



Major clinical outcomes of parendodontic surgery in patients with chronic non-communicable diseases: a systematic review

Brenda Lemes dos Reis^{1*}, Gabriel Silva Ferreira¹, Fábio Pereira Linhares de Castro¹

¹ UNORTE - University Center of Northern São Paulo, Department of Endodontics, São José do Rio Preto, São Paulo, Brazil.

*Corresponding author: Brenda Lemes dos Reis.

UNORTE - University Center of Northern São Paulo, Department of Endodontics, São José do Rio Preto, São Paulo, Brazil.

E-mail: drabrendalemes@hotmail.com

DOI: <https://doi.org/10.54448/mdnt25S216>

Received: 02-11-2025; Revised: 04-08-2025; Accepted: 05-11-2025; Published: 05-15-2025; MedNEXT-id: e25S216

Editor: Dr. Sanjeev Ariyandath Sreenivasan, MD MCh.

Abstract

Introduction: In the context of chronic diseases and the challenges of endodontic surgery, there are some cases where, even after the correct use of endodontic resources, treatment fails, and the endodontist's first option is to perform retreatment. **Objective:** It was to develop a systematic review to list the main approaches and clinical challenges of endodontic surgery. **Methods:** The systematic review rules of the PRISMA Platform were followed. The research was carried out from November to December 2024 in Scopus, Embase, 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 230 articles were found, and 37 articles were evaluated in full and 26 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 33 studies with a high risk of bias and 53 studies that did not meet GRADE and AMSTAR-2. It was concluded that periodontal surgery is a viable, safe, and effective alternative for patients with chronic diseases. Proper planning, where indications are taken into account, is directly linked to the success rate of clinical cases. Apicoectomy combined with apical curettage significantly improves the prognosis of the case. Mineral Trioxide Aggregate is the material most often described as having the highest positivity for retrofilling. The best way to perform a retroperitoneal preparation is with the aid of ultrasound. The laser is a technological advance in the decontamination of the apical region, and the microscope is a magnificent aid in visualizing the operated area, increasing the rate of surgical success. Through a correct diagnosis and the technique chosen

to perform the surgical treatment, it is possible to have a successful surgery and an excellent prognosis. Thus, the success rates of endodontic surgeries depend on the indication of the surgical modality, retro-obturator materials, previous quality of the root canal filling, treatment of the surgical pocket, execution of the surgical technique, and periodontal conditions.

Keywords: Parendodontic surgery. Endodontic surgery. Chronic diseases.

Introduction

In the context of chronic diseases and the challenges of endodontic surgery [1,2], there are some cases where, even after the correct use of endodontic resources, treatment fails, and the endodontist's first option is to perform retreatment. However, when the attempt to contain microbial proliferation in the apical portion is not feasible or amenable to a solution through a coronary access, endodontic surgery is indicated as a therapeutic complement [3-5].

In this regard, endodontic surgery is defined as a dental surgical procedure, performed in the periapical region or bordering regions, which aims to solve problems that have not been successfully treated through conventional endodontic treatment, receiving various names such as root surgery, endodontic surgery, endodontic surgery, apical surgery, or periapical surgery [6,7].

Authors emphasize that endodontic surgery is intended to provide healing to periradicular tissues, generating rehabilitation of dental function, and is indicated in cases such as retrofilling and periradicular tissue repair [8]. In non-surgical endodontics, in the vast majority of cases, good results are presented, however,

there are 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 for endodontic surgery [8,9].

The failure of non-surgical endodontics comes from the fact that, in some cases, the need for root canal treatment arises in response to technical and microbiological problems [10]. In this sense, Hizatugo et al. emphasize that the microbiological involvement of the patient is indicated as being one of the main causes of failure in non-surgical endodontic treatments [9,10]. Based on this, endodontic surgery is a safe and adequate surgical procedure for the treatment of teeth with periapical lesions that do not respond to conventional endodontic treatment or when retreatment is not possible. Endodontic surgery 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 [11].

As a corollary of this, endodontic surgery consists of removing the etiological agent, being the presence of bacteria and other microbial irritants, in the root canals, the most frequent consists of sealing all the available entry holes in the root canal system. Endodontic 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 that cannot be removed, perforation and fracture of the apical third of the root, in addition to pulp 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 have been exhausted [9-11].

Given this, this study developed a systematic review to list the main approaches and clinical challenges of endodontic surgery.

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: 07/17/2024. 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: 07/17/2024.

Data Sources and Search Strategy

The literature search process was carried out from

November to December 2024 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: "Parendodontic surgery. Endodontic surgery. Chronic diseases", 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 230 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 104 articles. A total of 37 articles were evaluated in full, and 26 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 33 studies with high risk of bias and 53 studies that did not meet GRADE and AMSTAR-2, according to Figure 1.

Figure 1. Selection of the articles.

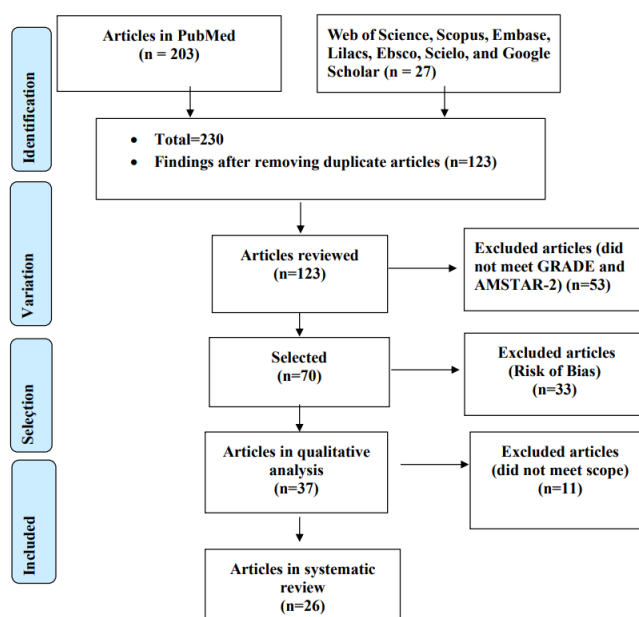
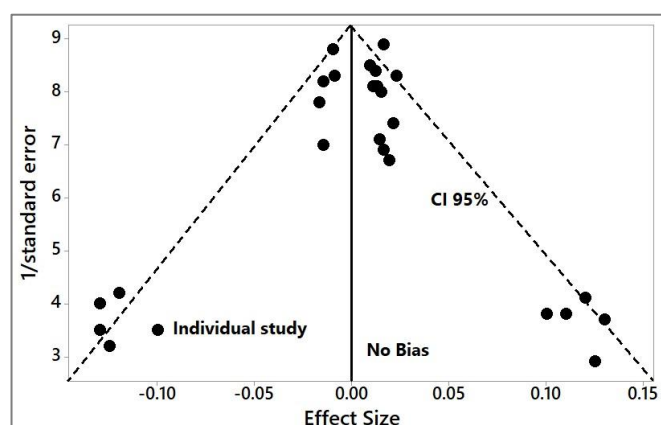


Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). The sample size was determined indirectly by the inverse of the standard error (1/Standard Error). This graph showed 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 (NTotal = 26 studies evaluated in full in the systematic review).



Source: Own Authorship.

Clinical Findings

An observational study of 68 patients with bacterial odontogenic sinusitis and endodontic disease with periapical lesions evaluated by an otolaryngologist and a dental specialist were included in this prospective observational cohort study. Patients who did not respond to clinical treatment of sinusitis (intranasal corticosteroids, saline mouthwashes, and antibiotics) and to clinical and root canal treatment, tooth extraction and endoscopic sinus surgery (ESS) or both were performed. A total of 87% of patients required surgical intervention. 12% improved after tooth extraction alone, 47% after ESS, and 31% required both procedures. The degree of maxillary sinus (MS) opacification did not correlate with the need for invasive procedures [12].

In this sense, endodontic surgery associated with endodontics is a treatment option when it is not possible to eliminate the etiological agent of the periapical inflammatory process in a conservative manner, that is, through conventional endodontic treatment [13]. Furthermore, Bramante and Berbert (2000) [14]

conceptualized endodontic surgery as the surgical procedure performed to resolve difficulties arising from endodontic treatment. In this sense, the success of the surgery is higher when it is supplemented by root canal retreatment [15]. Surgeries in the periapical region receive names that differentiate them, according to what is desired from their results [16].

For Cohen and Hargreaves (2007) [17], endodontic surgery is based on two objectives, the first of which aims to remove the etiological factor, and the second, to avoid recontamination of periodontal tissues after removal of the etiological agent. In this context, the main indications for endodontic surgery are anatomical complications, drainage, pain relief, iatrogenic problems, trauma, periodontal problems, need for biopsy, foreign elements in the apical region, incomplete or dilated apices, prosthetic procedures after endodontics, failures or problems during treatment, such as root perforation, unlocated canals, extravasation of materials, non-regression of periapical lesions, among others [18].

Ideal planning for endodontic surgery requires some essential factors for the diagnosis and surgical maneuver of the lesion. Complementary exams are essential for the quality of information necessary for the removal of the lesion, such as size and extension, its relationship with nearby anatomical structures, as well as the state of bone involvement [19]. The failure rate of non-surgical endodontic treatments is highly significant when the teeth undergoing treatment are located in oral regions where chemical preparation for the surgical procedure is not favorable, the access of the dentist and/or endodontist is unfavorable for performing the septic-necrotic procedure, and the affected area of the teeth is difficult to access so that the patient, at home, can maintain optimal quality of maintenance [5-7].

Therefore, it is important to emphasize that periendodontic surgery may be indicated for several dental procedures, such as [3-6]:

- ❖ Need to perform a biopsy of periradicular tissue;
- ❖ When it is necessary to visualize the periradicular tissues in the face of a perforation or suspected fracture/crack;
- ❖ When drainage is needed;
- ❖ When pain relief is required;
- ❖ In the feasibility of reducing anatomical complications;
- ❖ In order to correct and/or minimize iatrogenic problems;
- ❖ In the need to investigate trauma;
- ❖ When it is necessary to solve problems resulting from initiated/completed endodontic treatments;
- ❖ In the need to treat failures arising from previous treatment with or without the presence of a nucleus.

The main contraindications for endodontic surgery can be highlighted as systemic disease and psychological considerations, dental factors, including bone configurations or root configuration, and lack of surgical access, possible involvement of neurovascular structure where there is poor support tissue [6-9].

Regarding the preoperative evaluation of endodontic surgery, dental acts such as procedure, planning, and general health condition of the patient must be taken into account, and then proceed to a more in-depth secondary investigation of the case. Regarding the secondary preoperative investigation, it is essential to perform a complete anamnesis of the patient, giving special focus to their basic dental complaints, to enable greater interaction of data/information exchange between patient and professional, to carry out a thorough inspection of swellings, fistulas, regions with indicated sensitivity, percussion, sites with perforation, among other local aspects, and to perform periapical radiographic examinations [9].

Regarding periapical radiographic examinations, it is indicated that these are important in periendodontic surgery since they are used to deepen the evaluation of the apical region, allowing for greater detailing of fistulas. It has been reported that, in the dental field, digitalized radiography has also been used as a diagnostic basis for apical pathologies [9]. It is interesting to note that Computed Tomography (CT), especially the Cone Beam CT scanner, is indicated as having higher quality images and diagnostic efficacy [11]. After planning the surgical procedure, the surgical sequence must be idealized, which must follow with anesthesia, incision, divulsion, osteotomy, curettage, drying, transoperative radiography, and suturing [10,11].

Apical repair is highlighted, emphasizing the possibility of performing it in persistent lesions, post-endodontics, through simple apical curettage, in procedures where the extravasated material is beyond the apex or when the fractured instruments in the area present painful symptoms or lack of apical repair [8]. However, Lopes and Siqueira Júnior (2015) [20] do not corroborate the above, dictating that whenever one chooses to perform endodontic surgery, one should proceed with apicoectomy, since by neglecting this phase one would be leaving aside the agents causing the apical lesions that continued in the apical deltas, in the secondary canals and in the possible iatrogenic lesions, generated by the endodontist, which, in the vast majority of cases, are found in the apical portion of the roots with a dimension of approximately three millimeters.

Regarding the apical cut, Lopes and Siqueira Júnior (2015) [20] state that this has been performed at

30° and 45° for several years, but currently, due to the advent of the surgical microscope and ultrasound tips, this angle has been reduced to 90°. The 90° apical cut and the use of ultrasound, with angled tips, allow the creation of a retrograde cavity with a depth of 3 mm.

Parendodontic Surgical Modalities

Several surgical modalities can be performed, with emphasis on [21]:

- ❖ Surgical drainage;
- ❖ Periradicular curettage;
- ❖ Apicoectomy;
- ❖ Surgery with simultaneous root canal obturation;
- ❖ Retrograde obturation;
- ❖ Retroinstrumentation with retro-filling;
- ❖ Retroinstrumentation with retrofilling is associated with retrograde filling.
- ❖ Canalization;
- ❖ Rizectomy;
- ❖ Odontosection
- ❖ Surgical treatment of cysts.

A clinical case study described a periendodontic surgery procedure that was used to resolve a secondary infection due to contamination from a large root retainer. Dental elements with extensive intra-radicular metal retainers and acute periapical infections are always a challenge in endodontic clinics. It was concluded that the decision to perform periendodontic surgery with retro-preparation and retro-filling, using appropriate materials and techniques, was efficient in removing the etiological agent and achieving periapical health. The total regression of signs and symptoms, in addition to radiographic confirmation during follow-up, demonstrated the success of the case [22].

A cross-sectional observational clinical study analyzed the findings of high-magnification rigid endoscopy on the final surface of the root 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 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, craze 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 parameters studied. Therefore, fissure lines 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 [23].

The microbiological factor is indicated as the major cause of failures after the intervention. In these cases, root canal retreatment can be performed, aiming at reinstrumentation, cleaning, and new filling of the root canal. In addition, retreatment can be associated with apex 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 region of the lower central incisor. It has been shown that endodontic surgery is an effective and conservative treatment option compared to tooth extractions, and when performed correctly, with the help of good materials such as Mineral Trioxide Aggregate (MTA), it yields satisfactory results, restoring normal conditions to periodontal tissue, as well as the health and function of teeth affected by the inflammatory process [24].

In this sense, endodontic surgery is a set of procedures that aim to repair complications that could not be resolved through conventional endodontics, or when this is not possible. 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 cone beam tomographic monitoring for 4 years. It was concluded that the association of the surgical procedure with the application of low-power laser through photodynamic therapy enhanced the disinfection and elimination of bacteria persistent to the failure of the previous endodontic treatment [25].

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 goal 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 elevation of the flap, production of a small osteotomy, and the use of sonic or ultrasonic microtips will result in less trauma to the patient and faster post-surgical healing. An important step in apical surgery is to identify possible areas of leakage on the cut root surface and ensure adequate apical obturation [26].

In this scenario, due to the many cases of endodontic failure, periendodontic surgery has become viable and recommended for some patients. For example, apicoectomy is a surgery designed to preserve the integrity of the dental and oral organs, mainly

preserving the patient's health [27]. Furthermore, 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 [28].

Finally, the authors Glera-Suárez et al. (2022) [29] performed a retrospective cohort study to analyze the correlation between root width, the 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 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%. The premolar roots had a greater minimum dentin thickness (0.58 ± 0.25 mm) ($p < 0.003$) than the incisor roots. No significant association was found between the different measurements and the healing rate at one year, although the roots that failed to heal had lower minimum dentin thickness values than the roots that healed correctly. The position and type of tooth did not influence the healing result.

Conclusion

It was concluded that periodontal surgery is a viable, safe, and effective alternative for patients with chronic diseases. Proper planning, where indications are taken into account, is directly linked to the success rate of clinical cases. Apicoectomy combined with apical curettage significantly improves the prognosis of the case. Mineral Trioxide Aggregate is the material most often described as having the highest positivity for retrofilling. The best way to perform a retroperitoneal preparation is with the aid of ultrasound. The laser is a technological advance in the decontamination of the apical region, and the microscope is a magnificent aid in visualizing the operated area, increasing the rate of surgical success. Through a correct diagnosis and the technique chosen to perform the surgical treatment, it is possible to have a successful surgery and an excellent prognosis. Thus, the success rates of endodontic surgeries depend on the indication of the surgical modality, retro-obturator materials, previous quality of the root canal filling, treatment of the surgical pocket, execution of the surgical technique, and periodontal conditions.

CRediT

Author contributions **Conceptualization-; Formal Analysis-; Investigation-; Methodology-; Project administration-; Supervision-; Writing - original draft-; Writing-review & editing-** Brenda Lemes dos Reis, Gabriel Silva Ferreira, Fábio Pereira Linhares de Castro.

Acknowledgment

Not applicable.

Ethical Approval

Not applicable.

Informed Consent

Not applicable.

Funding

Not applicable.

Data Sharing Statement

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.

About The License©

The author(s) 2025. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License.

References

1. GBD 2021 Stroke Risk Factor Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet Neurol*. 2024 Oct;23(10):973-1003. doi: 10.1016/S1474-4422(24)00369-7.
2. GBD 2021 Tobacco Forecasting Collaborators. Forecasting the effects of smoking prevalence scenarios on years of life lost and life expectancy from 2022 to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet Public Health*. 2024 Oct;9(10):e729-e744. doi: 10.1016/S2468-2667(24)00166-X.
3. Kanagasingam S. The 2020 Guidelines for Periradicular Surgery: What You Need to Know. *Prim Dent J*. 2020 Dec;9(4):20-23. doi: 10.1177/2050168420963350.
4. Bucchi C, Rosen E, Taschieri S. Non-surgical root canal treatment and retreatment versus apical surgery in treating apical periodontitis: A systematic review. *Int Endod J*. 2022 Jun 28. doi: 10.1111/iej.13793.
5. Jia T, Qiao B, Ren Y, Xing L, Ding B, Yuan F, Luo Q, Li H. Case Report: Application of Mixed Reality Combined With A Surgical Template for Precise Periapical Surgery. *Front Surg*. 2022 Jun 10;9:923299. doi: 10.3389/fsurg.2022.923299.
6. Manfredi M, Figini L, Gagliani M, Lodi G. Single versus multiple visits for endodontic treatment of permanent teeth. *Cochrane Database Syst Rev*. 2016 Dec 1;12(12):CD005296. doi: 10.1002/14651858.CD005296.pub3. Update in: *Cochrane Database Syst Rev*. 2022 Dec 13;12:CD005296.
7. Jorge ÉG, Tanomaru-Filho M, Guerreiro-Tanomaru JM, Reis JM, Spin-Neto R, Gonçalves M. Periapical repair following endodontic surgery: two- and three-dimensional imaging evaluation methods. *Braz Dent J*. 2015 Jan-Feb;26(1):69-74. doi: 10.1590/0103-6440201300252.
8. Serrano-Giménez M, Sánchez-Torres A, Gay-Escoda C. Prognostic factors on periapical surgery: A systematic review. *Med Oral Patol Oral Cir Bucal*. 2015 Nov 1;20(6):e715-22. doi: 10.4317/medoral.20613.
9. Krastev B, Filipov I. Periapical Surgery. Epidemiology, indications and contraindications. Review. *J of IMAB*. 2020 Apr-Jun;26(2):3114-3121. DOI: <https://doi.org/10.5272/jimab.2020262.3114>
10. Setzer FC, Kratchman SI. Present status and future directions: Surgical endodontics. *Int Endod J*. 2022 Oct;55 Suppl 4:1020-1058. doi: 10.1111/iej.13783.
11. Iqbal A, Sharari TA, Khattak O, Chaudhry FA, Bader AK, Saleem MM, Issrani R, Almaktoom IT, Albalawi RFH, Alserhani EDM. Guided Endodontic Surgery: A Narrative Review. *Medicina (Kaunas)*. 2023 Mar 29;59(4):678. doi: 10.3390/medicina59040678.
12. Kwiatkowska M, Szczygielski K, Skrzypiec Ł, Jurkiewicz D. Predictive value of tooth and sinuses radiological characteristics in managing

- odontogenic sinusitis of endodontic origin. *Otolaryngol Pol.* 2024 Oct 17;78(5):33-42. doi: 10.5604/01.3001.0054.6744.
13. Orso, V. A; Filho, M. S; Cirurgia Parendodôntica: como e quando fazer. *R. Fac. Odontol. Porto Alegre, Porto Alegre*, 2006, v. 47, n.1, p. 20-23.
 14. Bramante CM, Berbert, A. Cirurgia paraendodôntica. São Paulo: Ed. Santos, 2000.
 15. Chandler NP, Koshy S. The Changing Role of the Apicectomy Ope-ration in Dentistry. *J. R. Coll. Surg.R. Fac. Odontol. Porto Alegre, Porto Alegre*, 2006, v. 47, n.1, p. 20-23.
 16. Pessoa, E.S. et al. Cirurgia Parendo-dôntica com Obturação Simultânea do Canal Radicular e Restauração Estético-funcional do Elemento Dental. *UnimarCiências, Marília*, 1995, v.4, n. 2, p.91-99.
 17. Cohen S, Hargreaves KM. Caminhos da Polpa, 9a edição, Rio de Janeiro: Elsevier Ltda, 2007, Cap. 20.
 18. Fagundes, Rafael Bainy et al. Cirurgia parendodôntica: uma opção para resolução de perfuração radicular – apresentação de caso clínico. *Rev Odontol UNESP, Araraquara. set./out., 2011.*
 19. Junqueira RB et al. Tomografia computadorizada de feixe cônico como instrumento complementar de diagnóstico e planejamento cirúrgico de cisto radicular: relato de caso clínico. *Revista de Odontologia da UNESP, Araraquara, SP.* 2011, v. 40, n.6, p 338-343.
 20. Lopes HP, Siqueira Júnior JF. Endodontia: Biologia e Técnica. 4º Ed. Rio de Janeiro: Elsevier Campus, 2015.
 21. Berger CR. Endodontia. 2018, 334-345.
 22. Graciano NR, Branco GS, Do Nascimento VR, Pfau EA, Brunini SHS, Tomazinho LF. Parendodontic surgery with retro preparation and retroobturation: case report. *Brazilian Journal of Surgery and Clinical Research – BJSCR.* 2021, Vol.34,n.1,pp.24-28.
 23. Glera-Suárez P, Pallarés-Serrano A, Soto-Peñaloza D, Tarazona-Álvarez B, Peñarrocha-Diago M, Peñarrocha-Oltra D. Endoscopic findings in periapical surgery. A cross-sectional study of 206 roots. *Med Oral Patol Oral Cir Bucal.* 2022 Jul 1;27(4):e375-e382. doi: 10.4317/medoral.25311.
 24. Silva JMD da, Silva G. de O., Vergetti F. de AC, Costa ARO da, Nascimento MG, Almeida Neto EM. de, Nogueira PTB de C, Vasconcelos RA de. (2022). Parendodontic Surgery as a Treatment Option: Case Report with One Year Follow-Up. *ARCHIVES OF HEALTH INVESTIGATION*, 11(5), 822–826.
<https://doi.org/10.21270/archi.v11i5.6010>
 25. Laranjeira AC de S, Silva S de A, Vieira TM, Sousa WV de, Ferreira G dos S, Torres RD, Albuquerque DS de. Paraendodontic surgery associate with photodynamic therapy: case report with 4 years follow-up. *RSD [Internet].* 2021Feb.28 [cited 2023Jun.12];10(2):e55010212868. Available from:
<https://rsdjournal.org/index.php/rsd/article/view/12868>
 26. von Arx T. Apical surgery: A review of current techniques and outcome. *Saudi Dent J.* 2011 Jan;23(1):9-15. doi: 10.1016/j.sdentj.2010.10.004.
 27. Souza IMM, Izidro AER. Cirurgia parendodôntica – apcertomia Revisão de literatura. *R Odontol Planal Cent.* 2020.
 28. Lieblisch SE. Current Concepts of Periapical Surgery: 2020 Update. *Oral Maxillofac Surg Clin North Am.* 2020 Nov;32(4):571-582. doi: 10.1016/j.coms.2020.07.007.
 29. Glera-Suárez P, Pallarés-Serrano A, Soto-Peñaloza D, Tarazona-Alvarez B, Penarrocha-Diago M, Penarrocha-Oltra D. Influence of root width and dentin wall thickness evaluated by endoscopy upon the outcome of periapical surgery. A cohort study. *Med Oral Patol Oral Cir Bucal.* 2022 Jul 1;27(4):e383-e391. doi: 10.4317/medoral.25314.