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Major clinical considerations of parendodontic surgery in patients with comorbidities: a systematic review

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Abstract

Introduction: In the context of patients with chronic comorbidities, parendodontic surgery (or apical or endodontic surgery) becomes a challenge, requiring increased care. Parendodontic surgery is performed in the periapical region or bordering areas, aiming to solve problems that have not been successfully treated with conventional endodontic treatment. **Objective:** It was to present major clinical considerations of parendodontic surgery in patients with comorbidities. **Methods:** The systematic review rules of the PRISMA Platform were followed. The research was conducted from September to October 2025 using the Scopus, PubMed, ScienceDirect, SciELO, and Google Scholar databases. The quality of the studies was assessed using the GRADE instrument, and the risk of bias was evaluated according to the Cochrane instrument. **Results and Conclusion:** A total of 177 articles were found, 36 of which were evaluated in full, and 11 were included in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 27 studies with a high risk of bias and 33 studies that did not meet GRADE and AMSTAR-2 standards. It was concluded that periapical surgery constitutes a viable, safe, and effective alternative for eliminating bacteria from within the root canal system, even in patients with chronic comorbidities. Periapical surgery is increasingly used to repair problems that have not been resolved through conventional endodontic treatment. Through a correct diagnosis and the chosen surgical technique, success and an excellent prognosis are possible. Thus, the success rates of periapical surgeries depend on the surgical modality indicated, retrograde filling materials, the previous quality of root canal obturation, treatment of the surgical site, execution of the surgical technique, and periodontal conditions. Associations have been observed between the most severe clinical presentations (Ludwig's angina and submandibular infection) and the complexity of clinical care.

Keywords: Comorbidities. Parendodontic surgery. Elimination of bacteria. Surgical modality. Periodontal conditions.

Introduction

In the context of patients with chronic comorbidities, parendodontic surgery – PS (or apical or endodontic surgery) becomes a challenge, and extra care is needed. PS is performed in the periapical region or bordering regions, with the purpose of solving problems that have not been successfully treated with conventional endodontic treatment [1-5]. Authors emphasize that PS aims to provide healing to periradicular tissues, generating rehabilitation of dental function, being indicated in cases such as retrograde filling and periradicular tissue repair [6].

In non-surgical endodontics, in the vast majority of cases, good results are obtained, but there are also cases of failure where the dentition does not have root access and there is a persistent pathological process that does not respond positively, leading to the need to perform PS [6,7].

Furthermore, the failure of non-surgical endodontics stems from the fact that, in some cases, the need for root canal treatment arises in response to technical problems combined with microbiological problems [8]. In this sense, Hizatugo and colleagues emphasize that the microbiological involvement of the

patient is pointed out as one of the main causes of failure in non-surgical endodontic treatments [7,8].

Based on this, PS is a safe and appropriate surgical procedure for the treatment of teeth with periapical lesions that do not respond to conventional endodontic treatment, or when retreatment is not possible. PS is a surgical technique that should be considered as a treatment option for resolving periapical problems. It is an alternative to avoid tooth extractions, being a treatment option when the conservative endodontic procedure has failed [9].

As a corollary to this, PS consists of removing the etiological agent, the most frequent being the presence of bacteria and other microbial irritants in the root canals, and sealing all available entry orifices in the root canal system [1,2]. PS is indicated in cases of persistent chronic periapical inflammation, with extensive apical radiolucent areas, restricted coronal access to the root apex due to insufficient retrograde sealing or root posts that cannot be removed, perforation and fracture of the apical third of the root, as well as pulp calcifications in the root third, among others. The choice to perform PS should be based on the evaluation of each case, and should only be indicated when all possibilities of conventional endodontic therapy have been exhausted [7-9].

Therefore, the present study aimed to present major clinical considerations of parendodontic surgery in patients with comorbidities.

Methods

Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. It was accessed on: 09/19/2025. The AMSTAR-2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. It was accessed on: 09/19/2025.

Data Sources and Search Strategy

The literature search process was carried out from September to October 2025 and developed based on Web of Science, Scopus, Embase, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The descriptors (DeCS/MeSH Terms. Available on: https://decs.bvsalud.org/) were used: *"Comorbidities. Parendodontic surgery. Elimination of bacteria. Surgical modality. Periodontal conditions",* and using the Boolean "and" between MeSH terms and "or" between historical findings.

Study Quality and Risk of Bias

The quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analysis of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's d test.

Results and Discussion

Summary of Findings

A total of 177 articles were found. Initially, duplicate articles were excluded. After this process, the abstracts were evaluated, and a new exclusion was performed, removing the articles that did not include the topic of this article, resulting in 96 articles. A total of 36 articles were evaluated in full, and 11 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 27 studies with high risk of bias and 33 studies that did not meet GRADE and AMSTAR-2, according to Figure 1.

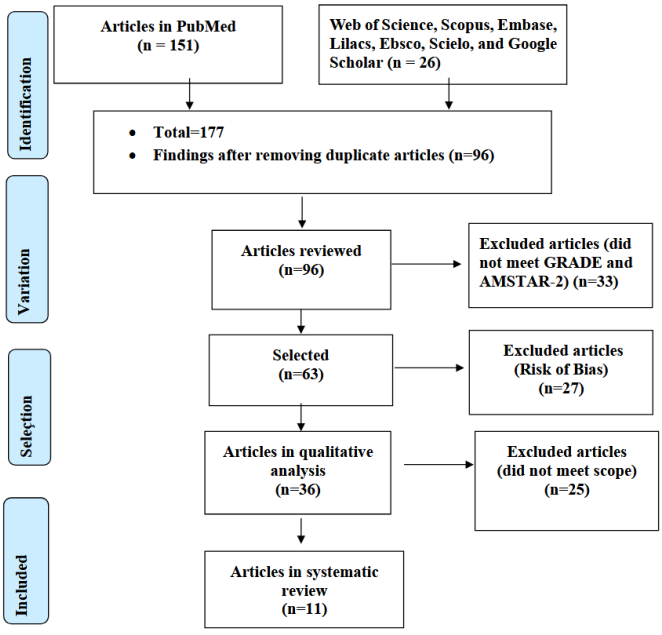

Figure 1. Selection of the articles. Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test

(d). The sample size was determined indirectly by the inverse of the standard error (1/Standard Error). This graph showed symmetrical behavior, not suggesting a significant risk of bias, both among studies with small sample size (lower precision) that are shown at the base of the graph and in studies with large sample size that are shown in the upper region.

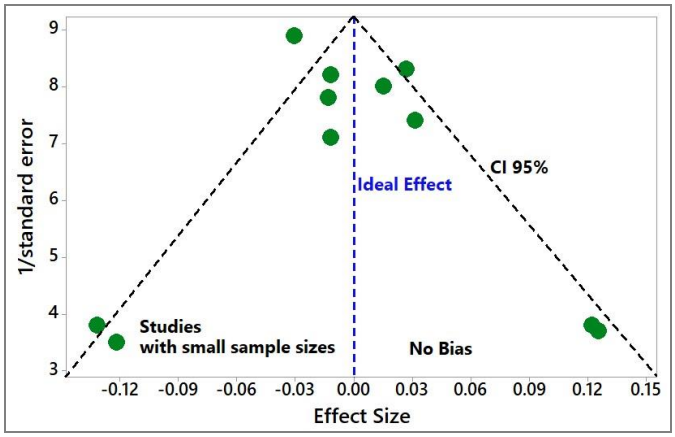

Figure 2. The symmetrical funnel plot suggests no risk of bias among the studies with small sample size that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (N = 11 studies evaluated in full in the systematic review). Source: Own Authorship.

Major Clinical Outcomes

Parendodontic surgery (PS) in patients with complex systemic conditions represents a significant clinical challenge, particularly in cases involving combined endodontic-periodontal lesions and extensive root resorptions. A case report described the single-session treatment of an oncology patient with multiple systemic comorbidities, presenting with a periapical and communicating endodontic-periodontal lesion, as well as external cervical root resorption. PS, combined with the repair of external cervical root resorption, was performed using bioceramic materials, through meticulous planning and management with cone-beam computed tomography and the aid of an operating microscope. After 12 months of follow-up, complete clinical and radiographic healing was observed, including periodontal ligament regeneration and full functional recovery of the tooth [10].

The authors Petroff et al. (2025) [11] evaluated the associations between tooth- and patient-related factors that result in severe odontogenic infections and their clinical care needs. The associations between tooth-related factors (type, location, presence/absence of caries, restorations, root canal obturation, apical periodontitis, and infection space), patientrelated factors (diabetes and smoking), and clinical management (length of hospital stay, number of days of intensive care unit stay, and need for general anesthesia) were explored. Of the 382 records identified, 189 met the inclusion criteria. Mandibular molars (95.8%) were the most frequently affected teeth. Eight (4.2%) had endodontic treatment, 27 (14.3%) were restored, 166 (87.8%) were carious, and 181 (95.8%) presented apical radiolucency. More than half of the sample consisted of smokers (56.9%), and 16.4% were diabetic. The most common infection occurred in the submandibular space (56.1%). One hundred and fifty-seven patients (83.1%) required admission to the intensive care unit, and the length of stay varied according to the location of the infection, with the buccal space having the shortest duration (median of 1 day) compared to the submandibular space (median of 4 days) ($p < 0.001$). The need for general anesthesia was associated with Ludwig's angina ($n = 3$, 100%) ($p = 0.04$) and submandibular space infection ($n = 104$, 98.1%) ($p < 0.001$), in addition to admission to the intensive care unit ($p < 0.001$).

In this context, the objective of endodontic treatment is the elimination of bacteria from inside the root canal system and the subsequent creation of an effective barrier to prevent the passage of microorganisms or their products into the periapical tissues. To eliminate this infection, conventional endodontic treatment or retreatment are the therapies of choice, but when these treatments fail or are impossible to perform, periapical surgery is often the next option [12].

PS has been increasingly used to repair problems that have not been solved through conventional endodontic treatment and endodontic retreatment, in order to keep the dental element functioning in the oral cavity. A clinical case study described a PS procedure, which was used to solve a secondary infection, due to the presence of contamination because of a large-bore root retainer. Dental elements presenting extensive metallic intra-radicular retainers and with acute periapical infections are always a challenge in endodontic practice. It is concluded that the decision to perform PS with retro-preparation and retro-obturation, using appropriate materials and techniques, was efficient for removing the etiological agent and achieving periapical health. The complete regression of signs and symptoms, in addition to radiographic confirmation during follow-up, evidenced the success of the case [13].

A cross-sectional observational clinical study analyzed the findings of highmagnification rigid endoscopy on the end surface of the root after apicoectomy of teeth undergoing periapical surgery. Patients underwent periapical surgery at the Oral Surgery and Implantology Unit (University of Valencia, Valencia, Spain) between 2011 and 2019. The final

sample consisted of 168 patients who underwent periapical surgery, with 177 operated teeth and 206 roots. Untreated canals were observed in 14 roots (6.8%). Isthmuses were identified in 74 roots (35.9%), mainly in the mesial root of the first lower molar (94.1%). In turn, manic lines were identified in 8.3% of the roots, cracks in 3.9%, and gaps in 53.4%. The prevalence of opaque dentin was 78.3%, with a higher presence in posterior teeth (90.3% in premolars and 86.2% in molars) than in anterior teeth (50.6%) ($p<0.001$). Patient age and dental restoration did not correlate with the parameters studied. Therefore, fissure and crack lines were observed in less than 10% of the roots, although opaque dentin was identified in 73% of the roots, mainly in posterior teeth, and gaps were found in more than half of the canals [14].

The microbiological factor is identified as the biggest cause of failures after intervention. In these cases, root canal retreatment can be performed aiming at reinstrumentation, cleaning, and new obturation of the root canal. In addition, retreatment can be associated with PS in an attempt to reverse the failure without tooth extraction. A clinical case report described a root canal retreatment associated with apical surgery with one year of follow-up in the lower central incisor region. It was shown that periapical surgery is an effective and conservative treatment option compared to extractions, and when performed correctly, with the aid of good materials such as MTA, it brings satisfactory results, restoring normal conditions to the periodontal tissue, as well as the health and function of teeth affected by the inflammatory process [15].

In this sense, periapical surgery constitutes a set of procedures that aim to repair complications that could not be solved through conventional endodontics, or when this is not feasible. Another clinical case report analyzed periapical surgery associated with dental photodynamic therapy. The case was conducted by accessing the root canal system retrogradely, with cone beam tomography follow-up for 4 years. It was concluded that associating the surgical act with the application of low-power laser through photodynamic therapy enhanced disinfection and the elimination of bacteria persistent after the failure of previous endodontic treatment [16].

Apical surgery is considered a standard oral surgical procedure. Often, it is a last resort to surgically preserve a tooth with a periapical lesion that cannot be treated with conventional endodontic (re)treatment. The main objective of apical surgery is to prevent bacterial leakage from the root canal system into the periradicular tissues. It is advisable to use a surgical microscope to perform apical surgery to benefit from magnification and illumination. In addition, the application of microsurgical techniques in apical surgery, i.e., gentle incision and flap elevation, production of a small osteotomy, and the use of sonic or ultrasonic microtips will result in less trauma for the patient and faster postsurgical healing. An important step in apical surgery is to identify potential leakage areas on the cut root surface and ensure proper apical obturation [17].

In this scenario, due to the excessive number of endodontic failures, PS has become viable and recommended for some patients. For example, apicoectomy is a surgery aimed at preserving the integrity of the dental and oral organ, mainly preserving the patient's health [18]. Apical surgery can preserve many teeth that remain symptomatic after conventional endodontic treatment, especially since endodontic failure can occur after 1 year, usually after the placement of a definitive restoration [19].

Finally, the authors Glera-Suárez et al. (2022) [20] carried out, through a retrospective cohort study, an analysis of the correlation between root width, the thickness of the remaining dentin wall determined by endoscopy, and the outcome of periapical surgery, involving patients who underwent periapical surgery between 2017 and 2019 at the University of Valencia (Valencia, Spain). One year after surgery, cone-beam computed tomography (CBCT) was used to assess healing relative to preoperative volumes. A total of 51 patients, comprising 52 teeth and 62 roots, were included in the study. The mean measurements were: maximum root width (4.13±0.84 mm), minimum root width (2.46±0.72 mm), peripheral dentin thickness (0.77±0.2 mm), and minimum dentin thickness (0.4±0.2 mm). The success rate was 82.2%. Premolar roots showed greater minimum dentin thickness (0.58±0.25 mm) ($p<0.003$) than incisor roots. No significant association was found between the different measurements and the healing rate at one year, although roots that did not heal had lower minimum dentin thickness values than roots that healed correctly. The position and type of tooth did not influence the outcome of the healing process.

Limitations

There is a lack of randomized controlled trials with robust sample sizes, as well as epidemiological and case-control studies.

Conclusion

It was concluded that parendodontic surgery constitutes a viable, safe, and effective alternative for eliminating bacteria from within the root canal system, even in patients with chronic comorbidities. Parendodontic surgery is increasingly used to repair

problems that have not been resolved through conventional endodontic treatment. Through a correct diagnosis and the chosen surgical technique, it is possible to achieve surgical success and an excellent prognosis. Thus, the success rates of parendodontic surgeries depend on the surgical modality indicated, retrograde filling materials, the previous quality of the root canal obturation, treatment of the surgical site, execution of the surgical technique, and periodontal conditions. Associations are observed between more severe clinical presentations (Ludwig's angina and submandibular infection) and the complexity of clinical care.

CRediT

Author contributions: **Conceptualization**; **Formal Analysis**; **Investigation**; **Methodology**; **Project administration**; **Supervision**; **Writing - original draft and Writing-review & editing-** Rita de Cássia Melleiro and Fábio Pereira Linhares de Castro.

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Ethical Approval

Not applicable.

Informed Consent

Not applicable.

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No additional data are available.

Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate®.

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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