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Retrospective Study On The Outcomes Of Apicoectomy Without Retrograde Filling For Periapical Inflammatory Cysts

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Abstract

Background: *Radicular cysts, common inflammatory lesions related to dental pulp, often necessitate apicoectomy when standard root canal therapy fails. This study explores long-term outcomes of apicoectomy on both inflammatory and non-inflammatory cysts, specifically evaluating the necessity of retrograde filling.* ***Materials and Methods:*** *Data from patients at Kalinga Institute of Dental Sciences and various clinics in Odisha (July 2015 - July 2024) were analyzed. Inclusion criteria involved patients over 20 years who underwent root canal therapy prior to apicoectomy. Clinical outcomes were assessed through symptoms and follow-up cone-beam computed tomography (CBCT).* ***Results:*** *A total of 246 teeth were analyzed (mean age 43.2 ± 13.2 years). Apicoectomies were performed on 171 inflammatory and 75 non-inflammatory cysts, with retrograde filling in 36 and 5 cases, respectively. Over an average follow-up of 3.6 ± 2.3 years, no recurrences occurred, and only 1.2% of non-retrograde filled teeth showed complications.* ***Conclusion:*** *Apicoectomy provides favorable long-term outcomes for both cyst types, indicating that retrograde filling may not be essential for success.*

Keywords: *Apicoectomy, Radicular Cysts, Retrograde Filling, Endodontics, Surgical Outcomes*

Introduction

Radicular cysts, also known as periapical cysts, are the most prevalent type of tooth root-related cysts and the second most common periapical lesions following periapical granulomas[1]. These chronic lesions develop from the proliferation of epithelial remnants within the periodontal ligament, typically in the epithelial rests of Malassez, and are triggered by inflammation or infection in the dental pulp[2]. On X-ray, radicular cysts present as distinct radiolucent areas at the apex of the root and may result in bone destruction[3]. Initial treatment

generally involves conventional root canal therapy or retreatment. However, if symptoms persist or complications arise—such as the presence of an intracanal post—endodontic surgery may be required. This surgery often includes apical resection (typically 2 to 3 mm from the root apex, accounting for lateral and accessory canals) and retrograde filling.

Retrograde filling, particularly with bioceramic materials, is used to seal the root canal system and eliminate infected or inflamed tissue around the root apex[4]. The success rates for these procedures vary between 69% and 76%[5], highlighting the importance of thorough root-end treatment for the long-term prognosis of radicular cysts and conditions like periapical abscesses[6]. Factors influencing periapical healing include preoperative periapical lesions with complete loss of the buccal plate, the quality of root end preparation, remaining thickness of apical root dentin, and the restoration status.

In contrast, cystic lesions such as odontogenic keratocysts (OKC) or ameloblastomas develop independently of bacterial infection in the root canal system and can lead to progressive jawbone expansion, potentially compromising adjacent teeth. In these cases, RCT may be necessary for the affected teeth before the complete removal of the cyst. Additionally, intentional RCT may be needed if tooth root resection is performed[7]. For oral and maxillofacial surgeons, the primary goal of apicoectomy is the complete removal of the cyst wall. The prognosis for teeth undergoing apicoectomy during cyst enucleation remains uncertain.

This study aims to compare the long-term prognosis of teeth affected by inflammatory (radicular) cysts with those affected by non-inflammatory cystic lesions following apicoectomy. We hypothesize that the prognosis would be similar between teeth affected by non-inflammatory cysts (not involving intracanal bacterial infection) and those with inflammatory cysts. Additionally, we will evaluate the necessity and impact of retrograde filling after root resection.

Materials and Methods

This retrospective study aimed to evaluate the clinical outcomes of apicoectomy in teeth affected by jaw cysts. Data were obtained from Department of Conservative Dentistry and Endodontics, Kalinga Institute of Dental Sciences along with few dental clinics and hospitals in Bhubaneswar and Cuttack, Odisha between July 2015 and July 2024.

The study's inclusion criteria were as follows:

(1) patients over 20 years of age,

(2) teeth that had undergone preoperative root canal therapy (RCT) by endodontic specialists,

(3) apicoectomy performed concurrently with cyst enucleation by an oral and maxillofacial surgeon, and

(4) follow-up cone-beam computed tomography (CBCT) imaging taken at least 6 months post-surgery.

Exclusion criteria included:

(1) incomplete or missing postoperative medical records and

(2) apicoectomy performed on teeth not associated with a cystic lesion.

The prognosis of the treated teeth was evaluated based on clinical symptoms (including percussion sensitivity, pain, periapical abscess formation, and periapical periodontitis) and radiographic findings from

follow-up CBCT scans. CBCT evaluations focused on several factors: the presence of well-defined corticated boundaries, lesion shape (curved or circular), internal structure, radiolucency, impact on adjacent anatomical structures (such as displacement or resorption of neighboring tooth roots), and perforation of the cortical plate.

Key variables examined in this study included the type of cyst (inflammatory versus non-inflammatory), use of retrograde filling, location of the cyst in the jaw, and specific tooth location. Histological analysis was used to classify cysts into two main categories: inflammatory cysts, such as radicular cysts, and non-inflammatory cysts, including dentigerous cysts and odontogenic keratocysts (OKCs). The primary outcomes were tooth survival and success rates following apicoectomy, with survival defined as the absence of further complications or interventions, and success defined as the absence of clinical symptoms or radiographic evidence of recurrence. Complications, such as the need for repeat RCT or extraction, were documented during the follow-up period.

Demographic variables, including age and sex, were analyzed between the two cyst categories using independent t-tests. Prognostic outcomes were assessed via the life table method. The influence of variables such as cyst type, cyst location, and the use of retrograde filling was analyzed using Pearson chi-square tests and logistic regression analysis. Data were expressed as mean ± standard deviation, and statistical analysis was conducted using IBM SPSS Statistics (version 27.0; IBM Corp.).

Results

A total of 246 teeth (139 male and 107 female patients; mean age 43.2±13.2 years) underwent apicoectomy during cyst enucleation, with 159 procedures performed on the maxilla and 87 on the mandible. Of these, 138 were anterior teeth and 108 were posterior. Apicoectomy was performed for 171 inflammatory cysts (radicular cysts) and 75 non-inflammatory cysts (odontogenic cysts, including OKCs). Retrograde filling using ProRoot (mineral trioxide aggregate, MTA; Dentsply Tulsa Dental) was completed by endodontic specialists in 36 teeth with inflammatory cysts and 5 teeth with non-inflammatory cysts (Table 1).

Over an average follow-up period of 3.6±2.3 years (range, 0.9-8.1 years), no recurrences of cystic lesions were observed. Postoperative complications were noted in only two of the 171 non-retrograde filled teeth with inflammatory cysts (1.2%), occurring 1 year after surgery. This case presented with symptoms of gingival fistula and pain, which were successfully managed through repeat root canal therapy (Re-RCT). Simple logistic regression analysis showed no statistically significant correlation between postoperative complications and factors such as cyst type, use of retrograde filling, jaw location, or tooth position.

Table 1. Demographic and Clinical Characteristics of Teeth Undergoing Apicoectomy

Feature	Teeth Affected by Inflammatory Cyst (n=171)	Teeth Affected by Non-Inflammatory Cyst (n=75)	P-value
Sex, male:female	98:73	41:34	0.520[1]
Age (yr)	40.1±13.6	47.2±14.8	0.058[2]
Jaw, maxilla:mandible	107:64	52:23	0.054[1]

Location, anterior:posterior	104:67	34:41	0.298[1]
Retrograde filling	36 (21.1)	5 (6.7)	0.248[1]
Postoperative lesion	2 (1.2)	2 (2.7)	0.452[1]

[1] Pearson's chi-square test. [2] Independent t-test. * Significant $p<0.05$

Values are presented as number, mean±standard deviation, or number (%).

Discussion

The hypothesis that the absence of retrograde filling in apicoectomy for inflammatory cysts, such as radicular cysts, would not significantly impact the surgical outcome was supported by our findings. No cyst recurrences were observed, and a high success rate of 98.8% was achieved for teeth that did not receive retrograde filling. This aligns with previous studies that showed no significant differences in apical sealing quality between cases with or without retrograde filling when comparing various root canal obturation techniques, such as bioceramic sealers or orthograde MTA fillings[8]. The lack of voids in the apical 3 mm and 1 mm sections of the resected root, regardless of retrograde filling, suggests that both approaches provide adequate root canal system sealing [9,10]. When retrograde filling is poorly executed, it can create gaps that foster bacterial proliferation, compromising treatment success [11]. While MTA is commonly used as a retrograde filling material due to its biocompatibility and ability to promote tissue regeneration, its drawbacks—such as handling difficulty and long setting time—can lead to washout under clinical conditions where bleeding and limited visibility pose challenges [12]. In our study, the high success rate without retrograde filling may be attributed to thorough preoperative root canal therapy (RCT) and coronal sealing by endodontic specialists, which ensured proper root canal disinfection. Radiographic and cone-beam computed tomography (CBCT) imaging confirmed this by showing compact apical obturation with gutta-percha and sealer[10].

According to Nair et al.[13], periapical lesions are predominantly inflammatory in nature, with their study revealing that 50% of such lesions were granulomas, 35% were periapical abscesses, and 15% were either pocket or true cysts. Pocket cysts remain connected to the infected root canal system, while true cysts are independent of the root [13,14]. Radicular cysts, although associated with the infected root canal system, follow a distinct pathological development compared to typical root canal infections. The European Society of Endodontology recommends a follow-up period of one year for postoperative outcomes, with further reviews extending up to four years to evaluate long-term results[15]. In line with these guidelines, our study, with an average follow-up of 3.6 years, demonstrates that apicoectomy is a favorable treatment option for teeth with inflammatory or non-inflammatory cysts, regardless of the use of retrograde filling. These results support the view that apicoectomy alone provides a reliable prognosis for managing odontogenic cysts in both scenarios.

Root canal therapy (RCT) involves a series of treatments aimed at removing infected pulp tissue, eliminating toxic irritants, and protecting the tooth from future microbial invasion[16]. However, due to the complex anatomy of the root canal system and the inherent challenges in completely eradicating all bacteria and byproducts, failure rates range from 4% to 15% [17]. Apicoectomy, a surgical endodontic procedure, focuses on apical cleansing and sealing, both critical for achieving successful outcomes. This procedure, along with

retrograde filling, is intended to seal any microgaps between the root canal filling material and the dentinal walls. Mineral trioxide aggregate (MTA) is a preferred retrograde filling material due to its excellent sealing ability, biocompatibility, and favorable tissue response around the root periphery.[18]

In this study, MTA was used for retrograde filling in only a limited number of cases. The high success rate achieved in teeth treated solely with apicoectomy, especially in cases of radicular cysts (98.8%), can be partly attributed to the thorough preoperative root canal therapy performed by endodontic specialists. While retrograde filling is often seen as the optimal treatment for apicoectomy, it requires significant resources, including extended general anesthesia time, bleeding control measures, and specialized equipment for the endodontist [19]. Given that the success rate for apicoectomy without retrograde filling in our study was notably high, compared to the general 80%-95% success rates reported for procedures involving MTA retrograde filling[20], our findings suggest that apicoectomy alone may be a highly effective treatment option for cyst-affected teeth.

Radicular cysts, classified as true cysts, feature a cavity encased by an epithelial wall that is not continuous with the canal lumen, as seen in histological sections. In contrast, bay cysts have a cystic space surrounded by an epithelial wall that is connected to the external root surface, with a direct opening into the canal lumen[21]. A 2020 histopathological and histobacteriological study on periapical cystic lesions treated via apicoectomy found bacterial presence in all examined cases, irrespective of whether the lesions were bay or true cysts[22]. This underscores the importance of infection control before cyst enucleation and apicoectomy to ensure successful outcomes. The most frequent cause of RCT failure is leakage around the canal filling material, often due to over-instrumentation, pathological resorption, or accessory canals and apical ramifications, which is why retrograde preparation and filling are generally recommended for endodontic success[23].

However, during cyst enucleation surgeries, particularly those requiring general anesthesia, there are challenges to performing high-quality retrograde treatments due to the increased duration under anesthesia and other surgical constraints. Despite these limitations, when cystic changes have occurred, the infection risk from canal bacteria is low if the teeth have undergone high-quality endodontic treatment. In such cases, apicoectomy alone can achieve successful outcomes during cyst enucleation. A limitation of this study is the small number of cases that involved retrograde filling or apicoectomy for non-inflammatory cysts. Future studies with larger sample sizes, preferably in a multicenter setting, may provide more comprehensive insights into these treatment outcomes.

Conclusion

The long-term outlook for teeth treated with apicoectomy is favorable, regardless of the cyst type. This suggests that the surgical procedure could be simplified by excluding retrograde filling without negatively impacting the treatment results.

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