability to promote cementogenesis and regeneration of the periodontal ligament.¹⁴ Numerous experimental and clinical studies have consistently demonstrated that MTA provides superior biological performance and favourable long-term healing compared with many conventional root-end filling materials.^{7,15}

The patient exhibited uneventful postoperative healing with progressive radiographic resolution of the periapical lesion and successful preservation of the affected tooth. Advances in endodontic microsurgery, including improved magnification, microsurgical instruments, ultrasonic retrograde preparation, bioactive calcium silicate-based materials, and enhanced case selection have significantly improved treatment outcomes, with recent systematic reviews reporting high success rates in appropriately selected cases.^{16,19,20} The present case reinforces the importance of an evidence-based treatment sequence consisting of nonsurgical retreatment followed by apicoectomy when conventional treatment alone is insufficient. Furthermore, preservation of the natural permanent tooth through surgical endodontic management remains

a predictable and biologically favourable alternative to extraction, particularly in young patients where maintenance of function, aesthetics, and alveolar bone is of paramount importance.^{17,18,20}

Recent evidence has further reinforced the predictability of successful endodontic microsurgery when performed using contemporary microsurgical techniques and bioactive root-end filling materials.²¹ Systematic reviews have demonstrated that modern calcium silicate-based bio ceramics and MTA provide comparable clinical and radiographic success rates, with no clear superiority of newer bio ceramics over MTA. Consequently, MTA continues to be regarded as a reliable benchmark material because of its well-documented sealing ability, biocompatibility, and long-term clinical performance.^{7,22} Furthermore, successful outcomes following apicoectomy depend not only on the choice of root-end filling material but also on meticulous case selection, thorough debridement of the periapical lesion, precise root-end preparation, and an adequate coronal restoration.²³ The favorable outcome observed in the present case further supports the role of apicoectomy as a predictable tooth-preserving procedure for managing persistent apical periodontitis when conventional endodontic treatment alone is insufficient.

The clinical evolution of endodontic microsurgery has significantly shifted the paradigm of apical defect management toward high-precision, biologically guided interventions. Koutroulis et al., 2024 explored in his contemporary clinical consensus that microsurgical apicoectomy offers a biologically respectful alternative to tooth extraction, supporting the long-term preservation of natural dentition.²⁴ Beyond traditional Mineral Trioxide Aggregate (MTA), the integration of modern hydraulic calcium silicate cements and premixed bioceramics such as Biodentine and EndoSequence BC RRM has revolutionized retrograde obturation by overcoming classic MTA limitations like prolonged setting time, tooth discoloration and handling difficulty.²⁵ Recent clinical evidence confirms that modern calcium silicate-based materials are all clinically effective when used within a dedicated surgical protocol, with success rates exceeding 90% in contemporary cohorts. Furthermore, systematic evaluations reveal that bio ceramics exhibit superior sealing ability, biocompatibility, and osteoconductive properties compared to traditional root-end materials like amalgam or zinc oxide–eugenol (Prasad Kumara et al., 2025). While material selection plays a pivotal role in preventing microleakage, long-term prognostic evaluations demonstrate that surgical factors such as the routine application of cone-beam computed tomography (CBCT) imaging, ultrasonic retro cavity preparation, operating microscopes, and operator experience remain primary determinants of successful periapical tissue regeneration.^{26,27}

IV. ETHICAL CONSIDERATIONS:

The patient was managed in accordance with accepted clinical standards after obtaining written informed consent for publication of clinical details and photographs from patient's parents. Patient confidentiality has been maintained throughout this report, and no personally identifiable information has been disclosed.

V. CONFLICT OF INTEREST:

The authors declare that there are no conflicts of interest related to this case report.

VI. CONCLUSION:

Persistent periapical pathology following root canal treatment presents a significant clinical challenge, particularly in young patients where preservation of the natural dentition is of paramount importance. This case demonstrates that surgical endodontic intervention, when performed following appropriate diagnosis and treatment planning, can successfully manage persistent periapical disease and preserve a strategically important permanent anterior tooth. Apicoectomy combined with meticulous peri radicular curettage, root-end resection, and retrograde filling using mineral trioxide aggregate resulted in satisfactory clinical and radiographic healing in the present case. The excellent biological properties of MTA, together with careful surgical technique and postoperative follow-up, contributed to successful resolution of the lesion and restoration of function. The present case further emphasizes the importance of recognizing inadequacies in previous endodontic treatment and selecting an evidence-based treatment strategy tailored to the individual patient. In adolescent patients, where preservation of alveolar bone and maintenance of aesthetics are particularly critical, surgical endodontic procedures continue to provide a predictable and conservative alternative to extraction.

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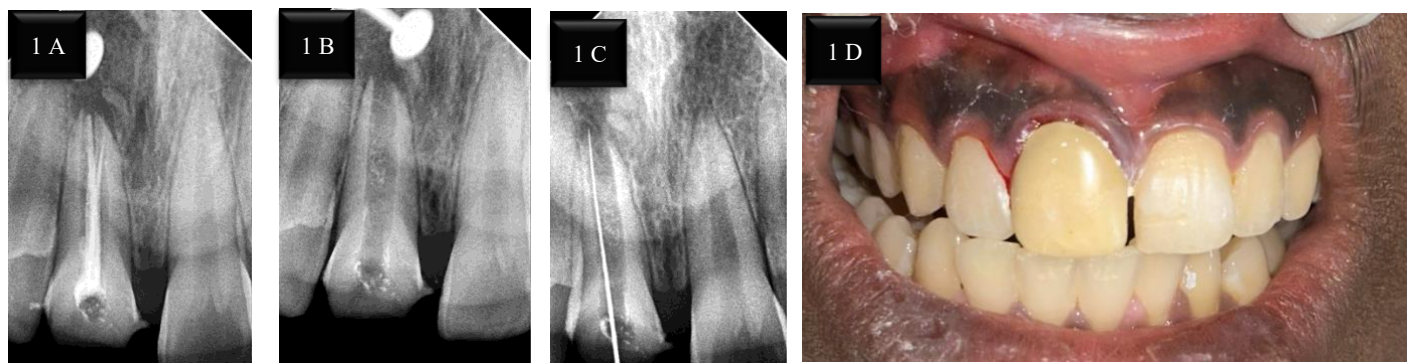


Figure 1A. Preoperative radiograph revealing periapical radiolucency. *Figure 1B.* Removal of existing gutta-percha *Figure 1C.* Working length determination. *Figure 1D.* Acrylic crown recementation.

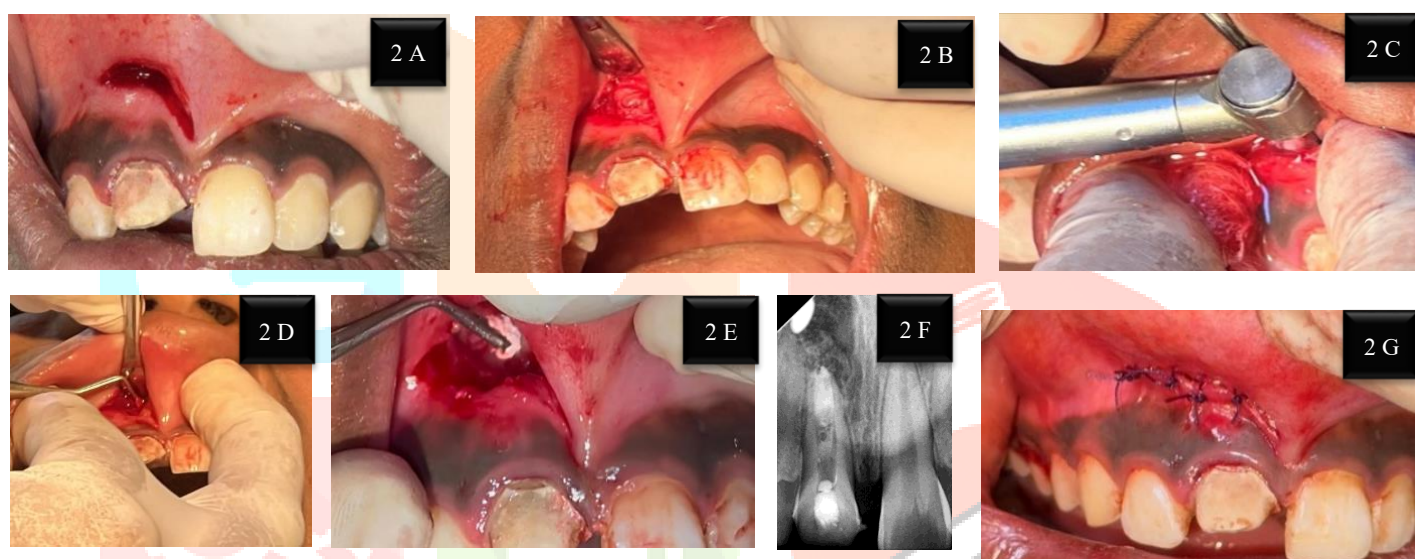


Figure 2A. Semilunar incision *Figure 2B.* Reflection of flap using elevator *Figure 2C.* Conservative Osteotomy *Figure 2D.* Peri radicular curettage *Figure 2E.* Root end filling material placement *Figure 2F.* IOPA radiograph recorded post root end filling *Figure 2G.* Simple interrupted sutured placed

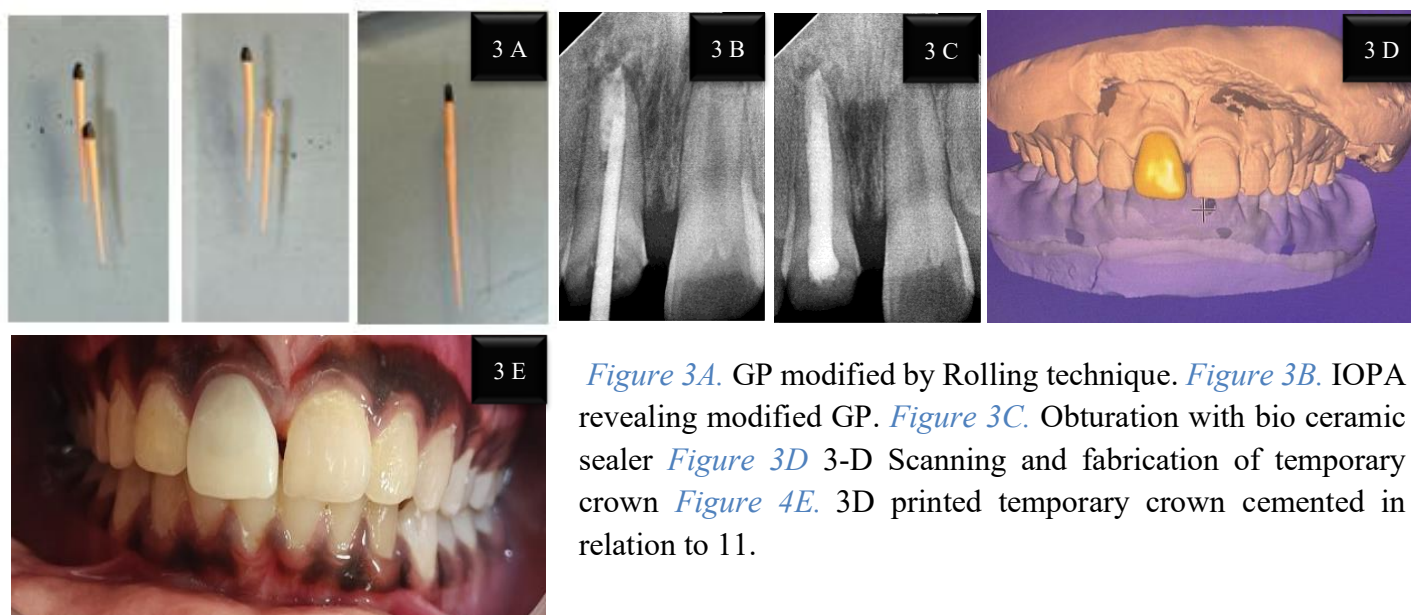


Figure 3A. GP modified by Rolling technique. *Figure 3B.* IOPA revealing modified GP. *Figure 3C.* Obturation with bio ceramic sealer *Figure 3D.* 3-D Scanning and fabrication of temporary crown *Figure 3E.* 3D printed temporary crown cemented in relation to 11.