



EFFECTIVENESS OF APICOECTOMY FOLLOWING FAILED ROOT CANAL THERAPY: A PROSPECTIVE CLINICAL STUDY

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ABSTRACT

Background: Failure of root canal therapy (RCT) remains a clinical challenge, often presenting with persistent periapical pathology or symptoms despite adequate nonsurgical treatment. Apicoectomy, a form of endodontic microsurgery, is frequently indicated when orthograde retreatment is not feasible or has failed.

Objective: To evaluate the clinical and radiographic effectiveness of apicoectomy in teeth with failed root canal therapy through a prospective clinical study design.

Methods: This prospective study included patients presenting with failed RCT requiring surgical intervention. Standardized apicoectomy procedures were performed, including apical resection, curettage of periapical pathology, and retrograde filling. Patients were followed at regular intervals, and outcomes were assessed clinically and radiographically using predefined success criteria.

Results: The majority of treated teeth demonstrated favorable healing with resolution of symptoms and progressive radiographic bone regeneration over the follow-up period. A gradual decline in success rate was observed with increasing follow-up duration, though most teeth remained clinically functional.

Conclusion: Apicoectomy is an effective treatment option for managing failed root canal therapy, providing satisfactory clinical and radiographic outcomes and allowing preservation of the natural tooth when nonsurgical retreatment is unsuccessful or impractical.

Keywords: Apicoectomy, failed root canal therapy, periapical surgery, endodontic surgery, clinical effectiveness.

INTRODUCTION

Root canal therapy (RCT) is one of the most commonly performed procedures in restorative and endodontic dentistry, with consistently high success rates reported in the literature.¹ Nevertheless, a subset of treated teeth continues to demonstrate post-treatment disease, characterized by persistent periapical radiolucency, clinical symptoms, or both.² Failure of root canal therapy is multifactorial and may be attributed to persistent intraradicular or extraradicular infection, missed canals, inadequate cleaning and shaping, complex canal anatomy, procedural errors, or coronal leakage over time.³

Persistent apical periodontitis following RCT represents a significant clinical dilemma. Patients often present with pain on mastication, tenderness to percussion, swelling, or sinus tract formation, which may compromise function and aesthetics.⁴ Radiographically, these cases show non-resolving or enlarging periapical lesions, indicating continued inflammatory response in the periapical tissues.⁵ The primary objective in managing such cases is eradication of infection and promotion of periapical healing while preserving the natural tooth whenever possible.¹

Management options for failed root canal therapy include nonsurgical endodontic retreatment, surgical endodontic intervention, or extraction followed by prosthetic rehabilitation.² Nonsurgical retreatment is generally considered the preferred approach as it allows direct disinfection of the entire root canal system. However, retreatment may be contraindicated or technically challenging in cases with obstructed canals, separated instruments, extensive post-core restorations, or well-adapted crowns where removal may jeopardize the remaining tooth structure.³ In situations where nonsurgical retreatment is not feasible or has failed, apicoectomy serves as a conservative tooth-saving alternative. Apicoectomy, also known as periapical or apical surgery, involves surgical access to the periapical region, resection of the apical portion of the root, removal of pathological tissue, and placement of a root-end filling to seal the apical terminus of the canal.⁴ By directly addressing the apical pathology and eliminating anatomical complexities such as apical deltas and lateral canals, apicoectomy aims to create a hermetic apical seal and facilitate periapical healing.

Historically, apical surgery demonstrated variable success rates, largely due to limited visualization, inadequate root-end preparation techniques, and suboptimal filling materials.⁵ However, the introduction of microsurgical principles, magnification, ultrasonic retro-tips, and biocompatible root-end filling materials has markedly improved treatment outcomes.⁶ Contemporary studies report significantly higher success rates compared to traditional techniques, highlighting the role of technological advancements in enhancing predictability.¹

Despite encouraging results from retrospective analyses and systematic reviews, there remains a relative paucity of well-designed prospective clinical studies evaluating the effectiveness of apicoectomy following failed root canal therapy.⁷ Prospective data are essential to better understand healing patterns, temporal changes in success rates, and factors influencing long-term outcomes. Therefore, the present prospective clinical study was undertaken to evaluate the clinical and radiographic effectiveness of apicoectomy in teeth with failed root canal therapy and to compare the findings with previously published literature.

MATERIALS AND METHODS

This prospective clinical study was conducted in the Department of Conservative Dentistry and Endodontics at a tertiary care dental institution after obtaining ethical approval from the institutional review board vide number (SIL/ERC/2-134). Written informed consent was obtained from all participants prior to enrolment.

Patients aged 18 years and above presenting with failed root canal therapy and indicated for apicoectomy were included in the study. Failure of root canal therapy was defined as the presence of persistent periapical radiolucency with or without clinical symptoms such as pain, tenderness, swelling, or sinus tract formation. Teeth with adequate periodontal support and restorability were selected. Teeth exhibiting vertical root fractures, advanced periodontal disease, or belonging to medically compromised or pregnant patients were excluded.

A total of 40 teeth in 40 patients were included. All surgical procedures were performed under local anesthesia following a standardized protocol. A full-thickness mucoperiosteal flap was reflected to

gain access to the periapical region. Granulation tissue was curetted, and approximately 3 mm of the root apex was resected using a high-speed bur under copious irrigation. Root-end cavity preparation was performed ultrasonically, followed by placement of mineral trioxide aggregate as the retrograde filling material. The surgical site was irrigated with sterile saline, flaps were repositioned, and sutures were placed. Postoperative instructions and medications were prescribed uniformly.

Patients were recalled at 3, 6, and 12 months for follow-up. Clinical evaluation included assessment of pain, swelling, sinus tract, tenderness to percussion, and tooth mobility. Radiographic evaluation was carried out using standardized periapical radiographs. Outcomes were categorized as successful, uncertain healing, or failure based on combined clinical and radiographic criteria. Data were analyzed using descriptive statistics, and success rates were calculated for each follow-up interval. Data were analyzed using descriptive statistics. Success rates were calculated at each follow-up interval.

RESULTS

A total of 40 patients (40 teeth) were evaluated in the present study. The study population consisted of 22 males (55%) and 18 females (45%), with a mean age of 34.6 ± 8.2 years. Maxillary anterior teeth accounted for the majority of cases (45%), followed by mandibular premolars (30%), maxillary premolars (15%), and mandibular anterior teeth (10%).

At the 3-month follow-up, 36 teeth (90%) were classified as successful, exhibiting absence of pain and signs of inflammation, along with reduction in periapical radiolucency. At 6 months, successful healing was observed in 34 teeth (85%). By the 12-month follow-up, 30 teeth (75%) demonstrated successful clinical and radiographic outcomes. Five teeth (12.5%) showed uncertain healing, while five teeth (12.5%) were categorized as failures due to persistent symptoms or enlargement of periapical lesions.

Overall, a gradual reduction in success rate was observed with increasing follow-up duration; however, the majority of teeth remained asymptomatic and functional at the end of one year.

Table 1 presents the demographic distribution of the study sample. The study population showed a balanced gender distribution, predominantly young to middle-aged adults.

Table 2 summarizes the clinical success rates at different follow-up intervals. Anterior teeth constituted the majority of cases, reflecting higher aesthetic demand and preference for tooth preservation.

Table 3 depicts radiographic healing patterns over time, A gradual reduction in success rate was observed with increasing follow-up duration, consistent with longitudinal healing patterns reported in the literature, while **Table 4** highlights the overall treatment outcome at 12 months. Despite some radiographic uncertainty, the majority of teeth remained clinically asymptomatic and functional.

Table 1. Demographic Characteristics of the Study Population

Variable	Frequency (n)	Percentage (%)
Male	22	55.0
Female	18	45.0
Mean age (years)	34.6 ± 8.2	

Table 2. Distribution of Treated Teeth

Tooth Type	Number of Teeth	Percentage (%)
Maxillary anterior	18	45.0
Mandibular anterior	4	10.0
Maxillary premolar	6	15.0
Mandibular premolar	12	30.0

Table 3. Clinical Success Rate at Different Follow-up Intervals

Follow-up period	Successful (n)	Success rate (%)
3 months	36	90.0
6 months	34	85.0
12 months	30	75.0

Table 4. Overall Treatment Outcome at 12 Months

Outcome category	Number of teeth	Percentage (%)
Successful healing	30	75.0
Uncertain healing	5	12.5
Failure	5	12.5

DISCUSSION

The present prospective clinical study evaluated the effectiveness of apicoectomy in the management of teeth with failed root canal therapy and demonstrated favorable clinical and radiographic outcomes over a 12-month follow-up period. The overall success rate of 75% observed at one year supports the role of apicoectomy as a predictable tooth-preserving treatment when nonsurgical retreatment is not feasible or has failed.

The high success rate observed at early follow-up intervals in this study is consistent with previous reports. Singh et al. (2022)⁸ reported success rates ranging from 86% to 91% for modern endodontic surgical procedures at short-term follow-up, emphasizing the influence of improved surgical techniques and materials. Similarly, Corbella et al. (2023)⁹ reported a success rate of approximately 83% at one year following apical surgery performed using microsurgical principles. The slightly lower success rate at 12 months in the present study may be attributed to differences in case selection, lesion size, and host healing response. A gradual decline in success rate with increasing follow-up duration was observed, a finding that has been widely reported in the literature. Longitudinal studies have demonstrated that while initial healing may be favorable, some cases show delayed or incomplete healing over time. This phenomenon may be explained by persistent extraradicular infection, cystic lesions, or microleakage at the root-end filling interface.¹⁰⁻¹³ Nevertheless, it is noteworthy that many teeth classified as having uncertain radiographic healing remained clinically asymptomatic and functional, highlighting the importance of considering both clinical and radiographic criteria when evaluating outcomes. The use of mineral trioxide aggregate as a root-end filling material in the present study may have contributed positively to the observed outcomes. MTA has been shown to possess superior sealing ability, biocompatibility, and osteogenic potential compared to traditional materials. Yang et al (2024)¹⁴ emphasized that modern apical surgery employing ultrasonic root-end preparation and biocompatible filling materials significantly improves healing rates.

When compared with nonsurgical retreatment, apicoectomy offers a viable alternative in selected cases. While retreatment success rates are reported to range between 70% and 80%, these outcomes are highly dependent on canal accessibility and restoration removal. In contrast, apicoectomy allows direct management of apical pathology without compromising existing restorations, making it particularly valuable in teeth with posts or crowns.

CONCLUSION

Within the limitations of this prospective clinical study, apicoectomy proved to be an effective and reliable treatment option for teeth with failed root canal therapy. The procedure demonstrated favorable clinical and radiographic outcomes and contributed to the preservation of natural dentition. Apicoectomy should be considered a viable alternative to extraction when nonsurgical retreatment is unsuccessful or impractical.

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