



Outcomes of clinical studies of periapical procedures (parendodontic surgery): a systematic review

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Abstract

Introduction: The attempt to contain microbial proliferation does not prove to be viable or solvable through coronary access, periapical or parendodontic surgery is indicated as a therapeutic complement. Periapical surgery is intended to provide healing to periradicular tissues, generating rehabilitation of dental function, which is indicated in cases such as retro filling and periradicular tissue repair. **Objective:** It was to carry out a systematic review to elucidate the main approaches to apical and periapical lesions and other complications through evidence from clinical studies of endodontic surgery. **Methods:** The systematic review rules of the PRISMA Platform were followed. The research was carried out from April to June 2023 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 127 articles were found, and 47 articles were evaluated in full and 18 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 13 studies with a high risk of bias and 21 studies that did not meet GRADE. Periapical surgery (parendodontic) 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 pins that cannot be removed, perforation and fracture of the apical third of the root, in addition to pulpal calcifications in the root third, etc. Increasingly

used to repair problems that were not resolved through conventional endodontic treatment and endodontic retreatment, parendodontic surgery with retro-preparation and retro-filling, using appropriate materials and techniques, was efficient for removing the etiological agent and obtaining periapical health. Paraendodontic surgery is an effective and conservative treatment option concerning tooth extractions, and when performed correctly, with the aid of good materials such as MTA, it brings satisfactory results.

Keywords: Periapical surgery. Parendodontic surgery. Apical lesions. Complications.

Introduction

Even if endodontic resources have been used correctly, treatment failure may occur, leading to endodontic retreatment [1]. When in the apical portion, the attempt to contain the microbial proliferation does not prove to be viable or amenable to solution through coronary access, endodontic surgery is indicated as a therapeutic complement [2,3]. In this context, endodontic surgery is defined as a dental surgical procedure, performed in the periapical region or bordering regions, which aims to solve unsuccessful problems through conventional endodontic treatment [4,5].

Given this, authors point out that endodontic surgery is intended to give healing to periradicular tissues, generating rehabilitation of dental function, being this indicated in cases such as retro filling and

periradicular tissue repair [6]. In non-surgical endodontics, in the vast majority of cases, they present good results, 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 give in with a positive response, leading to the need to perform endodontic surgery [6,7].

Still, the failure of non-surgical endodontics comes from the fact that, in some cases, the need for treatment of a root canal arises in response to technical problems added to microbiological problems [8]. In this sense, Hizatugo and collaborators point out that the microbiological involvement of the patient is considered to be one of the main causes of failure in non-surgical endodontic treatments [7,8].

In this respect, endodontic surgery is a safe and suitable for the treatment of teeth with periapical lesions that do not respond to conventional endodontic treatment, or when retreatment is not possible. Parendodontic surgery is a surgical technique that should be considered as a treatment option for solving periapical problems. It is an alternative to avoid tooth extractions, being a treatment option when the conservative endodontic procedure fails [9].

As a corollary, endodontic surgery consists of removing the etiological agent, and the presence of bacteria and other microbial irritants in the root canals, the most frequent procedure consists of sealing all available entry holes in the root canal system. Parendodontic surgery 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 pins unable to be removed, perforation and fracture of the root apical third, in addition to pulpal calcifications in the root third, among others. The choice of performing endodontic surgery should be based on the evaluation of each case and is indicated only when all possibilities of conventional endodontic therapy are exhausted [7-9].

Given this, the present study aimed to carry out a systematic review to elucidate the main approaches to apical and periapical lesions and other complications through evidence from clinical studies of endodontic surgery.

Methods

Study Design

The systematic review rules of the PRISMA Platform were followed. Available at: www.prisma-statement.org/. Accessed on: 06/27/2023.

Research Strategy, Quality of Studies and Risk of Bias

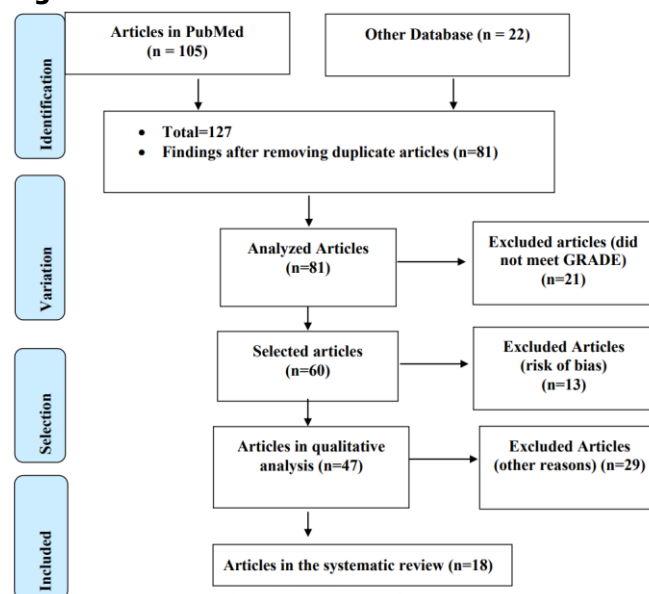
The search strategies for this systematic review were based on the keywords (MeSH Terms): *Periapical surgery. Parendodontic surgery. Apical lesions. Complications*. The research was carried out from April to June 2023 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. In addition, a combination of keywords with the Booleans "OR", "AND" and the operator "NOT" were used to target scientific articles of interest. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument.

Results and Discussion

Summary of Findings

A total of 127 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, resulting in 81 articles. A total of 47 articles were evaluated in full and 18 were included and developed in this systematic review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 13 studies with a high risk of bias and 21 studies that did not meet GRADE.

Figure 1. Flowchart - Article Selection Process.



Source: Own authorship

Major Clinical Results - Periapical Procedures

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 [10]. In this context, endodontic surgery

has been increasingly used to repair problems that were not resolved through conventional endodontic treatment and endodontic retreatment, to maintain the function of the dental element in the oral cavity. A clinical case study described a paraendodontic surgery procedure, which was used to solve a secondary infection, due to the presence of contamination due to a large caliber root retainer. Dental elements with extensive metallic intra-radicular retainers and with acute periapical infections are always a challenge in endodontic practice. It is concluded that the decision for endodontic surgery with retro-preparation and retro-filling, using adequate materials and techniques, was efficient for removing the etiological agent and obtaining periapical health. The total regression of signs and symptoms, in addition to radiographic confirmation during followup, showed the success of the case [11].

Furthermore, a cross-sectional observational clinical study analyzed the findings of high-magnification rigid endoscopy on the final root surface after apicoectomy of teeth undergoing periapical surgery. Patients underwent periapical surgeries at the Oral Surgery and Implantology Unit (University of Valencia, Valencia, Spain) between 2011 and 2019. The final sample consisted of 168 patients undergoing periapical surgery, with 177 teeth operated 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 mandibular first molar (94.1%). In turn, mania 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 greater presence in posterior teeth (90.3% in premolars and 86.2% in molars) than in anterior teeth (50.6%) ($p < 0.001$). The patient's age and dental restoration did not correlate with the studied parameters. Therefore, lines of fissures and cracks were observed in less than 10% of the roots, although opaque dentin was identified in 73% of the roots, mainly in the posterior teeth, and gaps were found in more than half of the canals [12].

The microbiological factor is pointed out as the major cause of failures after the intervention. In these cases, root canal retreatment can be performed with a view to reinstrumentation, cleaning, and new filling of the root canal. In addition, retreatment can be associated with endodontic surgery in an attempt to reverse the failure without tooth extraction. A clinical case report reported a root canal retreatment associated with apical surgery with a one-year follow-up in the lower central incisor region. It was shown that paraendodontic surgery is an effective and conservative

treatment option concerning extractions, and when performed correctly, with the aid of good materials such as MTA, it brings satisfactory results, returning normal conditions to the periodontal tissue, as well as health and function to the teeth affected by the inflammatory process [13].

In this sense, endodontic surgery constitutes a set of procedures that aim to repair complications that could not be solved through conventional endodontics, or when this is not possible to perform. Another clinical case report analyzed endodontic surgery associated with dental photodynamic therapy. The case was conducted by accessing the root canal system in a retrograde manner, with a 4-year cone-beam tomographic follow-up. It was concluded that the association of the surgical act with the application of low-power laser through photodynamic therapy potentiated the disinfection and elimination of persistent bacteria to the failure of the previous endodontic treatment [14].

Apical surgery is considered a standard oral surgical procedure. It is often a last resort to surgically retain 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 advised to use an operating microscope to perform apical surgery to benefit from magnification and illumination. Furthermore, the application of microsurgical techniques in apical surgery, i.e. gentle incision and elevation of the flap, production of a small osteotomy, and the use of sonic or ultrasonic micro tips will result in less trauma for the patient and faster post-surgical healing. An important step in apical surgery is to identify possible areas of leakage on the cut root face and ensure adequate apical obturation [15].

In this scenario, due to the many cases of endodontic failure, endodontic surgery has become feasible and recommended for some patients. As an example, apicectomy is a surgery intended to prevent the integrity of the dental and oral organs, mainly preserving the patient's health [16]. Also, 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 [17].

The authors Glara-Suárez et al. (2022) [18] carried out, through a retrospective cohort study, an analysis of the correlation between root width, thickness of the remaining dentin wall determined by endoscopy and the result 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 concerning preoperative volumes. A total of 51 patients, comprising 52 teeth and 62 roots, were included in the study. 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 had a 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 one-year healing rate, although roots that did not heal had lower minimum values of dentin thickness than roots that healed correctly. The position and type of tooth did not influence the healing result.

Conclusion

Periapical (parendodontic) surgery is indicated in cases of persistent chronic periapical inflammation, with extensive apical radiolucent areas, restricted coronal accesses to the root apex, due to insufficient retrograde sealing or root pins unable to be removed, perforation and fracture of the root apical third, in addition to pulpal calcifications in the root third, etc. Increasingly used to repair problems that were not resolved through conventional endodontic treatment and endodontic retreatment, endodontic surgery with retro-preparation and retrofilling, using appropriate materials and techniques, was efficient for removing the etiological agent and obtaining periapical health. Paraendodontic surgery is an effective and conservative treatment option concerning tooth extractions, and when performed correctly, with the aid of good materials such as MTA, it brings satisfactory results.

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Ethical Approval

Not applicable.

Informed consent

Not applicable.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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