Large Periapical Lesion Treatment Using Guided Tissue Regeneration: A Case Report

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Abstract

Background: Intraradicular and/or extraradicular bacteria have been consistently associated with primary and post-treatment periapical lesions. Although the initial success rate for orthograde endodontic procedures is high, complications after treatment are common. If pathosis persists following a root canal procedure, it is advisable to consider endodontic retreatment as the primary treatment option. When a non-surgical root canal treatment fails or is insufficient to save the tooth, surgical intervention becomes necessary. The regeneration of large periapical defects can be quite challenging after periradicular surgery. In such cases, the proliferation of gingival connective tissue or the migration of oral epithelium into the defect can hinder the formation of normal trabecular bone. Guided Tissue Regeneration (GTR) can be used alongside endodontic retreatment to facilitate the restoration of hard tissue in cases involving large periapical lesions.
Aim: The goal is to assess the impact of a resorbable collagen-based membrane and bone graft material following endodontic retreatment and cyst enucleation on the healing process of large periapical lesions.
Methods: Clinical and radiographic evaluations led to a provisional diagnosis of a radicular cyst, which was later confirmed through biopsy. Root canal retreatment was undertaken, during which surgical treatment included apical resection without retrograde filling and enucleation of the cyst, followed by the placement of the bone graft and the resorbable membrane.
Result: The combination of bone graft material and a resorbable barrier membrane alongside endodontic retreatment may have increased rapid bone regeneration in a large periapical lesion.
Conclusion: In case of a large periapical lesion the use of a bone graft material and resorbable barrier membrane conjunct with endodontic treatment/retreatment is the effective method, which provides the regeneration of a large periapical lesion in the shortest possible time. **(TCM-GMJ August 2025; 10 (2): P26-P31)**

Keywords: GTR, periapical lesions, periradicular/periapical surgery, root canal therapy, endodontic retreatment.

Introduction

Periapical periodontitis, also known as apical periodontitis, is an acute or chronic inflammatory lesion around the apex of a tooth root, due to bacterial invasion of the tooth's pulp. It is often a consequence of untreated dental caries. Other contributing factors can include occlusal trauma resulting from 'high spots' following restoration work, the expulsion of root filling material from the root canal, or bacterial infection stemming from the periodontium. Periapical periodontitis can progress into a periapical abscess, resulting from the dissemination of infection originating in the tooth pulp (odontogenic infection), or it can lead to a periapical cyst, characterized by a fluid-filled structure lined with epithelium.

The radiographic features of early-stage periapical inflammatory lesions might not exhibit any radiographic alterations - the diagnosis of such lesions depends entirely on clinical symptoms. In contrast, more longstanding lesions can display either resorption (radiolucent) or sclerotic (radiopaque) features, or a combination of both. Most periapical radiolucent lesions typically heal with standard Root Canal Therapy (RCT). RCT means shaping, cleaning, and decontaminating the spaces using files and irrigating solutions, followed by filling the shaped and disinfected canals. Although RCT procedures are generally effective, symptoms may persist or return (1,2,3)

In certain instances, bacterial infection can extend to the periradicular tissues and lead to an extraradicular infection. Biofilms that adhere to the apical extraradicular surfaces have been identified as a potential reason for the continued presence of apical periodontitis post-treatment Consequently, even when periapical periodontitis with an extraradicular infection has undergone conventional root canal treatment, healing may not occur if the pathogens have already spread beyond the reach of current treatment methods (4,5,6).

Given this, endodontic surgery is a reliable and effective treatment option for periapical lesions and is advised in cases of failure after standard endodontic treatment/

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retreatment or when orthograde treatment is inappropriate (7). In recent decades, the criteria for endodontic surgery have decreased. Surgical intervention should only be considered when non-surgical endodontic techniques have failed to resolve the infection and periapical disease. The main objective of this procedure is obtaining the regeneration of periradicular tissue, including the formation of a new ligament complex through the exclusion of any harmful agent within the physical limits of the affected root. In particular, in certain cases, only surgical intervention can solve the problem, such as when a chronic lesion is related to a periapical cyst (8, 9).

The surgical options available after unsuccessful RCT include Re-Root Canal Treatment (ReRCT) and apicoectomy, or extraction. The procedures of apicoectomy mean the elimination of necrotic and infected tissues, the resection of the apical part of the tooth with or without retrograde filling to avoid reinfection of the root canal (10, 11).

In situations involving large periapical lesions, regeneration can be a considerable challenge in periradicular surgery. In these cases, gingival connective tissue may proliferate, or oral epithelium may invade the defect, impeding the formation of normal trabecular bone. The outlook for apical surgery may be affected by the size or location of the periapical bony defect. A substantial lesion can be rehabilitated using Guided Tissue Regeneration (GTR) alongside endodontic treatment/retreatment. According to the American Academy of Periodontology, Guided Tissue Regeneration (GTR) is defined as a surgical procedure with the goal of achieving new bone, cementum, and periodontal ligament attachment to a periodontal disease tooth, using barrier devices or membranes to provide space maintenance, epithelial exclusion, and wound stabilization. Regenerative techniques are increasingly being employed in endodontic surgery. Periradicular regenerative surgery has presented clinically positive results for questionable teeth, confirming the formation of new tissues, showing radiographic resolution and even histologic evidence of apical tissue regeneration (12,13, 14,15). In GTR, the main objective behind the application of a membrane is to ease selective migration and the repopulating of progenitor cells in selected areas in the periodontal tissue (16). Thus, the fast way in which the oral epithelium proliferates and growth of the connective tissue for the bone defects is impeded, facilitates bone reparation (17). However, the various materials used in these techniques may influence healing differently (18, 19).

Methods

A 24-year-old male patient visited the clinic "Minankari" in Tbilisi, Georgia. Ten years prior, he experienced pain and swelling in tooth #11 during orthodontic treatment, leading to endodontic procedures on #11. The patient had been symptom-free for the following decade. Recently, he expressed concerns regarding discomfort in relation to teeth #11 and #12. He reported no pain or discharge associated with these teeth. The extraoral examination revealed no abnormalities. An intraoral clinical assessment of tooth #11 identified discoloration and inadequate resin restorations, while tooth #12 appeared intact. There were no signs of swelling, sinus tracts. Hyperemia was noted in the soft tissue surrounding teeth #11 and #12. Both teeth exhibited tenderness upon percussion and palpation. Evaluation of teeth #11 and #12 indicated normal probing depth of 3 mm. Pulp sensitivity tests using Endofrost (Roeko) showed no response from tooth #12.

Intra-oral periapical (IOPA) radiograph displayed a satisfactory root canal filling in #11, while tooth #12 remained intact. Significant periradicular bone loss was observed around both #11and #12(**Fig. 1).**

Cone Beam Computed Tomography (CBCT) revealed irregular apical root resorption in tooth #11 **(Fig.2.a, 2.b)**, along with the presence of a hypodense osteolytic area affecting both #11 and #12, partially bordered by a sclerotic halo **(Fig. 2.a, 2.c, 2.d).** It was noted that the lesion affected the root apices of the maxillary right central and lateral incisors (#11 and #12), resulting in the disruption of the labial cortical bone adjacent to the lesion while the palatal cortical walls of #11 and #12 remained intact **(Fig.2.d, 2.e).**

After a comprehensive review of the images and clinical findings, a provisional diagnosis of a radicular cyst was established, this was subsequently confirmed through biopsy. The proposed treatment plan included endodontic retreatment of #11, endodontic treatment of #12, and endodontic surgery#11, #12 utilizing the GTR technique. The patient consented to the treatment plan and signed a form permitting the implementation and scientific disclosure of his treatment.

Access to the canals of tooth #11 was achieved with an endo access bur (Dentsply Sirona Inc., Tulsa, Oklahoma). Gutta-percha removal was facilitated using a Gutta-Percha solvent (Endosolv E, Septodont Holding, Canada) and ProTaper Universal System retreatment files (PTUS, Dentsply Sirona Inc., Tulsa, Oklahoma). A drop of solvent was applied in the chamber to soften the gutta-percha, and a total of 0.25 ml was used. PTUS instruments D1, D2, and D3 were utilized for the retreatment using the crown-down technique up to D3. The working length was re-established with an apex locator (Root ZX, J. Morita Corp., Tokyo, Japan). Each canal (#11, #12) was shaped with ProTaper Next rotary files, X1 through X2 (Dentsply Maillefer, Ballaigues, Switzerland). During the instrumentation, the root canals were irrigated with 6 ml of 5.25% NaOCl, followed by normal saline. The irrigant was activated through passive ultrasonic irrigation using passive ultrasonic tips (Irrisafe #20/02, Newtron, Acteon, United Kingdom) for 30 seconds each. Calcium hydroxide was placed as an intracanal medicament (Ultracal XS, Ultradent, Jordan) for four weeks, and the access openings were sealed with a temporary filling material (Coltsol, Coltene, Altstatten, Switzerland).

Single Cone Technique (SCT) was conducted using ProTaper Gutta-Percha (Dentsply Maillefer, Ballaigues, Switzerland) paired with a Bioceramic sealer (BioRoot RCS, Septodont, Saint-Maur-des-Fossés, France). The coronal access was restored with an RMGIC base (Vitremer, 3M ESPE AG, Seefeld, Germany) and a composite restoration (Tetric Ceram, Ivoclar Vivadent).

For the surgical phase, the procedure began with a mouth rinse using chlorhexidine digluconate at 0.12% (Periogard® Colgate) for one minute. Extra-oral antisepsis of the surgical area was achieved using chlorhexidine digluconate at 2%. The periradicular regenerative surgery was performed under local anesthesia, as described below.

Anesthesia was administered through blocking the right infraorbital nerve along with supplemental infiltration at the tips of the central and lateral incisors, as well as blocking the nasopalatine nerve. A total of 8.8 mL of the anesthetic Articaine 4% with 1: 100000Articaine® epinephrine was utilized.

The surgical procedure was performed using Medical Dentist Surgical Binocular Magnifying Glasses with a magnification of 4.0X.

Sulcular horizontal incisions were created in the labial area, extending from the distal side of the left central incisor to the distal side of the right canine tooth. A vertical incision was made to release #11 and #12. Initially, a partial osteotomy was conducted employing a Piezotome M+ (Acteon) with substantial saline irrigation. The lesion was curetted using a Lucas-type alveolar curette. The excised lesion was submitted for histopathological assessment, which indicated a lining of non-keratinized stratified squamous epithelium with mixed inflammatory infiltration, leading to a diagnosis of an odontogenic radicular cyst.

With magnification assistance, the apical three millimeters of the right central and lateral incisors were resected using a Zecrya No. 151 drill (Dentsply-Maillefer®, Ballaigues, Switzerland), cooled with saline during the process. The bone cavity was then filled with xenograft GTO (OsteoBiol), and a bio-absorbable collagen membrane Evolution (OsteoBiol) was placed over it.

After repositioning the flap, it was first sutured at the junction of the vertical and horizontal incisions to achieve a tension-free closure. Subsequently, a horizontal suture was placed using simple interrupted sutures, followed by suturing the vertical incision, all executed with a 4-0 wire (VICRYL).

Post-operative care and pain management instructions were provided in writing, which included applying ice, utilizing dental floss, gentle brushing with a soft toothbrush, and rinsing with chlorhexidine digluconate at 0.12% for one minute after brushing in the morning and evening. Dietary recommendations were given, advising a liquid, paste, or frozen diet for the first 24 hours, and room temperature or cold food for the next 48 hours. The patient was prescribed postoperative antibiotics to be taken three times a day for five days and analgesics twice a day for the same duration. Seven days later, the patient returned for suture removal.

Results and discussion

One week later: The patient was recalled for follow-up examinations after 5 and 10 months

5-month follow- up: #11 and #12 were asymptomatic with no signs of infection. Periapical radiography showed the regeneration of labial cortical bone **(Fig. 3.a, 3.b)**, almost healed at #11**(Fig.3.c)** and healing process at #12 **(Fig.3.d).**

10-month follow- up: #11 and #12 were asymptomatic with no signs of infection. CBCT image showed the thickening of regenerated labial cortical bone **(Fig.4.a, 4.b, 4.c)** and healing was observed at #11**(Fig. 4.d)** and #12 **(Fig.4.e)**; however, the repaired alveolar bone appears more granular in comparison to the surrounding bone **(Fig. 4.d, 4.e).**

Surgical intervention may be the only solution to a problem, such as when a chronic lesion is associated with a larger size periapical cyst (7,8,14). In this case, the tomography revealed a hypodense area indicative of an inflammatory root cyst, which affected #11, #12. Moreover, apical root resorption was noted in #11, likely leading to challenges in cleaning and shaping the apical third previously, which allowed for the retention of contaminated materials and biofilm, perpetuating the periradicular issue and the formation of a large periapical lesion. In this setting, endodontic surgery was recommended as the preferred treatment. The steps involved in endodontic surgery include the removal of necrotic and infected tissue, resection of the tooth's apical portion and guarantee this result over time with a proper apical seal. Several procedures must be carried out properly to render endodontic surgery effective such as the hemostasis, the detection and removal of the lesion, the retrograde cavity preparation, and the correct placement of the filling materials. By cleaning the canal system, and sealing the defect or cavity, the surgeon can prevent or diminish the spread of bacteria in the periradicular tissues. The literature emphasizes the importance of this retrograde filling, which should hermetically seal the root extremity to avoid reinfection of the root canal (10,21). The Mineral Trioxide Aggregate (MTA) is a hydrophilic biomaterial which has been successfully used in root canals since 1993 and has been recommended as a gold standard for apical sealing due to its sealing ability, its osteogenic potential and its biocompatibility. However, MTA® has a long setting time, poor handling properties, a high economic cost, low resistance to compression and flexion, and in addition may cause discoloration of the treated tooth. In order to solve the clinical problems with MTA®, a wide range of bioceramic materials have been developed (22).

Techniques based on the 3 mm apical resection without retrograde preparation may represent a simplified and more conservative alternative to the standard procedures of apical surgery (23,24). Such simplification could be acceptable if there were suitable materials and techniques to overcome the drawbacks of their classic counterparts. Two possible options might be the intentional orthograde positioning of Mineral Trioxide Aggregate (MTA) or the SCT with bioceramic sealer (25,26) followed by the apical resection without further retrograde steps. The SCT represents a further simplification being fewer operators sensitive and capable of high-quality sealing ability. Especially in anterior teeth with very difficult local conditions (sharply angled teeth, abundant mental protuberance) where ultrasonic preparation of retrograde cavity could cause more compli-

cations (micro cracks, axis of retrograde cavity not longitudinal to the axis of the canal) than benefits. With regard to cases with no retrograde filling, there may be some benefits to this solution.

In our case the SCT with bioceramic sealer BioRoot RCS (Septodont, Saint Maur-des-Fosses, France) was used followed by the apical resection without further retrograde steps. This sealer consists of a powder and a liquid. The powder is composed of tricalcium silicate, zirconium dioxide, and povidone, and the liquid is composed of water, calcium chloride, and polycarboxylate. Tricalcium silicate-based sealers exhibit proven bioactivity in the presence of tissue fluids, with the deposition of hydroxyapatite ions on the surface of the material. This bioactivity induces the formation of hard tissue and the healing of connective tissue. Tricalcium silicates are highly hydrophilic which provides the advantage of allowing natural humidity in the dental canals and tubules, unlike other sealers, the behavior of which is impacted by humidity. They are dimensionally stable, and do not contract while hardening, but in fact expand slightly, and are insoluble in tissue fluids (25,26, 27).

Regenerative techniques are increasingly being employed in endodontic surgery; however, the various materials used in these techniques may influence healing differently. Recent studies have indicated improved outcomes for bony lesions treated with regenerative techniques, using a bone graft material and resorbable barrier membrane conjunct with endodontic retreatment. Literature has reported on the use of bone graft materials to improve periapical healing (28, 29, 30 31).

Liu TJ et al (2021) (32), demonstrated positive healing and repair results of Regenerative techniques, as they improve periapical lesion healing after endodontic surgery. The combined use of collagen membranes and bone graft materials may be beneficial as an adjunct to endodontic surgery.

A systematic appraisal of the literature demonstrated some general improvement in surgical endodontic outcomes by Guided Tissue Regeneration techniques. Sumangali et al. (2021) (33)conducted a systematic review and meta-analysis evaluating various bone regenerative materials for periradicular surgery. Their meta-analysis showed higher success rates when bone graft materials were used

Fig. 1 Preoperative periapical radiograph

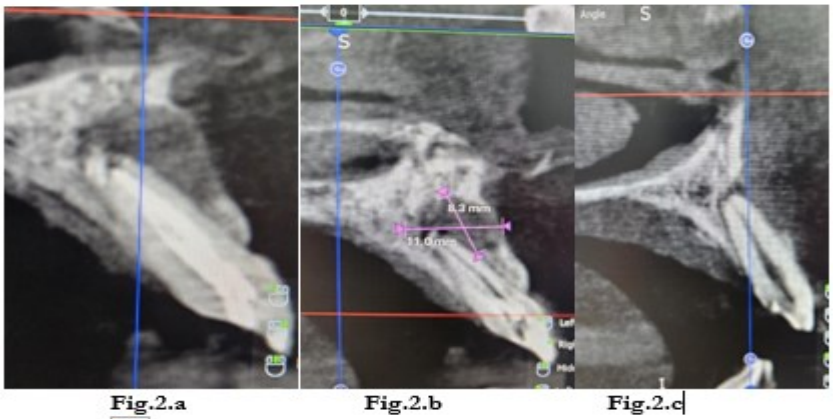

Fig.2.a **Fig.2.b** **Fig.2.c**

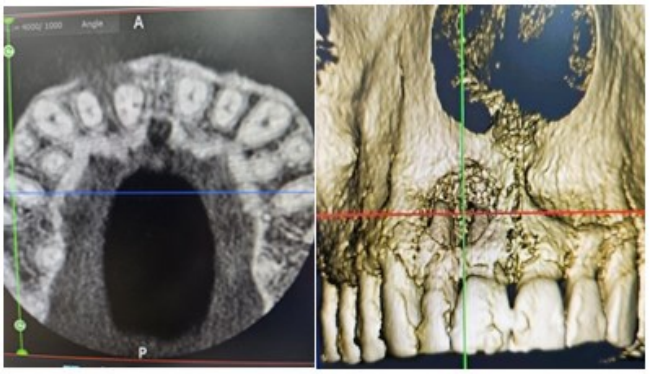

Fig.2.d **Fig.2.e**

Fig.2 Preoperative CBCD images

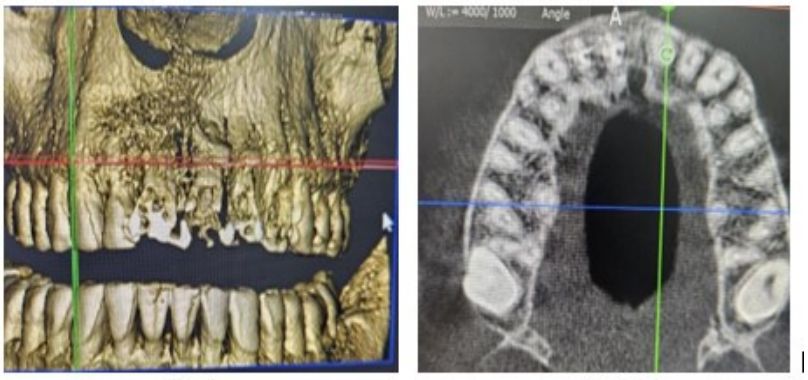

Fig.3.a **Fig.3.b**

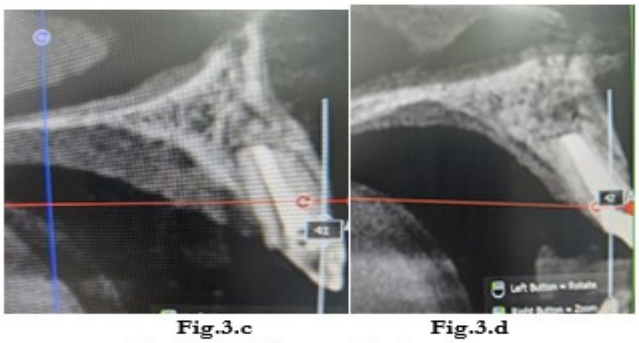

Fig.3.c **Fig.3.d**

Fig.3 CBCD images after 5 months

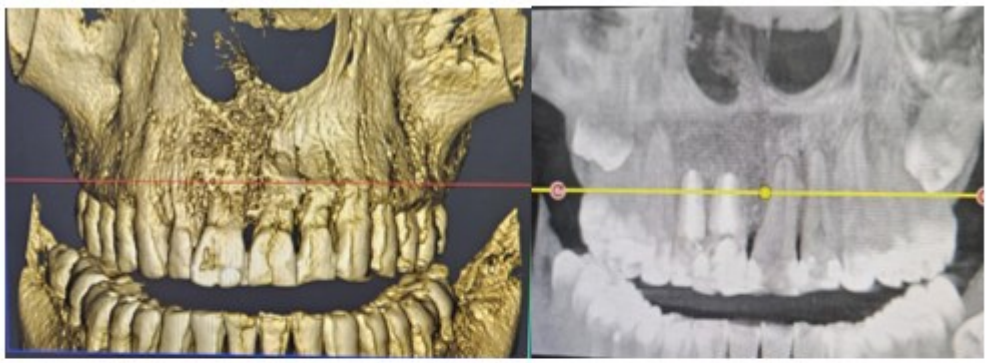

Fig.4.a Fig.4.b

Fig.4.c. Fig.4.d Fig.4.e

Fig.4 CBCD images after 5months

in conjunction with barrier materials. Zubizarreta-Macho et al. (2022) (34)appraised the clinical evidence on the efficacy of Guided Tissue Regeneration techniques and included 11 randomized clinical trials comparing six Guided Tissue Regeneration techniques, including bone graft, membrane, membrane plus bone graft, platelet-rich plasma or membrane plus platelet-rich plasma. Both the membrane and the membrane plus bone graft techniques demonstrated statistically significant odds ratios compared to procedures conducted without Guided Tissue Regeneration.

In several studies CBCT was reported to be more accurate than periapical radiography and demonstrated a good agreement with histopathology, (35,36,37). In the current case, the initial radiograph suggests that the lesion appears to involve only the right central maxillary incisor. Through Cone Beam Computerized Tomography (CBCT), it was possible to observe irregular apical root resorptions in the involved #11. Also, the presence of an (hypodense) osteolytic area #11 #12 was observed, partially delimited by sclerotic halo (hyperdense) **(Fig.2).** It was observed that the lesion involved the root apexes of the maxillary right central and lateral #11 #12, promoting rupture of the labial cortical bone adjacent to the lesion, palatal cortical wall of #11 and #12 was not involved **(Fig.2).**

Overall, the success of endodontic treatment is measured through a combination of clinical, radiographic, and histopathological factors. In terms of radiographic standards for assessing healing, it is recognized that CBCT serves as an essential resource in endodontic procedures, particularly for monitoring bone recovery after treatment (38,39,40).

The microsurgical approach with Guided Tissue Regeneration is associated with better illumination and enlargement of the surgical field, thereby providing adequate access to the intraosseous defect and debridement thereof with greater precision and minimal trauma (41).

In the present case, the magnification allowed for a greater precision in the management of the enucleation of the lesion, as well as primary closure without tension, thereby favoring an adequate evolution of the wound with minimal discomfort. Additionally, at 5 and 10 months of follow-up in the clinical and radiographic evaluation, successful results were observed which were attributed to adequate surgical management and the use of correct regeneration biomaterials.

Conclusion

The microsurgical management of a radicular cyst using the Guided Tissue Regeneration technique, resorbable membrane of type I bovine collagen and bovine xenograft after apicoectomy of the associated tooth without retrograde seal, allowed for successful removal of the periapical lesion and generated an environment conducive to healing in both hard and soft tissues. The successful outcome of this case confirms the efficacy of Guided Tissue Regeneration using correctly-chosen biomaterials for the enucleation of the radicular cyst. Therefore, dentists should be aware of the potential benefits of these biomaterials that may be used to provide quality treatments for their patients.

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