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Surgical Management Of Radicular Cyst : A Case Report With Histopathological Confirmation

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Abstract

Radicular cysts are the most common inflammatory odontogenic cysts found in the jaws, accounting for approximately 52–68% of all jaw cysts. These lesions originate from the proliferation of epithelial rests of Malassez in the periodontal ligament, triggered by chronic periapical inflammation due to pulp necrosis. Due to their slow-growing nature and often asymptomatic presentation, these cysts frequently reach a significant size before being clinically detected. This case report describes a 48-year-old male patient who presented to Soelastri Dental and Oral Hospital, Surakarta, with a chief complaint of a retained root in the lower left posterior region for approximately three years. The patient reported a prior history of pain that had been self-managed. Clinical examination revealed a retained root in tooth 35 (FDI notation), with positive palpation and negative percussion findings. Periapical radiography showed a well-defined unilocular radiolucency with a sclerotic cortical border, measuring approximately 4 × 3 mm in the periapical region. Surgical management was performed under inferior alveolar nerve block and infiltration anesthesia. A triangular mucoperiosteal flap was elevated, followed by alveolar bone reduction, radiks extraction, cyst enucleation, thorough curettage, and placement of a hemostatic sponge. Primary wound closure was achieved using 4-0 silk sutures. In conclusion, histopathological examination confirmed the diagnosis of a radicular cyst, characterized by stratified squamous epithelial lining and chronic suppurative inflammation within the fibrous capsule. A two-week postoperative follow-up showed good mucosal healing without complications. This case highlights the importance of integrating clinical, radiographic, and histopathological evaluations for accurate diagnosis and appropriate surgical management of radicular cysts associated with retained roots.

Keywords: Radicular cyst, Enucleation, Histopathology.

INTRODUCTION

Odontogenic cysts are a heterogeneous group of jaw lesions of significant clinical importance due to their potential to cause local bone destruction, displacement of adjacent teeth, as well as in rare cases, malignant transformations (Bonanthaya et al., 2021). Among these lesions, radicular cysts also known as periapical cysts or dental cysts are the most commonly found inflammatory odontogenic cysts, accounting for 52–68% of all jaw cystic lesions (Setyawan, 2017). These lesions show predilection in the third and fourth decades of life and are more common in males than females (Setyawan, 2017).

The pathogenesis of radicular cysts is closely related to pulp necrosis due to caries, trauma, or restoration procedures. Bacterial toxins and inflammatory mediators originating from the infected root canal system stimulate the proliferation of Malassez epithelial remnants in the apical periodontal ligament (Nair, 2004; Rios Osorio et al., 2023). Liquefaction necrosis of the proliferating epithelial mass, combined with an osmotic pressure gradient across the epithelial layer, promotes progressive cystic expansion. Pro-inflammatory cytokines including interleukin (IL)-1, IL-6, IL-8, IL-12, IL-17, and tumor necrosis factor-α (TNF-α), as well as growth factors such as epidermal growth factor (EGF), keratinocyte growth factor (KGF), and transforming growth factor (TGF-α and TGF-β) regulate the inflammatory cascade and epithelial proliferation (Firgina & Setyawan, 2024; Al & Sugiharto, 2025).

The indolent and asymptomatic nature of radicular cysts often results in delayed diagnosis, especially when it comes to root residue in patients who have lost part or all of their teeth. If left untreated, these lesions can lead to progressive resorption of the alveolar bones, resorption of adjacent

tooth roots, tooth shift, paresthesia, and in extreme conditions, pathological fractures (Wu et al., 2022). Differential diagnosis includes periapical granulomas, periapical abscesses, lateral periodontal cysts, and other odontogenic cysts; histopathological examination remains the gold standard for definitive diagnosis (Bane et al., 2022).

Surgical management, especially ennucleation, is a therapeutic option for small to medium-sized radicular cysts, especially if the causative tooth cannot be maintained (Firgina & Setyawan, 2024; AboulHosn et al., 2019). Thorough removal of the cyst layer is essential to minimize the risk of recurrence.

In addition to the main etiological factors in the form of pulp infections, the development of radicular cysts is also influenced by the complex interaction between the host's immune response and the virulence of microorganisms. Activation of immune cells such as T-lymphocytes and macrophages plays a role in maintaining a sustained chronic inflammatory response, which ultimately supports epithelial proliferation and cystic cavity formation (Rios Osorio et al., 2023).

Radiographically, radicular cysts generally appear as unilocular radiolucent lesions with well-defined boundaries and often accompanied by thin cortical lines. However, this picture is not always specific so it is difficult to distinguish from periapical granulomas based on conventional radiography alone. The use of cone beam computed tomography (CBCT) can provide a more accurate three-dimensional picture of lesion size and its relationship with anatomical structures (Setyawan, 2017; Rios Osorio et al., 2023).

In clinical practice, delays in diagnosis often occur due to the asymptomatic nature of the lesion and its slow growth. Many new cases are detected incidentally through routine radiographic examinations or after complications have arisen, thus confirming the importance of periodic examinations (Wu et al., 2022).

In terms of management, the therapeutic approach to radicular cysts is highly dependent on the size of the lesion, location, and condition of the underlying tooth. Ennucleation is the main method, while in large lesions, decompression or marsupialization can be considered (AboulHosn et al., 2019; Bane et al., 2022).

Histopathological confirmation is a crucial step in establishing a definitive diagnosis and distinguishing radicular cysts from other odontogenic lesions that have a similar clinical picture but different biological behaviors (Bane et al., 2022; Al & Sugiharto, 2025).

Although various studies have addressed aspects of the pathogenesis, diagnosis, and management of radicular cysts, there are still gaps in the literature regarding the comprehensive integration of clinical, radiographic, single-stage surgical findings, and histopathological confirmation in a single systematic report, particularly in cases related to residual roots (gangrene radix). Most previous studies have focused more on large lesions or a phased approach, so the evidence on the effectiveness of single-stage enucleation in small lesions with specific clinical conditions is still limited (AboulHosn et al., 2019; Bane et al., 2022). In addition, the influence of individual risk factors such as smoking habits on the selection of management strategies and treatment options is also still under-reported in an integrated manner.

Based on these gaps, this case report aims to comprehensively describe the clinical, radiographic, surgical management, and histopathological confirmation aspects of radicular cysts related to the remaining mandibular roots in one integrated approach. In particular, the study emphasized the effectiveness of single-stage enucleation in small lesions as well as considering patient risk factors in clinical decision-making. Thus, the novelty of this study lies in the presentation of an integrated and contextual diagnostic and therapeutic approach, which provides clinical implications in the form of the importance of early detection, the selection of therapies based on individual conditions, and the obligation of histopathological examination as a standard of practice to improve the accuracy of diagnosis and treatment success.

RESEARCH METHODS

Research Design

This study uses a *case report* design that aims to comprehensively describe the diagnosis process, surgical management, and histopathological confirmation in cases of radicular cysts associated with radix gangrene.

Research Subject

The subject of the study was a 48-year-old male patient who came to Soelastri Dental and Oral Hospital (RSGM Soelastri), Surakarta, with complaints of root residue in the posterior region of the left mandible. The patient had no history of systemic disease (ASA I) and had an active smoking habit.

Inspection Procedure

The examination was carried out through anamnesis, extraoral and intraoral clinical examinations, and radiographic examination using panoramic radiography. Interim diagnosis is established based on the integration of clinical and radiographic findings, taking into account the diagnosis of disparities such as periapical granulomas and residual cysts.

Surgical Procedure

The surgical procedure is performed in a single surgical session under local anesthesia through an inferior alveolar nerve block followed by additional infiltration. A triangular mukoperiosteal flap (Neumann) was performed, followed by an osteotomy to open access to the lesion. The remaining roots are extracted and the cyst is thoroughly nucleated, then curettage of the bone cavity and bone smoothing is performed. Bone defects are treated with the application of collagen sponges, and wounds are closed using simple interrupted suture techniques.

Histopathological Examination

The ennucleated specimen was fixed in a 10% formalin solution and sent to the anatomical pathology laboratory for histopathological examination using hematoxilin-eosin (H&E) staining to establish a definitive diagnosis.

Post-Operative Care and Ethics

Patients were given postoperative antibiotic and analgesic therapy and a two-week follow-up was carried out for wound healing evaluation. Follow-up is planned to monitor bone regeneration and possible recurrence. This research has obtained ethical approval as well as informed consent from patients for medical procedures and scientific publications.

RESULTS AND DISCUSSION

Case

A 48-year-old male patient came to the Oral and Maxillofacial Surgery outpatient clinic of Soelastri Dental and Oral Hospital (RSGM Soelastri), Surakarta, Central Java, Indonesia, with the main complaint of root residue in the left posterior region of the mandibula. Patients reported that the tooth had been painful about three years earlier, which was only resolved by taking 500 mg of mefenamic acid without a doctor's prescription. At the time of the visit, the patient does not complain of pain, but the remaining roots interfere with the chewing process and are often a place of retention of food residues. The patient has no previous history of dental care.

The patient did not report any drug, food, or environmental allergies, and denied a history of systemic disease (American Society of Anesthesiologists [ASA] I). Family history shows a similar condition in the form of root residue in both parents of patients without identified systemic diseases. Social history shows the habit of active smoking one pack per day, which is known to be an important risk factor for wound healing disorders and increased postoperative complications (Saputra et al., 2023).

Extraoral examination did not show any facial asymmetry, lymphadenopathy, or trismus. Intraoral examination identified root residue in tooth 35 (lower left second premolar based on FDI

notation). The pulp sensitivity test cannot be performed due to the absence of a dental crown. Percussion results were negative, palpation of buccal vestibulum showed mild compressive pain (+), and no tooth mobility (degree 0). The patient's oral hygiene was classified as poor with a moderate to poor OHI-S score, characterized by the presence of supragingival plaque and supra- and subgingival calculus deposits in several teeth.

Panoramic radiographic examination showed the presence of a solidly bordered unilocular radiolucent lesion with a sclerotic cortical edge, measuring about 4 × 3 mm in the periapical region of tooth 35. The lesions are oval in shape with continuous cortical borders, which are consistent with the picture of periapical cystic lesions. No resorption of adjacent tooth roots or involvement of the inferior alveolar nerve canal was found.

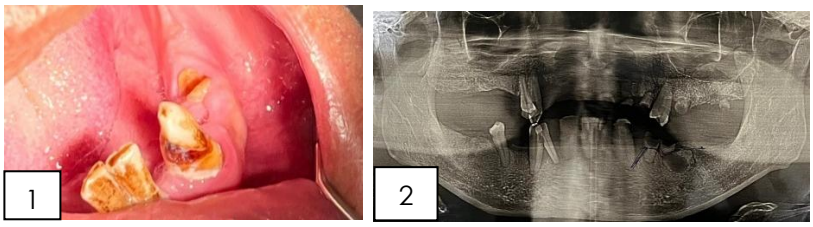

Figure 1. Clinical photo, figure 2. Panoramic Radiography

Based on the integration of anamnesis, clinical findings, and radiographic images, a provisional diagnosis was established in the form *of a radicular cyst related to the remaining mandibular root in tooth 35*. Differential diagnoses considered include periapical granulomas, residual cysts, and dentigerous cysts the latter of which are less likely in the absence of non-eruptive teeth. The definitive diagnosis is postponed pending the histopathological evaluation of the surgical specimen.

After a comprehensive discussion with the patient regarding the diagnosis, etiology, proposed surgical procedure, expected outcomes, and potential complications including pain, swelling, trismus, and risk of postoperative recurrence, written informed consent is obtained. Ethical approvals and case documentation permits from patients for publication purposes are obtained in accordance with institutional guidelines.

Case Management

All surgical procedures were carried out in one surgery session at RSGM Soelastri. Preoperative vital signs within normal limits (blood pressure: 116/78 mmHg; pulse: 82 times/minute; respiratory rate: 18 times/minute; temperature: 36.4 °C), confirm the hemodynamic feasibility for local anesthesia. After preoperative oral antisepsis with a 0.2% povidone-iodine gargle and topical application of benzocaine, local anesthesia is administered. Inferior alveolar nerve block (BNAI) was performed using 1.0 mL of 2% lidocaine with 1:100,000 adrenaline, supplemented by buccal and lingual infiltration (0.5 mL each) near the root apex. The effectiveness of anesthesia is confirmed by the absence of pain in gingival probing and local blanching. A triangular mucoperiosteal flap (Neumann) is designed with a vertical release incision in the mesial aspect of the tooth 35 and a horizontal sulcular incision extending posteriorly. Full-thickness periosteal elevation is performed in an indirect area above the cyst; Partial-thickness dissections are used in the zone where the cyst is expected to be attached. The flap base is deliberately made wider than the apexe to ensure adequate vascular perfusion.

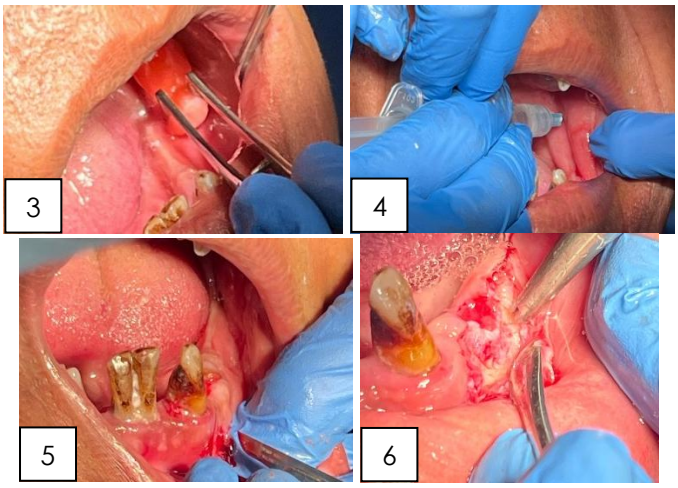

Figure 3. Application of topical anesthesia, figure 4. Anaesthesia, figure. 5. Triangular flap incision, figure 6. Flap opening

Cystic lesions are exposed through osteotomi using a surgical spherical bur under continuous irrigation of a sterile saline solution, with the reduction of the alveolar bone continued until the entire circumference of the cyst is accessible. The remaining roots are separated from the cyst wall using an elevator (elevator Bein) and extracted with lower molar root forceps. En-bloc ennucleation of the cyst, including its capsule in its entirety, is performed with a bent periapical curettage and hemostatic scissors. Thorough curettage of the residual bone cavity is performed to remove all remaining granulated tissue. The sharp edges of the bones are smoothed with a bone file.

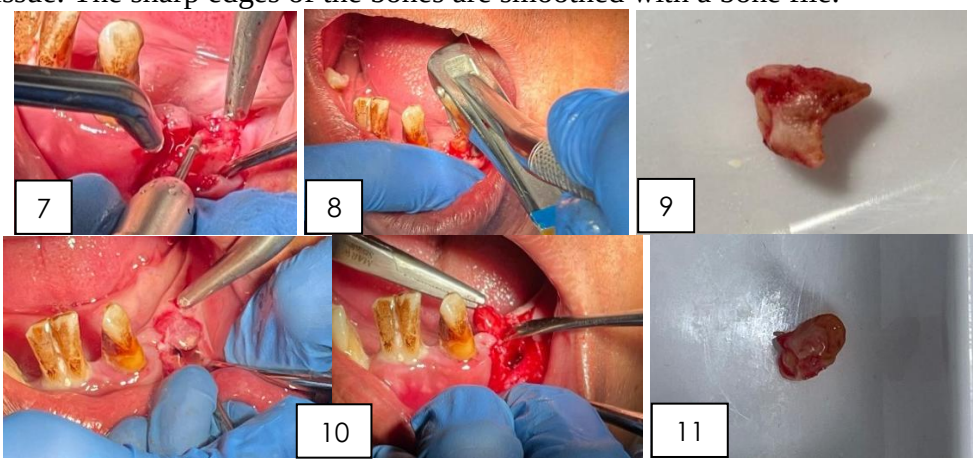

Figure 7. Osteotomy, figure 8. Extraction radix 35, figure 9. Root Residue (Gangrene Radix 35), Figure 10. Enucleation, Figure. 11. Cystic lesions

After irrigation with a sterile saline solution and 0.5% povidone-iodine, an absorbable hemostatic collagen sponge is placed inside the bone defect to minimize dead space and reduce the risk of postoperative hematoma as well as secondary infection.[7,11] The flaps are repositioned and sewn with 4-0 silk thread using a simple interrupted stitching technique. Cystic specimens are immediately fixed in solution *Formalin buffer* 10% and sent for histopathology examination to the Pathology Laboratory of PKU Muhammadiyah Hospital Surakarta. Postoperative instructions are given to the patient. Pharmacotherapy included oral amoxicillin 500 mg three times a day for seven days and mefenamic acid 500 mg twice daily as needed for pain. The stitch removal is scheduled two weeks later.

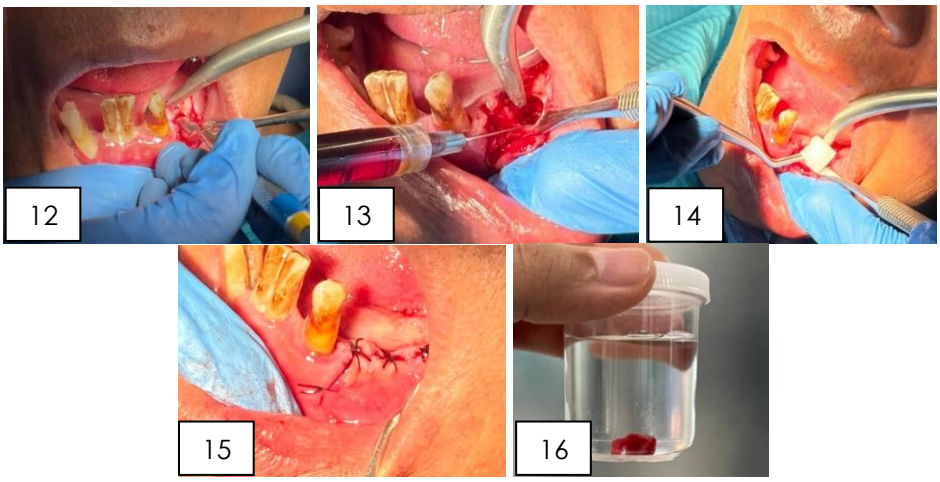

Figure 12. Bone smoothing, figure 13. Irrigation, figure 14. Sponge applications
Figure 15. Cyst specimen, figure 16. Suturing

Macroscopic examination of the surgical specimen showed a single fragment of soft tissue measuring 0.7 × 0.6 × 0.3 cm, white in color, and with a supple consistency. All specimens are processed for examination. Microscopic evaluation (staining of hematocillin and eosin) showed a cystic layer consisting of layered squamous epithelium without keratinization, with focal areas of mild epithelial hyperplasia accompanied by irregular rete ridge-like arch characteristic histological description due to inflammatory stimulation. The fibrous connective tissue capsule showed moderate edema and diffuse infiltrated by lymphocytes and histiocytes, with dispersed neutrophils consistent with chronic suppurative inflammatory patterns. Cholesterol crystal gaps sometimes found in radicular cysts are not identified in this specimen. There was no evidence of epithelial dysplasia, atypical mitosis, or impressive images of malignant transformations. The overall histopathological pattern is consistent and confirmed as a radicular cyst (inflammatory odontogenic cysts, WHO classification 2022).

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HASIL PEMERIKSAAN PATOLOGI ANATOMI

Asal Jaringan	:	Periapikal radix gigi 35
Makroskopis	:	Diterima jaringan dalam pot identitas sesuai. 1 buah jaringan ukuran 0,7x0,6x0,3 cm, putih, kenyal, semua cetak.
Mikroskopis	:	Jaringan dilapisi epitel skuamosa kompleks yang monomorf, sebagian mengalami hiperplasia ringan. Stroma sembab, disebuk cukup limfosit, histiosit dan sedikit neutrofil. Tidak didapatkan tanda ganas
Kesimpulan	:	Jaringan periapikal radix gigi 35: Histopatologis menyokong diagnosis Kista periapikal dengan proses radang kronis supuratif

Surakarta, 26 Februari 2026
Dokter Pemeriksa

Fikar Arsyad Hakim, dr. Sp.PA

Tidak diperlukan tanda tangan basah karena sudah dilakukan tanda tangan elektronik

Figure 15. Results of anatomical pathological examination

Patients are reviewed two weeks postoperatively for suture removal. Patients reported no pain, swelling, or functional impairment. Clinical examination shows satisfactory primary wound healing, with mucosal closure and color normalization consistent with the surrounding tissues. No signs of dehisensus, wounds, infections, or other early complications were found. Follow-up in the sixth and twelfth months is recommended to monitor evidence of bone regeneration (assessed by periapical radiography) and detect possible recurrence, acknowledging that this is a limitation of the case report.

Figure 14. Control After 2 Weeks

Discussion

This case is a representation of a clinically common but diagnostic and surgical instructive scenario, a radicular cyst that develops slowly around the remaining roots that have been neglected for years. The patient's prolonged history of self-management of pain without consulting a dental professional, combined with the asymptomatic clinical course typical of radicular cysts, reflects the public health challenges due to low awareness of dental care (Wu et al., 2022; Firgina & Setyawan, 2024).

In addition, the patient's behavioral factors also contribute to the delay in diagnosis. The use of analgesics without medical supervision can mask the initial symptoms so that the patient does not seek professional treatment immediately. This condition has the potential to prolong the course of the disease and increase the risk of complications. Therefore, promotive and preventive efforts through dental and oral health education are important aspects in reducing the incidence of similar cases (Wu et al., 2022).

From a pathobiological perspective, the sequence of events in this case corresponds to an established model of radicular cyst formation. Pulp necrosis, which is most likely initiated by caries, results in persistent bacterial infections in the root canal that trigger periapical inflammation. Pro-inflammatory bacterial products and cytokines such as TNF-α, IL-1β, and IL-6 stimulate the proliferation of Malassez epithelium remnants to form epithelial-lined cystic cavities. The osmotic gradient due to epithelial cell degeneration and the accumulation of inflammatory exudate also encourage cyst expansion. In addition, T-lymphocytes play an important role in the regulation of this process through macrophage activation and advanced cytokine production (Firgina & Setyawan, 2024; Rios Osorio et al., 2023; Al & Sugiharto, 2025). These findings are in line with the report of Rios Osorio et al. (2023) which emphasize the dominant role of inflammatory mediators in maintaining lesion progressivity, although some other studies suggest that not all radicular cysts undergo progressive expansion, but rather they can remain stable depending on the balance of the host's immune response.

From a clinical point of view, it is important to note that the size of the lesion does not always reflect the severity or duration of the disease. Lesions as small as in this case can be the result of a long-lasting chronic pathological process. This suggests that the interaction between microorganism virulence and host immune response has a more decisive role than lesion size alone, so a thorough evaluation is still needed even if the radiographic picture appears minimal.

A radiographic picture of unilocular periapical radiolusensia with a clear cortical border is a typical characteristic of radicular cysts, although it is not specific enough to definitively distinguish it from periapical granulomas or other periapical lesions. The use of cone beam computed tomography (CBCT) can provide more accurate three-dimensional information related to lesion boundaries, relationships with important anatomical structures such as the inferior alveolar nerve and mental foramen, and bone thickness (Setyawan, 2017). This is consistent with previous studies that showed that CBCT has a higher sensitivity and specificity than conventional radiography in evaluating periapical lesions. However, limited access and cost are often obstacles in daily clinical practice, so panoramic radiography is still widely used as an initial modality.

The selection of enukleation as the main surgical modality in this case is considered appropriate. Ennucleation allows complete excision of the cyst along with its capsule and is the

preferred choice for small to medium-sized lesions (generally <3 cm) without the involvement of vital structures. This is in line with the report of Bane et al. (2022) which showed the success of enucleation in eliminating lesions thoroughly with a low recurrence rate. In contrast, AboulHosn et al. (2019) reported that in large lesions, the combined approach of decompression and ennucleation was more effective in reducing the risk of complications. This difference in approach confirms that the selection of surgical techniques should be individual based on the characteristics of the lesion and the patient's condition.

In addition, the success of the surgical procedure is also influenced by the right operative technique. The adequacy design of the mukoperiosteal flap allows optimal access to the lesion while maintaining the vascular supply of the tissue, thus supporting good primary healing. The principles of atraumatic surgery, including adequate irrigation and bone smoothing, are instrumental in minimizing postoperative complications such as infection and wound dehydration.

Management of bone defects after engravation is also an important consideration. The use of hemostatic collagen sponges in this case aims to minimize dead space and support the formation of blood clots as the basis for bone regeneration. These findings are in line with Wang et al. (2022) who stated that in minor defects, spontaneous healing with the help of a simple scaffold is quite effective without the need for additional grafting interventions. However, Saputra et al. (2023) show that in a wider range of defects, the use of guided bone regeneration (GBR) techniques can provide more optimal results in maintaining bone volume. In this context, the decision not to use grafts in this case is considered appropriate considering the small size of the lesion and the presence of smoking risk factors that can hinder the success of bone regeneration.

Patient risk factors, such as smoking habits, also need to be considered in determining treatment strategies. Smoking is known to interfere with the process of angiogenesis and slow down tissue healing, potentially affecting the outcome of therapy. Therefore, education regarding smoking cessation is an important part of the comprehensive management of patients to improve the long-term prognosis (Saputra et al., 2023).

Histopathological confirmation is an essential step in establishing a definitive diagnosis. Findings in the form of layered squamous epithelium without keratinization, focal hyperplasia, and chronic inflammatory infiltration are consistent with the diagnosis of radicular cysts and help rule out the possibility of other lesions such as keratocystic odontogenic cysts or ameloblastoma (Bane et al., 2022). Other studies also emphasize that histopathological examinations serve not only as a confirmation of the diagnosis, but also as an important step to detect the possibility of more aggressive pathological transformations, although they are rare.

The main limitation of this case report is the relatively short duration of follow-up, which is two weeks, so it does not allow a thorough evaluation of bone regeneration and potential recurrence. This is in contrast to longitudinal studies such as those reported by Siahaan and Kesuma (2025), which emphasize the importance of long-term monitoring of up to one year or more to ensure the success of therapy. Therefore, long-term follow-up with serial radiography is highly recommended. In addition, the non-use of CBCT and the absence of immunohistochemical analysis are other limitations that can be considered for future research.

Overall, this case report contributes novelty through a comprehensive approach that integrates clinical findings, radiographic, one-stage surgical procedures in the form of enucleation along with root residue extraction, as well as histopathological confirmation as the gold standard of diagnosis. In contrast to some previous reports that have focused on large lesions or a gradual approach, this case confirms that small lesions with favorable anatomical conditions can be effectively treated through a conservative approach without the need for additional regenerative procedures. The clinical implications of these findings are the importance of early detection and thorough evaluation of root residues that are often overlooked, as well as the selection of surgical strategies tailored to the size of the lesion and the patient's risk factors, such as smoking habits. In addition, these results emphasize that routine delivery of specimens for histopathological examination should be the standard of practice

to ensure accurate diagnosis and prevent misdiagnosis of other, more aggressive odontogenic lesions. A multidisciplinary approach that combines clinical, radiographic, and histopathological aspects is key in improving treatment outcomes and minimizing the risk of recurrence.

CONCLUSION

This case report documents the successful management of radicular cyst surgery related to the remaining mandibular root through simultaneous enucleation and root extraction. The diagnosis is definitively confirmed through histopathological examination, which rules out malignant transformations and other high-frequency odontogenic pathologies. This case emphasizes the importance of early clinical and radiographic assessment of root remains, the necessity of submitting all surgical specimens for histopathological evaluation, as well as the value of a comprehensive multidisciplinary diagnostic approach integrating clinical, radiographic, and histopathological data in achieving the best outcome for patients. Extended longitudinal follow-up and patient education regarding oral hygiene and smoking cessation remain critical components of holistic care in these cases.

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