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# Combined Nonsurgical and Surgical Endodontic Management of an Affected Maxillary First Molar In a 14 Year-Old Patient: A Case Report

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## Abstract:

**Objective(s):** This report aimed to illustrate the advantage of a hybrid endodontic treatment protocol—integrating orthograde retreatment with subsequent microsurgery—to resolve persistent endodontic failure in permanent molar of a growing patient, thereby preventing premature extraction. **Case:** A 14-year-old male was referred with a chronic apical abscess and a persistent sinus tract related to the maxillary right first molar (#16). Initial management involved conventional orthograde retreatment; however, the periapical pathology failed to resolve after a three-month observation period. Consequently, endodontic microsurgery was initiated. The surgical protocol incorporated the employment of a high power dental operating microscope, ultrasonic retro-tips, and retrofilling with a bioactive ceramic (Cold Ceramic), supplemented by guided tissue regeneration (GTR). Subsequent clinical and radiographic evaluations at one, six, and 12 months confirmed complete osseous regeneration and resolution of symptoms. **Conclusion:** For adolescent patients where implants are contraindicated due to incomplete skeletal development, endodontic microsurgery offers a predictable strategy for retaining natural dentition.

**Keywords:** Endodontic surgery; Magnification; Microsurgery; Osteotomy; Posterior region

## Introduction

The intention of endodontic treatment is to eradicate infection present in the root canal system [1]. Success of endodontic treatment is dependent on chemical and mechanical preparation, thorough sealing of root canal structure and receiving a proper permanent coronal restoration [2]. Primary orthograde endodontic treatments have high success rates, in spite of that, post-treatment complications are not rare [1]. Nonsurgical root canal retreatment (NS-ReT) is designated when the initial root canal treatment fails to salvage the periapical disease and is a reliable treatment option due to its high success rate (78%-87%) [3]. Should this procedure fail, or if it is not feasible, a surgical intervention is an option [4]. While NS-ReT remains the primary choice of intervention for management of teeth with failed endodontic treatment, endodontic microsurgery has proven to be a predictable and minimally invasive alternative for saving the native tooth [5].

Endodontic surgery is more commonly undertaken when the affected area is in anterior region [5]. but if the operating site is in the posterior region, endodontic surgery is often shunned in order for extraction and replacement with an osseointegrated implant. Anatomical considerations such as mandibular canal in lower arch, maxillary sinus in upper arch, together with limited approach to posterior zone of the mouth and also lack of clinician's experience may be grounds to avoid endodontic surgery in this area [6]. When endodontic surgery is the only choice to retain the tooth, it should not be eluded. Saving the natural tooth is a necessity when the patient is a child who has not yet developed full skeletal growth and loss of the natural permanent posterior teeth can affect the child's physical growth, self-esteem, and social development. Preservation of permanent first molar is a matter of the greatest importance since these teeth are fundamental for a stable occlusion [7].

The comprehension of modern concepts of endodontic surgery which improves the healing process and treatment outcome is the means to high success rate in this method of endodontic treatment [8].

## Cases

A 14 year-old male patient was admitted to Department of Endodontics of Shahid Beheshti dental school, Tehran, Iran with a chief complaint of persistent discomfort, localized inflammation, and a history of abscess formation in the maxillary right posterior quadrant. The patient's parents reported no relevant systemic medical condition, and he was not under any medications at the time of consultation. He had poor oral hygiene and reported history of transient pain in tooth number #16.

Extra-oral examination revealed no abnormality. Intra-oral inspection demonstrated a large amalgam restoration on tooth #16 and a sinus tract on the attached buccal gingiva, with no evidence of widespread soft tissue swelling. Pulpal

sensibility tests including thermal (dichlorodifluoromethane as cold spray and heated gutta percha) and electric pulp testing were applied on teeth #15, #16, and #17 which elicited normal response on tooth #15 and #17, and no response on tooth #16. Periapical tests including palpation, percussion, bite test, periodontal probing, and mobility test were implemented on teeth #15, #16, and #17. Palpation was performed with thumb on buccal vestibule and index finger on the palate, percussion was performed with the handle of a mouth mirror, and bite test was done with a tooth slooth to rule out the presentation of any cracks. Probing was performed with a WHO probe, and mobility was evaluated with the handle of two mouth mirrors positioned on the buccal and palatal surface of the mentioned teeth. All tests elicited normal results on teeth #15 and #17. Tooth #16 was painful on percussion, palpation, and bite test, although it showed normal mobility and no periodontal pocket.

Radiographic assessment demonstrated a prior root canal treatment of unsatisfactory quality on tooth #16, and periapical radiolucency with the size of more than five millimeters present on mesial and distal roots (Figure 1-A). These findings supported a diagnosis of a previously treated tooth with chronic apical abscess.

Following a discussion of viable management strategies, including extraction versus nonsurgical retreatment (NS-ReT), the patient and his parents opted for retreatment to retain the natural tooth. Written informed consent was obtained prior to treatment initiatiation.

**Nonsurgical Retreatment Protocol**

The NS-ReT was executed in two visits with one week interval. The retreatment was carried out under administration of local anesthesia (2% lidocaine with 1:80,000 epinephrine, DarouPakhsh, Tehran, Iran), via infiltration technique and standard rubber dam isolation. After preparation of access cavity, three canals were detected. Chloroform (Morvabon, Tehran, Iran) and SP1 rotary retreatment files (SP1 rotary retreatment, Fanta Dental, China) were used in a crown-down technique to clean the canals of previous obturation materials. The working length was assessed using an electrical apex locator (Root ZX, J Morita, Japan), and confirmed by digital radiography (Kodak RVG Radiography System; Kodak, Toronto, Ontario, Canada). Canal preparation was completed using SP1 ProTaper Gold rotary files (SP1 Gold Rotary, Fanta Dental, China). Root canal disinfection was obtained with 2 mL of 5.25% sodium hypochlorite (Golrang, Pakshoo Co., Iran) in each canal and subsequent activation with ultrasonic (Woodpecker U6 ultrasonic scaler; PD1 tips, power: 4 V; USA) for 20 seconds in each canal. Mesiobuccal 2 canal was found, disinfected and prepared in the same manner. The canals were filled with calcium hydroxide paste (CH; Aria Dent, Tehran, Iran) as intracanal medicament which was prepared by mixing calcium hydroxide powder with sterile saline, using a Lentulo spiral filler size #25 (Mani, Japan). The access cavity was temporarily sealed with Cavit filling material (Nikdarman, Tehran, Iran).

One week later, the patient returned and his symptoms had subsided and retreatment was completed. Due to the destruction of apical constriction, Cold Ceramic (Sarv Javid Modares, Yazd, Iran) was applied as apical plug in all canals and manually condensed in apical 3 millimeters using pluggers (#40 and #50), and remaining part of the canals were obturated using hydraulic condensation with Fi-G Woodpecker Gutta-percha Condensation System (Guilin Woodpecker Medical Instruments Co.Ltd). Finally, the access cavity was temporarily restored using a light-cured glass ionomer and later replaced with a permanent composite restoration at the one-month follow-up) Figure 1-B, C).

At the three-month follow-up, the patient reported a recurrence of symptoms, and clinical examination revealed that the sinus tract associated with tooth #16 had not healed. Gutta-percha tracing confirmed the tract's origin adjacent to the mesiobuccal root (Figure 1-D).

Cone Beam Computed Tomography (CBCT) (NewTom Vgi, Italy) was obtained to analyze the area in axial, coronal and sagittal planes. The scans exhibited periapical lesions involving both buccal and palatal roots, maxillary sinus mucosal thickening, and buccal cortical plate perforation (Figure 1- E, F).

Given the quality of the orthograde retreatment and the risks associated with removing the bioceramic plug, periapical surgery was deemed the most appropriate course of action. Informed consent was obtained from his parents and endodontic periapical surgery was planned.

**Surgical Intervention**

Following antiseptic preparation with 0.2% Chlorhexidine and 10% Betadine (inside and outside of the mouth, respectively), local anesthesia was administered via infiltration (2% lidocaine with 1:80,000 epinephrine, DarouPakhsh, Tehran, Iran) at the apex of tooth #16. A triangular sulcular full mucoperiosteal flap incision was designed and made with number #15 blade on teeth #15 to #17 with the releasing on tooth #15. The flap was elevated thoroughly using a periosteal elevator. The osteotomy was performed at the site of buccal cortex perforation using a round bur on a surgical handpiece (COXO- Foshan Chuangxin) and was expanded to expose the buccal roots. Granulation tissue was removed by curettage. Haemorrhage was halted by using a cotton pellet saturated with Ferric sulfate (AV Ferrisol, Dental Express). Three millimeters of the Mesiobuccal and distobuccal roots were resected by a fissured bur on a surgical handpiece (COXO- Foshan Chuangxin). The root end shaping was performed using

ultrasonic diamond tip (Woodpecker Ultrasonic Endodontic Retropreparation Tips ED10 1/pk, ED20D 10/pk) and retrofilled with Cold Ceramic. The bony defect was grafted with mineralized bone allograft (Regen, mineralized bone allograft, Tehran, Iran) and covered with a resorbable membrane (Regen, membrane tissue, Tehran, Iran). The flap was repositioned and sutured using a 5-0 absorbable vicryl suture (M.F.G: Pezeshkyaran A.R.S) in single interrupted manner and one sling suture on tooth #16. The whole surgical process was done using a high power dental operating microscope (Carl Zeiss, Oberkochen, Germany) with magnification ranging from 4x to 16x. (Figure 2).

Patient was examined radiographically immediately after periapical surgery, and post-operative evaluations at one, six, and 12 months demonstrated complete clinical and radiographic healing (Figure 3). The patient remained symptom-free.

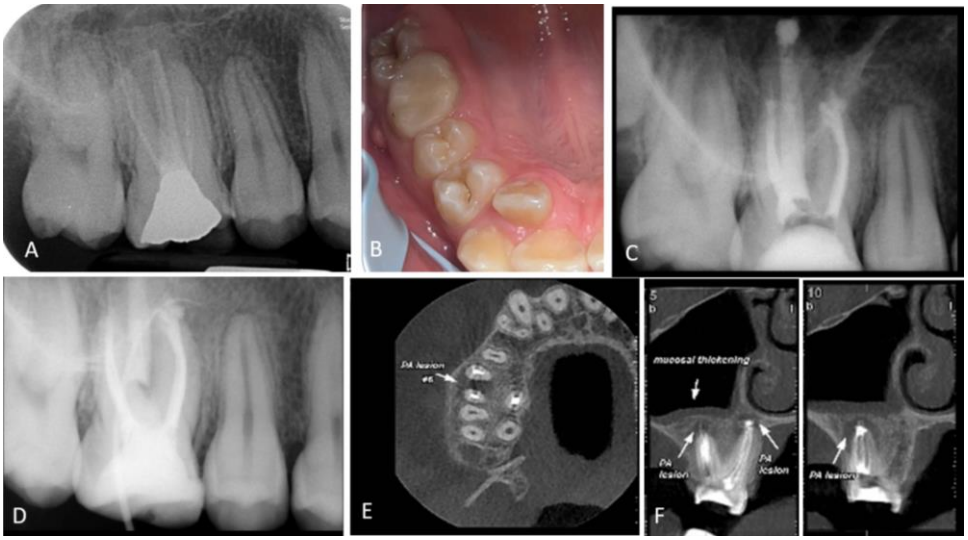


**Figure1: A: Initial visit periapical radiograph, B: sinus tract visible on tooth #16, C: immediate periapical radiograph after nonsurgical retreatment, D: periapical radiograph of sinus tract tracing which illustrates the gutta percha adjacent to the mesiobuccal root, E: Axial view CBCT showing periapical lesion between mesiobuccal and distobuccal roots, F: Sagittal and coronal view CBCT showing periapical lesion present on buccal and palatal roots, mucosal thickening of maxillary sinus, and perforation on buccal cortex.**

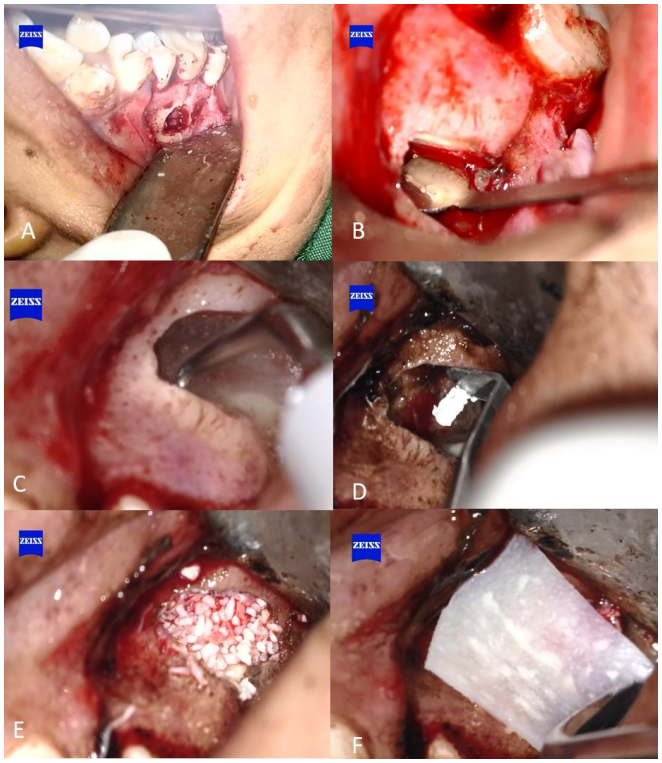


**Figure 2: A: Osteotomy site, B: mesiobuccal end-root after resection, C: end-root preparation with ultrasonic tip D: placement of Cold Ceramic in mesiobuccal end-root, E: bone particulate placed in osteotomy site, F: absorbable membrane placed on the osteotomy site.**


**Figure 3: A: immediate post-surgical periapical radiograph of tooth #16, B: one-month post-surgical follow-up periapical radiograph C: six-months post-surgical follow-up periapical radiograph, D: 12-months post-surgical follow-up periapical radiograph, patient remained symptom-free.**

## Discussion

Endodontic surgery is typically viewed as a last-line approach for tooth preservation, serving as an alternative to extraction and implant placement. In pediatric and adolescent cases, such as the 14-year-old patient presented here, dental implants are not a viable option due to the incomplete craniofacial growth [9]. Therefore, the surgical objective is focused on creating a hermetic apical seal and removing the infected and pathological tissues to facilitate regeneration and prolong the tooth's survival.

Endodontic surgery has a notably high success rate of 78%-91% according to a recent systematic review and meta-analysis [10]. This success is associated with factors such as tooth type, lesion size, age, choice of root-end filling material, and prior NS-ReT [10-12].

Recent studies suggest that type of tooth is a prognostic factor for endodontic surgery. The success rate is shown to be inferior for maxillary and mandibular molars in comparison to teeth in the anterior zone mostly due to surgical access difficulties [11, 12]. Saving the natural tooth is of utmost importance, especially if this tooth is first permanent molar. The importance of the first permanent molars in occlusal balance has been well documented and the premature loss of this tooth can trigger a cascade of complications, including tipping of adjacent teeth and disruption of the dental arch integrity, which is detrimental for maxillofacial growth [13].

Some investigations indicate that teeth with larger periapical lesions exhibit reduced success rates compared to those with smaller lesions [14], potentially due to complex host-microbial interactions and extensive tissue destruction [14]. Although according to a recent systematic review and meta-analyses, there is no statistically significant association between lesion size and surgical outcomes [15]. In the present case, the lesion size was a decisive factor in clinical decision-making. Since there was no radiographic evidence of reduction in lesion size in three months after NS-ReT, the endodontic surgery was chosen to eradicate the source of persistent infection.

Modern endodontic microsurgery represents a significant advancement over traditional apicoectomy, since it demands high power magnification, ultrasonic root-end preparation with delicate retro-tips, and root-end filling with advanced bioceramic materials [5]. The use of dental operating microscopes is associated with higher success rate of surgical endodontic interventions [11]. The application of microscope in the present case assisted us during the conservative osteotomy, removal of granulation tissue, more precise root resection, and a better-centered and minimally invasive root-end preparation.

Studies also have shown that NS-ReT prior to surgery can influence the long-term outcome of surgery and concluded that a NS-ReT can enhance canal debridement [12, 16]. In this case, the orthograde retreatment was performed prior to surgery and it optimized the disinfection and root canal system debridement.

As highlighted in literature, the integration of ultrasonic instrumentation has significantly refined surgical protocols. In this specific case, the utilization of ultrasonic retro-tips was pivotal for resection of roots and preparation of isthmus and unreachable areas. Unlike traditional rotary burs, ultrasonic devices allow for a more conservative cavity design and facilitate the thorough debridement of complex anatomical structures between the canals, which is critical for long-term surgical success [17]. The use of ultrasonic tips in this case optimized the retro-preparation in a minimally invasive manner and formed a well-defined cavity for retro-fill material.

Calcium silicate-based materials have been utilized in endodontics as superior materials for many purposes. Biomaterials have the ability to stimulate periapical tissue regeneration and can enhance periapical repair [18]. They also have superior sealing abilities that can prevent microbial leakage [19]. Cold Ceramic (Sarv Javid Modares, Yazd, Iran) was selected as the retrofilling material in this case due to

its bioactive characteristics and superior sealing efficacy in moist environments. These properties are consistent with recent findings on calcium silicate bioceramics, which suggest that bioactivity and dimensional stability are essential for promoting periapical healing and ensuring biological compatibility [20].

Evidence from the latest systematic review and meta-analysis had illustrated that bone regenerative materials along with the guided tissue regeneration (GTR) can be helpful for achievement of successful outcomes in peri-radicular surgeries and aid in the long-term favorable prognosis of endodontic cases [21]. Bone regenerative materials facilitate the correction of large osseous defects frequently encountered in periapical surgical procedures. Other studies have also shown benefits in application of GTR in endodontic surgeries [22-24]. The use of bone regenerative material and GTR in this case was dictated by the large size of the lesion to improve bone formation and healing.

## Conclusion

When standard endodontic procedures and subsequent retreatments fail to resolve periapical pathology, surgical management serves as an alternative for maintaining the natural tooth. With a meticulous case selection and the integration of modern technologies including high power magnification, ultrasonic tips, and bioceramic materials, it is now considered a predictable treatment option and can obtain successful outcomes in the long-term.

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M.N.B.: Writing – Review & Editing; B.Z.: Supervision; S.T.M.: Writing – Original Draft.

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**Ethical Approval Code:** According to institutional guidelines, ethical approval was not required for this case report, however a written consent form was obtained from the patient and all procedures were conducted in accordance with the principle of the Declaration of Helsinki.

**Informed Consent Statement:** Written informed consent was obtained from the patient and all identifying information has been anonymized.

**Data Availability Statement**: All relevant data supporting this study are included within the article.

**Using AI:** No artificial intelligence tools were used in the preparation of this manuscript.

**Conflict of Interest**: No conflicts of interest to declare.

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