

PAREDODONTIC SURGERY: LITERATURE REVIEW

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Abstract: Paraendodontic surgery is a technique responsible for treating the failures of traditional endodontics. This modality seeks to remove the infectious etiological agent and regenerate tissues in the periapical region. Therefore, it is considered a conservative technique as it values the maintenance of the tooth in the oral cavity. The objective of this research is to contribute to the knowledge of dental surgeons about the different techniques of surgical endodontics and their indications, aiming to reestablish the patient's well-being. For this, a search was carried out in the Google Scholar and Scielo databases, using the following descriptors "Root canal preparation", "Endodontics" and "Apicoectomy" including articles, monographs from 2006 to 2023. After applying the inclusion and exclusion criteria, 30 articles were selected for full reading. It is concluded that failure to clean the root canal, due to its anatomy or failure in chemical/mechanical preparation, is the main cause of failure in endodontic treatment, resulting in the persistence of pathogens, making it necessary to indicate paraendodontic surgery as a last resort before exodontia is recommended.

Keywords: Paraendodontic surgery. Endodontic treatment. Apicoectomy.

Endodontic therapy consists of coronal opening, shaping, cleaning, disinfection, and three-dimensional sealing of the root canal system. In this universe, for there to be a favorable prognosis, it is necessary to carry out a good chemical and mechanical preparation with the aim of completely disinfecting the root canals (MORETI et al., 2019).

The anatomy of the tooth, correct instrumentation and irrigation must be taken into consideration, avoiding excessive force on the instrument in order to prevent it from fracturing, in addition to the need to discard endodontic files that show wear. Fractured

instruments inside the root canal, for example, often prevent the apical portion of the tooth from being disinfected, which reduces the chances of success of the treatment carried out (MORETI et al., 2019).

The negative prognosis of endodontic treatment is the result of technical failures, steps that are neglected by the operator resulting in poor infection control. Therefore, eliminating the source of infection is a crucial factor in promoting tooth recovery and maintaining it in the stomatognathic system (HONORATO et al., 2020). On the other hand, there are cases in which all steps were respected and still resulted in failure due to microbial factors and root anatomy (ROCHA et al., 2018).

Paraendodontic surgery consists of a technique used when conventional endodontic treatment presents an unfavorable prognosis (SAMPAIO, 2021). This surgical procedure is indicated when factors such as instrument fracture, apical perforations and anatomical anomalies that prevent conventional instrumentation are present (CARVALHO; PEREIRA, 2021).

In this context, paraendodontic surgery can be considered a conservative treatment, as it aims to treat and maintain the tooth element in the oral cavity and thus avoid possible extraction. The modalities commonly used can range from periapical curettage to apicoectomy with or without retrograde filling (HONORATO et al., 2020). To this end, it is essential that dental surgeons (DCs) know the indications and techniques used in each case, as it is considered by many to be a complex procedure (CARVALHO; PEREIRA, 2021).

The objective of this work is to provide knowledge to Dental Surgeons (DC) through a literature review on the indications, medications and different techniques of paraendodontic surgery.

METHODOLOGY

The present study consists of a bibliographic literature review, in which a search was carried out in the databases: Google Scholar and Scielo, using the following descriptors: “Paraendodontic surgery”, “Endodontic treatment” and “Apicoectomy”. Articles and monographs published from 2006 and 2023 in the Portuguese language were included and the works that were most relevant to the topic were selected. Articles that were not available in full and studies not related to the topic in question were excluded. Among the articles available in the databases, around 30 articles/monographs were selected for full reading, through combinations of keywords.

LITERATURE REVIEW

ENDODONTIC

Endodontics is a dental specialty responsible for treating diseases of the dental pulp and periradicular region with the aim of maintaining the tooth element in the oral cavity, providing aesthetics and functionality of the tooth. Endodontic treatment is a routine treatment in dental offices, as it is an alternative to extractions. Therefore, the patient must follow the following steps: coronary opening, chemical-mechanical preparation and filling of the root canal system (ANDRADE, 2019).

After coronary opening, which will provide access to the canal system, endodontic instruments together with the irrigating solution are responsible for the chemical and mechanical preparation of the root canal. The files promote the mechanical removal of microorganisms, while the irrigating solution, such as sodium hypochlorite (NaOCl), provides chemical removal that maximizes the removal of debris from the interior of the canal, in addition to having a solvent and antimicrobial effect on organic matter. The instruments and the irrigating solution

promote the widening of the canal, which significantly reduces the bacterial population (SIQUEIRA JÚNIOR et al., 2012).

After chemical and mechanical preparation of the root canal, it must be filled in three dimensions, sealing it and preventing communication between the periapical tissue and the root canals.

The success of endodontic treatment depends on a correct diagnosis, root canal anatomy, pathology, pathophysiology, instruments and equipment used, in addition to the skill of the CD. In addition to those mentioned, it is necessary to avoid damaging healthy tissues, promote adequate waterproofing and filling of the canal system. In this context, the absence of pain, swelling, fistula, drainage, changes in the periapical physiology of the tooth in function and regression of periapical bone rarefaction indicate a favorable prognosis for endodontic treatment (KORCHAK, 2021).

In the endodontic scenario, conventional treatment is not always successful, as it is prone to complications, errors and accidents. The study by Oliveira and Santos (2018), reports that fractures of files inside the root canal can occur due to the manufacture of the instrument, anatomy of the canal, which may be curved or atretic, excessive use of the instrument, lack of professional skill and excessive force.

Furthermore, perforations can occur during access, when investigating the entrance to the canals, excessive removal of dentin in areas of fragility, root deviations and attempts to remove or circumvent a fragment. In this sense, the prognosis will depend on the location and size of the perforation, root length, presence or absence of periodontal communication, in addition to the time between its occurrence and closure, as well as contamination and the type of material used to seal the perforation. (ARANTES; BOER; 2022).

Faced with this problem, endodontic retreatment must be chosen, however, it is not always capable of resolving the case, with paraendodontic surgery as a last resort, which aims to treat failures of non-surgical endodontic treatment (LODDI, 2022).

This surgical procedure must be indicated in cases that require drainage, anatomical complications of the tooth, teeth that have prosthetic crowns and root posts that do not favor endodontic retreatment, iatrogenic problems, persistence of the lesion, need for tissue biopsy and problems during treatment conventional, such as drilling (RAMOS, 2022).

MICROBIAL FACTORS

Bacteria and microorganisms that remain in the root canal are the main causes of failure in conventional endodontic treatment, which can occur due to failure in chemical and mechanical preparation, failure in apical and coronal sealing, iatrogenic events such as perforations and/or fractures of endodontic instruments (BORGES, 2020). After retreatment, failure is proven when apical radiolucency does not disappear within four years or when the patient presents symptoms and clinical signs of inflammation (MATOS, 2021).

Endodontic infections can be divided into primary, secondary and persistent. Primary infections are polymicrobial, with gram-negative anaerobic bacteria predominating. This type of infection affects teeth that have not yet undergone endodontic treatment and arises from pulp necrosis. In secondary infections, bacterial species that are not part of the oral microbiota, such as *Staphylococcus aureus* and *Enterococcus faecalis*, are introduced into the canal due to a break in the aseptic chain, which can occur due to a lack of absolute isolation, contaminated instruments, remaining caries, teeth kept open to drainage,

fracture or loss of restorative material. In persistent infection, it is common to find a smaller number of bacterial species, or a single species, being gram-positive anaerobic. Eventually, gram-negative bacteria such as *Fusobacterium nucleatum* can be found, and fungi such as *Candida albicans* can also be found, which easily adapt to adverse microenvironments (ROCHA et al., 2018).

Although the infection has a polymicrobial nature, *Enterococcus faecalis* is the most prevalent bacterial species in canals that require retreatment (MATOS, 2021). The study by Cavalcante and Oliveira (2021) reports that *Enterococcus faecalis* is present in 90% of cases of persistent infection, as it has the ability to penetrate the dentinal tubules, and grow in the form of a biofilm or single colony, managing to sustain itself in conditions adverse and resistant to the effects of calcium hydroxide.

In this universe, bacterial location is an important factor for microbial resistance to occur, since areas with branches, isthmuses and the interior of dentinal tubules are unfavorable for the performance of instruments, irrigating solutions and intracanal medication (ROCHA et al, 2018).

The branches of root canals are classified into: main canal, collateral canal; side channel; secondary channel; accessory channel; interchannel or interconduct; recurring channel; reticular canals and the apical delta, which are multiple branches of the main canal in millimeters of the apical portion of the tooth. The apical critical zone is located in the final four millimeters of the root of the tooth. This area has an intimate relationship with the tissues and structures of the periapex, which are the apical root canal, apical foramen and foramina. It is in this region that most problems occur, as it may contain microorganisms present in the dentinal canaliculi, on the walls of the foramina, in the

lateral and accessory canals, and also in the periapical tissues (MELO; LIMA; 2008).

PARAENDODONTIC SURGERY

In 1978, the first publication on paraendodontic surgery occurred, which was performed at that time by oral and maxillofacial surgeons who only performed apical curettage (SAMPAIO, 2021). According to Bicca (2021), paraendodontic surgery has recently become the responsibility of the endodontist, since he knows the anatomy of the canals and roots, as well as the implications in a periapical process.

Periradicular surgery, as it is called by Ramos (2022), requires a correct treatment plan based on clinical and radiographic examination, choice of surgical technique, type of incision and divulsion, as well as determination of the osteotomy site and type ideal suture for the case in question.

With advances in science, this procedure is now considered safe, with an 80% success rate according to studies in recent years (SAMPAIO, 2021). However, this surgery is contraindicated when the apex of the dental element is in an anatomical region of risk, such as the nasal fossa, maxillary sinus, mental foramen and mandibular canal, as well as presenting an acute pathological process, having short roots and compromised bone support or the patient presenting decompensated systemic diseases, such as diabetes (RAMOS, 2022).

The studies by Bicca (2021) and Moreti et al. (2019) show that the most used surgical modalities are apicectomy, apicectomy with retrograde filling, apicectomy with instrumentation and retrograde root canal filling, periapical curettage and root canal filling simultaneously with the surgery.

In this context, a thorough clinical and imaging evaluation is essential, using conventional radiography and mainly cone

beam computed tomography as it provides greater precision, which enables a three-dimensional assessment of the dental element. The favorable prognosis of this surgery has increased considerably in recent years with the emergence of surgical microscopes, ultrasonic inserts and bioceramic cements that promote the sealing of the apex (COUTO, 2022). In this sense, intraoperative complications can be minimized with the use of an operating microscope with a minimum magnification of 10x, which allows microsurgery to be performed, root preparation using ultrasonic tips and apical filling with cement that has reparative properties (XAVIER JÚNIOR et al., 2023).

The study by Barioni et al. (2023), reports that the laser is the best option for performing paraendodontic surgery. In this sense, the Er:YAG laser does not present a significant increase in temperature due to its water spray system. During the procedure, it results in excellent coagulation, with less operative and post-operative bleeding, shorter surgical time, less edema and pain. During apex resection, the Er:YAG laser produces a smoother surface compared to the cut performed by conventional drills, which causes minimal epithelial damage, resulting in low inflammatory reaction and faster healing.

The prognosis of paraendodontic surgery depends on factors such as age, sex, location of the tooth, preoperative signs and symptoms, quality of the preoperative filling, previous apical surgery, periodontal involvement and size of the lesion. The evaluation of the result is carried out by observing the presence of symptoms, the presence of signs such as mobility, the presence of function and clinical and radiographic healing (XAVIER JÚNIOR et al., 2023).

Radiographic healing from surgery is currently divided into 4 categories: complete healing, when there is new bone formation;

incomplete healing, presence of scar tissue; uncertain healing; unsatisfactory healing. Cone beam computed tomography is the imaging test of choice to evaluate long-term surgical healing (XAVIER JÚNIOR et al., 2023).

APICAL CURETAGE

This technique aims to remove pathological tissue from the alveolus in its apical or lateral region of the dental element, and can also be used to remove iatrogenic foreign bodies located in this area (RAMOS, 2022). With the use of surgical curettes compatible with the size of the lesion, all granulation tissue must be removed under constant irrigation with sterile saline. Therefore, there is a great chance of success when this technique is combined with others (LODDI, 2022).

In view of the above, curettage of pathological tissue, in addition to being necessary to provide better root visibility and reduce the infectious focus, is also necessary to send part of the lesion for histopathological analysis and correct diagnosis of the disease (XAVIER JÚNIOR et al, 2023). In this context, although it is a common practice in dental surgeries, this surgical modality must not be used in isolation when the pathology is related to the root canal (LODDI, 2022). Furthermore, it is necessary that the curettage is not exaggerated so as not to cause damage to neighboring structures (BICCA, 2021).

APICECTOMY

This surgical modality consists of resection of the apical portion of the tooth, removing all infected tissue (CARLESSO; SANTOS, 2019). This technique is performed after apical curettage, promoting a perpendicular cut using drills or ultrasonic tips in order to remove apical deltas and the number of lateral canals (RAMOS, 2022).

Apicoectomy is indicated in cases of

inability to perform traditional treatment, when there is extravasation of filling material through the apex, root fracture with pulp involvement, perforated root, root resorption and exudate in the permanent root canals. On the other hand, it must not be indicated when there is complexity in access, great bone loss, unfavorable root length, the patient has systemic problems such as heart, kidney, liver and even psychological problems (SOUZA, 2021).

APICECTOMY WITH RETROGRADE FILLING

This involves creating a cavity in the apical region followed by filling with retrofilling material with the purpose of sealing the apical region, creating a blockage between the adjacent apical tissues and the root canal, preventing possible contamination. This technique is indicated in cases where there are canals inaccessible by the conventional technique, either due to factors such as calcifications, malformations, fractured instruments in the root canal and the presence of root pins, when it is necessary to remove apical deltas, cement resorption gaps, torn roots, materials extruded in the apical region, root branches and perforations, fracture in the apical third, symptoms after conventional treatment and insufficient filling of the root canal, also being indicated when adequate apical sealing was not achieved using the conventional technique (MELO, 2022).

This technique is performed conventionally by cutting the root using a frusto-conical drill, positioned perpendicular to the axis of the tooth, at a 90° angle, cutting from the distal to the mesial, following the introduction and removal movements. During resection, there must be constant irrigation with saline solution, in order to cool the drill and not promote tissue heating, which could result in injury or necrosis of the dentin and cementum

(MELO, 2022).

In this context, to facilitate the operator's visualization, a bevel must be made directed to the professional so that it is also possible to evaluate the quality of the sealing of the remaining apex. Cutting the root must be done by removing the entire infected portion, indicating removal of 1/3 of the root, which eliminates a large part of the secondary canals, which are normally responsible for reinfecting the bone cavity (MELO, 2022).

APICECTOMY WITH INSTRUMENTATION AND FILLING OF THE ROOT CANAL VIA RETROGRADE

It consists of instrumenting and filling the root canal from the dental apex. It is indicated, for example, when the filling of the canal is deficient, after cementing a prosthetic crown, pulp necrosis occurs, when it is not convenient to remove a root post. Access to the canal must be achieved by grinding the apex of the tooth with a troco-conical drill or apical file to carry out the instrumentation to the desired extent and caliber necessary for obturation with a gutta-percha cone. Irrigation must be carried out with saline solution, then the canal must be dried with an absorbent paper cone and obturated, applying vertical pressure for full penetration, remaining 1mm short of the foramen (BICCA, 2021).

FILLING THE ROOT CANAL SIMULTANEOUS WITH THE SURGICAL ACT

This modality is indicated when inflammatory exudate is present even after good instrumentation of the root canal and replacement of calcium hydroxide paste dressings, that is, when we are facing chronic lesions (KORCHAK, 2021). In this technique, osteotomy, curettage, completion of the canal preparation followed by filling are performed.

At the end, an x-ray must be performed to ensure that the procedure was correct. After confirming the success of the procedure, suturing must be performed (SAMPAIO, 2021).

This technique is contraindicated in cases where there is acute inflammation present, impossibility of prior debridement and inaccessibility to the root apex (GUIMARÃES et al., 2006).

MARSUPIALIZATION

Infection of the root canal system can result in a root cyst, in this sense, conventional endodontic treatment promotes the elimination or substantial reduction of antigens present in the canals and periapical tissues, which will normally result in a decrease in antigenic activity providing repair. Of region. On the other hand, in cases of extensive lesions or those involving important anatomical areas, treatment with marsupialization and decompression maneuver is necessary, as they promote a decrease in intracystic pressure and a reduction in the size of the periapical lesion (FONSECA et al., 2019).

This technique consists of placing a drain communicating the lesion with the oral cavity, making it essential to collect the material for histopathological analysis. Monthly follow-up must be carried out to monitor the position of the drain and evaluate any tissue changes in the region, as well as monitor the reduction of the lesion. After significant regression of the lesion is found through periapical radiography and cone beam computed tomography, paraendodontic surgery may be indicated, as it no longer poses a risk to important anatomical areas (COUTO, 2022).

REBUTTURE MATERIAL

For surgical endodontic therapy to be successful, the retrofilling material must have essential characteristics such as: being non-toxic, biocompatible, non-mutagenic, insoluble, having adequate radiopacity, sealing capacity and being easy to handle. Over the years, several materials have been used as retrograde obturators, such as: amalgam, composite resins, cements based on zinc oxide and eugenol, cements based on glass ionomer, cements based on calcium hydroxide, cohesive gold, Cavit and mineral trioxide aggregate (MTA). Amalgam was widely used in the 80s, but it gave way to other materials, as they had a better biological and sealing response (BRAMANTE, 2020).

In the 90s, Torabinejad introduced MTA to the market, a material routinely used in endodontics, especially in cases of retrograde filling. Over the years, modifications to its composition were made with the aim of improving clinical development, promoting color stability, releasing calcium ions, having an alkaline pH and being biocompatible (XAVIER JÚNIOR et al., 2023).

According to Korchak (2021), MTA is the cement of first choice because it has the necessary characteristics, in addition to having calcium and phosphorus in its composition, which are also found in the hard tissues of the teeth. Therefore, it is considered the most biocompatible cement currently, as it stimulates the repair of root cementum, presents ideal adhesion, low solubility and provides regeneration of periapical tissues.

DISCUSSION

Even with the advancement of science in dentistry, especially in endodontics, it is not possible to eliminate all factors that have the potential to lead to failures in endodontic treatment, which may occur due to the anatomy of the root canals, iatrogenic and

bacterial resistance to intracanal medication (LIMA JÚNIOR, 2021).

The purpose of paraendodontic surgery is to treat problems caused by the conventional technique or those that could not be solved by it. In this case, the first option must always be endodontic treatment and retreatment, and only when these are not possible or satisfactory, must one opt for the surgical technique as a last resort to maintain the dental element in the mouth (SILVA; MACHADO, 2022).

Proof of failure after traditional endodontics is performed through signs and symptoms such as pain, abscess and the appearance of a fistula. Furthermore, radiographic monitoring must be carried out, since even in the absence of pain, a radiolucent image can be observed indicating the permanence or progress of the lesion (NOBREGA et al., 2022).

For Korchak (2021), as it is not an emergency surgery, after diagnosis it must be planned by evaluating the patient's systemic condition, the degree of difficulty and the professional's skill so that it is possible to choose the technique that best suits the case. The favorable prognosis of paraendodontic surgery depends on an individualized assessment, taking into consideration, the anatomy of the region and the technique indicated.

Still in the study by Korchak (2021), it was evaluated that all methods of paraendodontic surgery are effective, however, the one that stands out most is apicectomy with retrograde obturation, as it promotes resection of the apex where the system's ramifications are located. of channels, places where it is not possible to instrument and where the irrigating solution cannot reach, making it impossible to sanitize these branches. Next, the apex is sealed with a chosen filling material, which prevents communication with the surrounding tissues.

CONCLUSION

It is concluded that paraendodontic surgery is indicated in these cases and that there is still bacterial infection even after endodontic retreatment. It proved to be an invasive, but conservative technique, since it aims to maintain the tooth element in the oral cavity, therefore the technical knowledge of

the dental surgeon is essential for a favorable prognosis.

In this sense, the success of endodontic surgery depends on factors such as: indication of the surgical modality, retrofilling material, previous quality of root canal filling, treatment of the surgical site, professional skill, periodontal conditions, among other aspects.

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