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Assessing the efficacy of apicoectomy without retrograde filling in treating periapical inflammatory cysts

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Abstract (J Korean Assoc Oral Maxillofac Surg 2024;50:140-145)

Objectives: The necessity of retrograde filling after apicoectomy is controversial in cases of non-inflammatory cysts as opposed to bacteria-related periapical abscesses. This study aims to investigate whether the presence or absence of retrograde filling during apicoectomy has differential long-term prognostic implications between inflammatory and non-inflammatory cysts.

Materials and Methods: This retrospective study included patients who underwent tooth apicoectomy during jaw cyst enucleation between 2013 and 2022, and who underwent follow-up cone-beam computed tomography for at least 6 months. The prognosis of the tooth was evaluated during the follow-up period according to the cyst type, the presence or absence of retrograde filling, mandible or maxilla, and location.

Results: A total of 147 teeth was included in this study. All the operated teeth underwent preoperative root canal treatment by an endodontic specialist. Apicoectomy was performed for 119 inflammatory cysts and 28 non-inflammatory cysts. Retrograde filling was performed on 22 teeth with inflammatory cysts and 3 teeth with non-inflammatory cysts. All teeth survived the 3.5-year follow-up (range, 1.0-9.1 years). However, 1 tooth with an inflammatory cyst developed complications 1 year after surgery that required re-endodontic treatment.

Conclusion: The prognosis of a tooth treated by apicoectomy without retrograde filling during cyst enucleation is favorable, regardless of the cyst type.

Key words: Radicular cyst, Odontogenic cyst, Retrograde filling, Root canal therapy, Prognosis

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I. Introduction

Radicular cysts, also known as periapical cysts, are the most prevalent type of tooth root-related cysts and are the second most common periapical lesion following periapical granulomas[1,2]. These chronic lesions arise from the growth of epithelial remnants in the periodontal ligament, typically in the epithelial rests of Malassez; they are triggered by inflammation or infection in the dental pulp[3]. On X-ray, radicular cysts appear as a distinct radiolucent area at the apex of the root and may lead to bone destruction[4]. The initial treatment often involves conventional root canal therapy or retreatment. However, if symptoms persist after such treatments or factors like an intracanal post complicate retreatment, endodontic surgery may be necessary; such surgery might include apical resection (approximately 2 to 3 mm from the root apex due to lateral and accessory canals) and retrograde filling.

Retrograde filling, particularly with bioceramic materials, is advised to eliminate infected or inflamed tissue around the root apex. The filling effectively seals the root canal system to prevent further bacterial leakage into the periapical tissues[5]. The survival rates for these procedures range from 69% to 76%[6], which emphasizes the critical nature of thorough root-end treatment for the long-term prognosis of radicular cysts and conditions like periapical abscess[7]. The factors that influence periapical healing include preoperative periapical

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lesions with complete loss of the buccal plate, quality of root-end preparation, remaining thickness of apical root dentin, and restoration status.

Conversely, cystic lesions such as odontogenic keratocysts (OKC) or ameloblastomas, which develop independently of bacterial infection in the root canal system, can also cause progressive jawbone expansion and may jeopardize the vitality of adjacent teeth. In these instances, RCT may be necessary for the affected teeth before completely removing the cyst; furthermore, intentional RCT might be required if the tooth root needs to be resected[8]. For oral and maxillofacial surgeons, the primary goal of apicoectomy is complete removal of the cyst wall. Currently, the prognosis for teeth that have undergone apicoectomy during cyst enucleation is uncertain.

This study aims to compare the long-term prognosis of teeth affected by inflammatory (radicular) cysts to 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. The necessity and impact of retrograde filling after root resection are also evaluated.

II. Materials and Methods

This retrospective study aimed to assess the outcomes of apicoectomy in teeth affected by jaw cysts. Data were collected from patients who underwent cyst enucleation procedures in the Department of Oral and Maxillofacial Surgery at Jeonbuk National University Hospital between January 2013 and December 2022. The inclusion criteria were: (1) age >20 years, (2) teeth that underwent preoperative RCT by endodontic specialists before the surgery, (3) apicoectomy performed simultaneously with cyst enucleation surgery by an oral and maxillofacial surgeon, and (4) follow-up cone-beam computed tomography (CBCT) scans at least 6 months after surgery. The exclusion criteria were: (1) lack of medical records postoperatively and (2) apicoectomy performed on a tooth that was not affected by a cyst. The prognosis of the teeth was evaluated based on the clinical symptoms (percussion, pain, periapical abscess, and periapical periodontitis) and CBCT results on the apex of the involved tooth. The CBCT results evaluated were well-defined corticated limits, shape of lesion: curved or circular, internal structure, radiolucency, effect on surrounding structures: displacement and resorption of the roots of adjacent teeth, and cortical plate perforation[9]. This study focused on various parameters, including the type of cyst (inflammatory or non-inflammatory), use of retrograde filling, location of the cyst in the jaw, and specific location of the tooth.

The cysts were classified into two categories based on histologic results: inflammatory cysts, specifically radicular cysts, and non-inflammatory cysts, including dentigerous cysts and OKCs. The primary outcome measures were survival and success rates of the teeth following apicoectomy, which were defined respectively as the absence of complications and the need for further intervention during the follow-up period. Complications included the need for re-RCT or extraction.

Demographic information, including age and sex, was analyzed between the two cyst types (inflammatory and non-inflammatory) using independent *t*-tests. The prognosis of the teeth was assessed using the life table method. Pearson chi-square tests and logistic regression analysis were used to analyze the effects of cyst type, cyst location, and use of retrograde filling. Data are expressed as mean±standard deviation and were analyzed using IBM SPSS Statistics (ver. 27.0; IBM Corp.).

III. Results

Through medical chart review, 147 teeth (89 male and 58 female; mean age, 42.3±14.4 years; 106 maxilla and 41 mandible; 98 anterior and 49 posterior) underwent apicoectomy of teeth during cyst enucleation. In total, 119 apicoectomies were performed for inflammatory cysts (radicular cysts) (Fig. 1) and 28 for non-inflammatory cysts (odontogenic cysts, including OKCs).(Fig. 2)

Retrograde filling was performed by endodontic specialists with ProRoot (mineral trioxide aggregate, MTA; Dentsply Tulsa Dental) in 22 teeth with inflammatory cysts and three teeth with non-inflammatory cysts.(Table 1)

During the 3.5±2.6 years (range, 1.0-9.1 years) of follow-up, there was no recurrence of cystic lesions. Postoperative complications occurred in one non-retrograde filled tooth among 119 teeth (0.8%) with inflammatory cysts at 1 year postoperatively. The symptoms (gingival fistula and pain) were treated with Re-RCT.(Fig. 3) Simple logistic regression analysis revealed no statistical significance in the postoperative complications of the teeth in terms of cyst type, retrograde filling, jaw, and location.

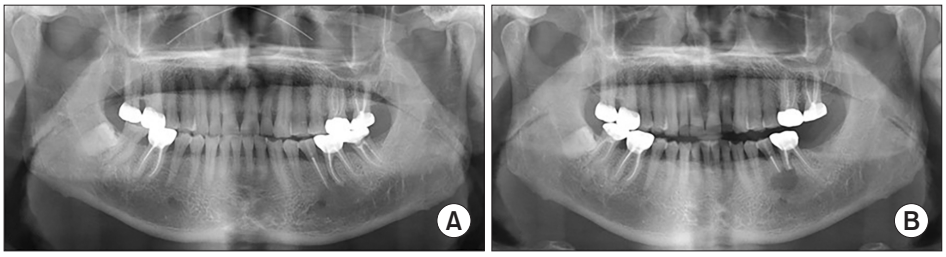

Fig. 1. Radiograph of a patient with a radicular cyst. A. Preoperative panoramic view. B. Postoperative panoramic view.
Jeong-Kui Ku et al: Assessing the efficacy of apicoectomy without retrograde filling in treating periapical inflammatory cysts. J Korean Assoc Oral Maxillofac Surg 2024

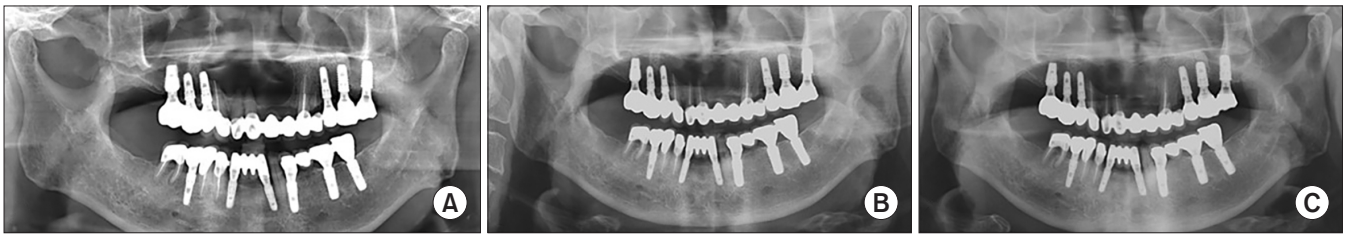

Fig. 2. Radiograph of a patient with an odontogenic keratocyst on the anterior maxilla. A. Initial panoramic view. B. Preoperative panoramic view after prior root canal therapy. C. Postoperative panoramic view.
Jeong-Kui Ku et al: Assessing the efficacy of apicoectomy without retrograde filling in treating periapical inflammatory cysts. J Korean Assoc Oral Maxillofac Surg 2024

Table 1. Demographic and clinical information of teeth that underwent apicoectomy according to cyst type

	Teeth affected by inflammatory cyst (n=119)	Teeth affected by non-inflammatory cyst (n=28)	*P*-value
Sex, male:female	73:46	16:12	0.420[1]
Age (yr)	41.1±15.2	48.2±14.9	0.028[2]
Follow-up period (yr)	3.7±2.7	2.9±1.9	0.226[2]
Jaw, maxilla:mandible	90:29	16:12	0.045[1]
Location, anterior:posterior	81:38	17:11	0.298[1]
Retrograde filling	22 (18.5)	3 (10.7)	0.247[1]
Postoperative lesion	2 (1.7)	1 (3.6)	0.472[1]

[1]Pearson's chi-square test. [2]Independent *t*-test.
Values are presented as number, mean±standard deviation, or number (%).
Jeong-Kui Ku et al: Assessing the efficacy of apicoectomy without retrograde filling in treating periapical inflammatory cysts. J Korean Assoc Oral Maxillofac Surg 2024

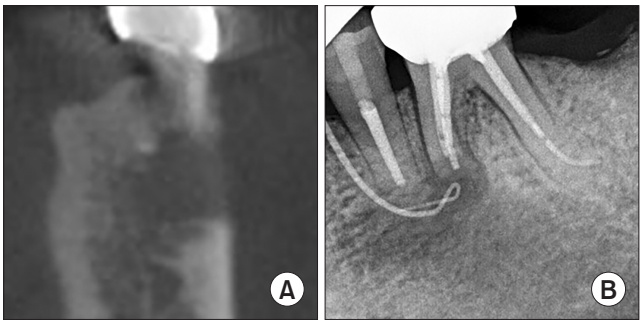

Fig. 3. Postoperative radiograph of the patient from Fig. 1. A. Incomplete bone healing demonstrated on cone-beam computed tomography one year after the surgery. B. Gutta percha tracing from the gingival fistula.
Jeong-Kui Ku et al: Assessing the efficacy of apicoectomy without retrograde filling in treating periapical inflammatory cysts. J Korean Assoc Oral Maxillofac Surg 2024

IV. Discussion

The author assumed that the surgical outcome of cystic development as opposed to apicoectomy due to intracanal infection would not be significantly affected by apical sealing (to prevent reinfection by intracanal bacteria). There was no cyst recurrence, and a success rate of 99.2% was achieved for teeth that did not receive retrograde filling, including cases of radicular cysts. In another study that compared two orthograde root canal obturation techniques (single cone technique with a bioceramic sealer or orthograde MTA filling) with or without retrograde filling[10], there was no significant difference in the filling voids within the apical 3 mm and 1 mm of the resected root. This result suggests that the techniques were similarly effective in achieving adequate filling of the root canal system, regardless of retrograde filling. Poorly executed retrograde filling can lead to voids or gaps in the apical regions, which provide favorable conditions for bacterial proliferation[11,12]. MTA is the most commonly used retrofilling material due to its biocompatibility and ability to induce tissue regeneration[13]. However, it has the disadvantage of being difficult to handle and having a long setting time, which can lead to washout[14]. In actual clinical practice, apicoectomy can be challenging due to factors such as bleeding and limited visibility, hindering MTA manipulation. This often leads to incomplete retrograde filling, which may compromise the sealing of the root canal system and potentially lead to treatment failure. In our study, the success of the procedure was

not affected by retrograde filling in an inflammatory cyst. This result is thought to be partly due to RCT and coronal sealing by an endodontic specialist, which ensured effective root canal disinfection. The disinfection was confirmed by compact obturation of the apical resection area using gutta percha cones and sealer in computed tomography or radiographic images[12].

According to Nair et al.[15], periapical lesions primarily exhibit inflammatory characteristics. Their research found that 50% of these lesions were granulomas, 35% were periapical abscesses, and 15% were either pocket cysts or true cysts. Pocket cysts are directly linked to the infected root canal system, whereas true cysts are independent of the root[15,16]. While radicular cysts are indeed connected to the infected root canal system, the pathological development of these cysts follows a different pathway compared to root canal infections. The European Society of Endodontology recommends a follow-up period of one year, with subsequent reviews extending up to four years for research on post-surgery outcomes[17]. Therefore, the authors in this study concluded that, based on an average 3.5-year follow-up in this study, apicoectomy alone is a favorable option for treating teeth affected by inflammatory or non-inflammatory odontogenic cysts regardless of the use of retrograde filling.

Root canal therapy is a sequence of treatments for the infected pulp of a tooth to remove the infected tissue and toxic irritants and protect the decontaminated tooth from future microbial invasion[18]. However, because of the well-known complexity of the root canal system and the acknowledged difficulty of completely eliminating all bacteria and their by-products from the canal system, failures occur at a reported rate of 4% to 15%[19]. Apicoectomy is a surgical endodontic treatment during which apical cleansing and sealing are crucial factors for successful outcomes. Therefore, apicoectomy and retrograde filling are used to seal the microgap between the prior root canal filling material and the dentinal wall. MTA has practical advantages that include superior sealing capability, biocompatibility, and effective tissue response of the peripheral root[20]. In this study, retrograde filling was performed using MTA in all cases. The fact that both the presurgical RCT and retrograde filing were conducted by an endodontic specialist may have contributed to the effective outcomes. Retrograde filling may be considered the ideal treatment approach in apicoectomy; however, intraoperatively during cyst enucleation, considerable resources are essential to prepare for general anesthesia time, bleeding control, and the microscope and other instruments for the endodontic specialist[21,22]. In our study, the success rate for teeth affected by radicular cysts that underwent only apicoectomy was 99.2%. This is notably high compared to the success rates of 80%-95% (mean, 84%) generally reported for retrograde filling using MTA[23]. Therefore, our success rate of apicoectomy alone for teeth affected by a cyst is clinically significant.

Radicular cysts, classified as true cysts, are characterized by the presence of a cavity bordered by an epithelial wall that is not continuous with the canal lumen in any of the serial histologic sections. Lesions classified as bay cysts have a cystic space surrounded by an epithelial wall that joins the external root surface. The bay cyst cavity has a direct opening into the canal lumen[24]. In 2020, a histopathological and histobacteriological study of periapical cystic lesions that underwent apicoectomy demonstrated the presence of bacteria in all cases examined, regardless of the histopathologic diagnosis (such as bay or true cysts)[25]. Therefore, infection control prior to cyst enucleation and apicoectomy is important for successful results. The most common cause of RCT failure is perceived leakage around the canal filling material due to overinstrumentation or pathologic resorption and accessory canals/apical ramifications; therefore, clinicians generally agree on retrograde preparation and filling for endodontic success[26,27]. However, during cyst enucleation surgeries involving general anesthesia, there are limitations in providing high-quality retrograde treatment due to issues such as increased duration under general anesthesia. Within the limitations of this study, when cystic changes have already occurred, there are few infectious symptoms caused by bacteria in the canal. If the teeth have received high-quality endodontic treatment, it is possible to achieve successful outcomes by solely performing apicoectomy during cyst enucleation. A limitation of this retrospective study is the small numbers of patients who underwent retrograde filling and those who had apicoectomy for non-inflammatory cysts. Further research may be necessary involving a larger number of patients in a multicenter study.

V. Conclusion

The long-term prognosis for teeth undergoing apicoectomy is acceptable regardless of the type of cyst involved. This finding supports the potential simplification of the surgical procedure without compromising the treatment outcome by omitting retrograde filling.

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Authors' Contributions

J.K.K. and W.Y.J. participated in data collection and writing the manuscript. J.K.K., W.Y.J., S.O.K., and J.Y.Y. participated in the study design and performed the statistical analysis. S.O.K. and J.Y.Y. participated in the study design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

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Ethics Approval and Consent to Participate

Institutional Review Board Statement: This study was approved by the Institutional Review Board (IRB) of Jeonbuk National University Hospital (IRB No. 2023-09-006), and was conducted according to the principles of the Declaration of Helsinki for research on humans. The written informed consent was waived by the IRB due to the retrospective nature of the study.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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