Case Report

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Surgical Management of a Persistent Radicular Cyst in a Maxillary Lateral Incisor: A Case Report with a 6-Year Follow-Up

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Abstract

Radicular cysts are the most common odontogenic cysts, typically resulting from chronic periapical infection. Although most resolve with nonsurgical endodontic therapy, persistent or enlarging lesions may require surgical intervention. This report describes a rare case of a radicular cyst that progressed despite orthograde retreatment. A 38-year-old woman presented with an endodontically treated left maxillary lateral incisor (#22) associated with a well-defined periapical radiolucency (8×8 mm). Following orthograde retreatment, the lesion enlarged to 11×11 mm over 8 months, although the tooth remained asymptomatic. Surgical endodontic management with apical resection and root-end filling using calcium-enriched mixture cement was performed. At 44-month recall, radiographs and cone-beam computed tomography demonstrated complete bony regeneration and re-establishment of the periodontal ligament. Clinical and radiographic assessments at 6 years confirmed stable periapical healing and functional retention of the tooth, despite a traumatic crown fracture at 64 months, which was successfully restored. Surgical endodontic treatment using biocompatible materials can result in complete and durable healing of large radicular cysts, even in cases where orthograde endodontic retreatment is unsuccessful.

Key words: Calcium-enriched mixture cement, Dental radiography, Endodontics, Mineral trioxide aggregate, Radicular cyst

Introduction

Apical periodontitis is a common consequence of pulp necrosis and microbial invasion of the root canal system (1). Although successful root canal treatment (RCT) typically resolves such lesions, the persistence or development of a periapical radiolucency following RCT is indicative of treatment failure. Histopathologically, periapical lesions are broadly classified into periapical granulomas and periapical (radicular) cysts, the latter accounting for approximately 60%–70% of all jaw cysts. Radicular cysts are inflammatory odontogenic lesions that originate from the epithelial cell rests of Malassez in response to chronic periapical inflammation associated with non-vital teeth (2).

Radicular cysts are generally classified into two types, namely pocket (bay) cysts, which maintain communication with the root canal system, and true (apical) cysts, which are completely enclosed by an epithelial lining and lack any connection to the canal space. Clinically and radiographically, these lesions are often asymptomatic and typically appear as well-circumscribed, round or ovoid radiolucencies at the apex of involved teeth. Two-dimensional imaging, such as periapical or panoramic radiographs, is commonly used for initial detection; however, it cannot reliably distinguish between cysts and granulomas. Features suggestive of a cystic lesion include a well-corticated border, large size (>10 mm), and a unilocular, homogenous radiolucent appearance (3). Histologically, true cysts demonstrate a central cavity lined by non-keratinized stratified squamous epithelium, surrounded by a fibrous wall with chronic inflammatory infiltrate.

Notably, true radicular cysts are generally unresponsive to nonsurgical endodontic therapy or retreatment due to their self-sustaining epithelial lining and lack of communication with the root canal system (4). These lesions may remain quiescent or exhibit progressive enlargement over time, even in

asymptomatic cases, and often require surgical endodontic intervention, especially when serial imaging reveals growth despite adequate orthograde RCT (5).

A critical component of surgical endodontic treatment is root-end filling, which is intended to create a hermetic apical seal, prevent microleakage, and facilitate periapical healing. The ideal root-end filling material should be biocompatible, dimensionally stable, radiopaque, antimicrobial, and bioactive, with the ability to promote cementogenesis and osteogenesis. Over recent decades, traditional materials have been replaced by calcium-silicate-based biomaterials. Among these, ProRoot mineral trioxide aggregate has long been considered the gold standard due to its superior sealing ability and tissue compatibility. However, calcium-enriched mixture (CEM) cement, a more recent alternative, offers additional benefits, such as enhanced biocompatibility, faster setting time, and superior regenerative potential (6).

Surgical endodontic intervention is indicated when periapical lesions persist or increase in size after appropriate nonsurgical retreatment. The present case highlights the progressive behavior of a true radicular cyst that did not respond to orthograde therapy; however, it was successfully managed through surgical endodontic treatment with root-end resection and CEM cement root-end filling. A 6-year follow-up confirmed complete periapical healing, functional tooth retention, and a stable long-term outcome, despite a later traumatic crown fracture. Although radicular cysts are well documented, reports with long-term clinical, radiographic, and three-dimensional follow-up remain limited, highlighting the importance of documenting treatment outcomes over extended observation periods.

Case

A 38-year-old medically healthy woman (American Society of Anesthesiologists classification: ASAI) presented for the evaluation of a persistent periapical radiolucency associated with the left maxillary lateral incisor (#22). The lesion had been incidentally discovered during a routine dental examination. The patient was asymptomatic, and the tooth remained functional.

Clinical examination revealed no swelling, sinus tract, or tenderness to percussion or palpation. Tooth #22 was non-vital and restored with a composite resin restoration. Periodontal probing depths were within normal limits (≤3 mm), and no mobility was detected.

An initial periapical radiograph (Fig. 1A) showed a well-circumscribed, round periapical radiolucency measuring approximately 8×8 mm at the apex of tooth #22, which had previously undergone RCM. The patient was referred to an endodontist, and nonsurgical endodontic retreatment was performed one month later. However, the postoperative radiograph (Fig. 1B) revealed a slight increase in lesion size to 9×9 mm. Although the patient remained asymptomatic, follow-up radiography at 8 months demonstrated further lesion enlargement to 11×11 mm (Fig. 1C), consistent with treatment failure and suggestive of a persistent radicular cyst unresponsive to orthograde endodontic retreatment.

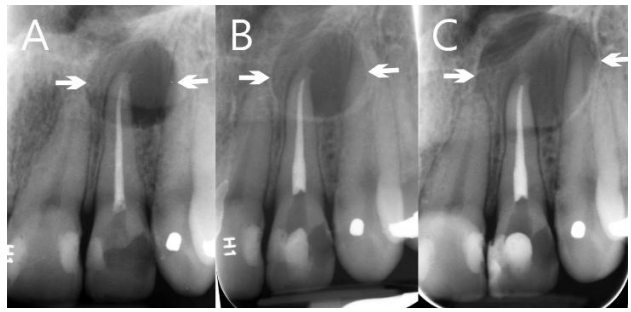

Figure 1. Progressive enlargement of a persistent periapical lesion associated with tooth #22. (A) Initial periapical radiograph showing a well-circumscribed, unilocular radiolucency (approximately 8×8 mm; indicated by white arrows) at the apex of tooth #22, suggestive of a periapical lesion despite previous root canal treatment. (B) One-month postoperative radiograph following nonsurgical retreatment reveals a slight increase in lesion size (approximately 9×9 mm; indicated by white arrows), confirming a lack of healing. (C) Eight-month follow-up radiograph demonstrating further enlargement of the lesion (approximately 11×11 mm; indicated by white arrows), consistent with treatment failure and suggestive of a true radicular cyst unresponsive to orthograde endodontic retreatment.

Due to the progressive enlargement of the lesion, surgical endodontic intervention was planned, including apical resection and root-end filling with CEM cement (BioniqueDent, Tehran, Iran). Written informed consent was obtained before the procedure.

Preoperatively, the mouth was rinsed with 0.2% chlorhexidine gluconate, and 400 mg ibuprofen was administered for analgesia. The procedure was performed under local anesthesia using 2% lidocaine with 1:80,000 epinephrine (DarouPakhsh, Tehran, Iran), under aseptic conditions.

The incision was performed using a No. 15 surgical blade to ensure precise soft tissue reflection. A full-thickness submarginal curved mucoperiosteal flap was elevated from the buccal aspect to preserve the marginal gingiva and provide adequate surgical access. After flap reflection, thinning and partial resorption of the buccal cortical plate were observed. A conservative buccal osteotomy was performed using a round carbide bur under copious sterile saline irrigation to expose the whole lesion. The cystic lesion was carefully enucleated in its entirety, and thorough curettage of the periapical area was performed to remove all pathological tissue. The resorption of palatal cortical plate was observed. Approximately 2-3 mm of the root apex was resected perpendicular to the long axis of the tooth using a fissure bur. A 3-mm deep root-end cavity was ultrasonically prepared using retro-tips (Joya Electronics, Tehran, Iran) to minimize the bevel angle and enhance apical sealing. The prepared cavity was filled/sealed with CEM cement (Fig. 2A). The surgical site was irrigated and closed with 4-0 monofilament sutures. No systemic antibiotics or additional analgesics were prescribed. Sutures were removed after 7 days.

The immediate postoperative radiograph confirmed a well-adapted root-end filling with no voids (Fig. 2A). At the 44-month recall, periapical radiography (Fig. 2B) and cone-beam computed tomography (CBCT) (Fig. 2C) showed complete periapical healing, reformation of the cortical plate, restoration of the lamina dura, and normalization of the periodontal ligament (PDL) space. The tooth remained asymptomatic and fully functional.

Figure 2. Surgical management and radiographic healing following root-end resection and retrograde filling with CEM cement. (A) Immediate postoperative periapical radiograph confirming apical resection and a dense, void-free root-end filling with CEM cement in tooth #22 (white arrow). (B) Forty four-month follow-up periapical radiograph showing complete resolution of the periapical radiolucency, re-establishment of the lamina dura, and intact periodontal ligament space (white arrow). (C) CBCT scan at the same recall reveals complete bone regeneration at the previous lesion site and reformation of the buccal cortical plate, confirming radiographic healing in all dimensions (white arrow).

Histopathologic examination of the enucleated lesion confirmed the diagnosis of a radicular cyst. Microscopic analysis revealed a cystic cavity lined by non-keratinized stratified squamous epithelium of variable thickness, with epithelial proliferation and arcading patterns suggestive of chronic inflammatory stimulation (Fig. 3A). The cyst wall comprised fibrous connective tissue exhibiting chronic inflammatory infiltration, predominantly lymphocytes and plasma cells (Fig. 3B). These features are characteristics of an inflammatory odontogenic cyst originating from the epithelial cell rests of Malassez. No evidence of epithelial dysplasia, foreign body reaction, or granulomatous inflammation was observed. The histological findings supported the diagnosis of a true cyst, explaining the lesion's progressive growth and non-responsiveness to orthograde retreatment.

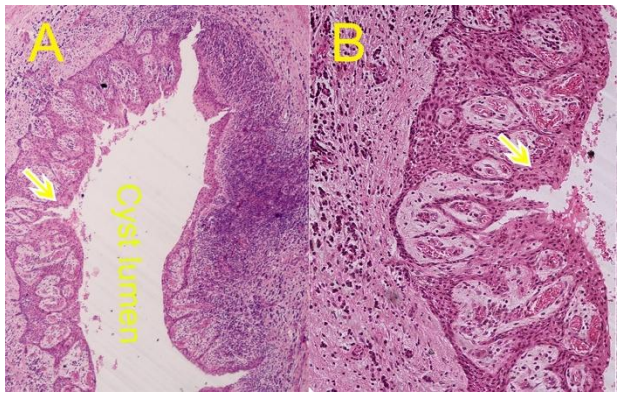

Figure 3. Histopathological features of the enucleated lesion confirm a true radicular cyst. (A) Hematoxylin and eosin-stained section showing a cystic cavity lined by non-keratinized stratified squamous epithelium with arcading proliferation, typical of an inflammatory radicular cyst (white arrow). (B) The cyst wall exhibits fibrous connective tissue with chronic inflammatory infiltrate predominantly composed of lymphocytes and plasma cells, confirming the inflammatory nature of the lesion. No features of epithelial dysplasia (white arrow), foreign body reaction, or granulomatous inflammation were observed.

At 64 months, the patient sustained a traumatic crown fracture due to a sports-related fall (Fig. 4A). The tooth was successfully restored with a post-and-core buildup followed by a full-coverage crown. The final panoramic radiograph at the 6-year follow-up (Fig. 4B) confirmed complete and stable periapical healing, with no signs of lesion recurrence or pathology. Clinically, the tooth remained asymptomatic, functional, and stable, with no signs

of mobility. The patient expressed satisfaction with the outcome, appreciated the preservation of her natural tooth, and reported no discomfort during the 6-year follow-up.

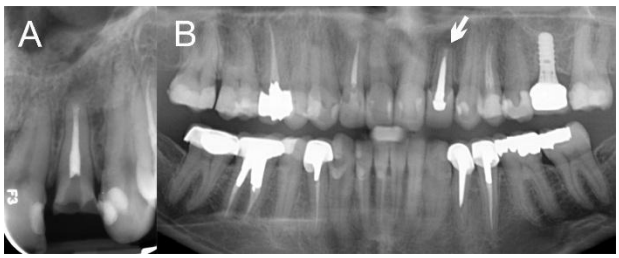

Figure 4. Long-term follow-up demonstrating clinical success and functional restoration post-trauma. (A) Periapical radiograph depicting a traumatic crown fracture of tooth #22 sustained at 64 months post-surgery. (B) Six-year follow-up panoramic radiograph showing continued periapical health, stable supporting bone structures, and absence of recurrence. The tooth was successfully rehabilitated with post-and-core and full-coverage crown, preserving function and esthetics.

Discussion

Radicular cysts are the most prevalent odontogenic cysts and typically arise as a chronic sequela of pulpal necrosis and persistent periapical inflammation. Their development is attributed to the activation and proliferation of epithelial cell rests of Malassez in response to microbial antigens and proinflammatory mediators. Among them, true radicular cysts, which are entirely encapsulated by a self-sustaining epithelial lining and lack communication with the root canal system, pose a unique clinical challenge, as they are often less/non-responsive to nonsurgical endodontic treatment or orthograde retreatment (7), and often require surgical intervention for definitive resolution. In the present case, lesion persistence and progressive enlargement following technically adequate nonsurgical retreatment were indicative of a self-sustaining true cyst. While orthograde endodontic therapy generally achieves high success rates in apical periodontitis (87% and 71% with lenient and strict criteria, respectively, within 1-3 years) (8), its efficacy is significantly reduced in lesions with cystic characteristics. Key prognostic factors contributing to treatment resistance include lesion size, lack of apical communication, and the autonomous proliferation of epithelial cells.

The observed lesion growth from 8×8 mm to 11×11 mm over 8 months, despite conventional endodontic retreatment, justified surgical endodontic intervention. Surgical enucleation allowed for complete removal of the cystic lining, and root-end resection with retrograde filling ensured a hermetic apical seal, both essential for halting further epithelial proliferation and promoting periapical healing.

Material selection for root-end filling is a critical determinant of surgical success. In this case, CEM cement was chosen for its superior handling properties, short setting time, and well-documented bioactivity. CEM promotes both cementogenesis and osteogenesis, and its sealing ability is comparable to mineral trioxide aggregate (4, 6, 9). Over the 6-year follow-up, this bioceramic material demonstrated sustained periapical healing, as evidenced by radiographic regeneration of the lamina dura, PDL space, and cortical plate. Histopathologic examination confirmed the diagnosis of a true radicular cyst, with characteristic features including a non-keratinized stratified squamous epithelial lining and dense chronic inflammatory infiltrate, without signs of epithelial dysplasia or foreign body reaction. This histological confirmation corroborated the radiographic and clinical findings, reinforcing the necessity of surgical management in such cases.

Importantly, three-dimensional assessment via CBCT at 44 months postoperatively revealed comprehensive bony regeneration, which is often underappreciated in conventional two-dimensional imaging. CBCT's diagnostic superiority lies in its ability to detect subtle cortical remodeling and assess the true extent of osseous healing, particularly in cases with large preoperative lesions or prior surgical intervention.

A noteworthy event occurred at 64 months postoperatively, when the patient sustained a traumatic crown fracture unrelated to the original pathology. Despite this complication, the tooth maintained apical health and structural stability. It was successfully rehabilitated with post-and-core buildup and a full-coverage crown. This outcome highlights the long-term durability of biologically based surgical endodontic therapy and supports the conservative philosophy of preserving natural teeth whenever possible.

From a clinical standpoint, persistent periapical radiolucencies associated with endodontically treated teeth require careful longitudinal radiographic follow-up, even when patients remain asymptomatic (4, 10, 11). Progressive enlargement, well-defined borders, and lack of response to orthograde retreatment are features that increase the likelihood of cystic pathology and justify

consideration of surgical intervention using minimally invasive procedures (5, 12, 13). Surgical enucleation enables complete removal of pathological tissue and provides histopathologic confirmation, which remains the gold standard for differentiating true radicular cysts from other periapical lesions (14). When combined with apical resection and an effective retrograde seal using bioactive materials, surgical endodontic treatment can result in predictable periapical healing and long-term preservation of natural dentition (15).

Conclusions

This case underscores the pivotal role of surgical endodontics in managing persistent true radicular cysts, particularly when nonsurgical retreatment proves ineffective. The use of CEM cement as a root-end filling material facilitated robust periapical healing and long-term tooth retention, as confirmed through 6 years of clinical and radiographic follow-up. Key determinants of success included: i) accurate differential diagnosis using both radiographic and histopathologic criteria; ii) strategic surgical planning for cyst enucleation and apicoectomy; and iii) application of a bioactive and biocompatible root-end filling material. This case adds to the growing body of evidence supporting surgical endodontics with biomaterial-based apical sealing as a predictable and durable treatment option for true radicular cysts.

Ethics Approval and Consent to Participate

Ethical approval was not required for this retrospective case report in accordance with institutional guidelines. Written informed consent was obtained from the patient before treatment and for participation in this report.

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Data Availability Statement

All data generated or analyzed during this study are included in this published article. No additional datasets were generated.

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Authors' Contribution

S.A. was responsible for the study conception and design, clinical management of the case, data acquisition, analysis and interpretation, manuscript drafting, and final approval of the submitted version.

Conflict of Interest

The author declares no conflicts of interest related to this study.

Declaration of Generative Artificial Intelligence (AI) in Scientific Writing

The author declares that generative artificial intelligence tools were used solely for language editing and improvement of grammar and clarity.

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