



ADVANCING ENDODONTIC SURGERY: INSIGHTS INTO APICECTOMY AND CYSTECTOMY PROCEDURES

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ABSTRACT:

Background: Endodontic therapies are crucial for managing dental pulp infections that may lead to periapical abscesses. Surgical interventions, including apicectomy and cystectomy, are employed to address these conditions effectively.

Objective: This descriptive bibliographic study aims to elucidate the theoretical and technical aspects of peripheral surgical procedures in endodontics, focusing on apicectomy and cystectomy, derived from various scholarly sources.

Methods: Information was gathered from books, scholarly publications, scientific articles, and specialized websites to delineate the foundational concepts and techniques of apicectomy and cystectomy in endodontics.

Results: The core principles of periodontal and root surgery emphasize meticulous care of treated teeth, occlusal and periodontal tissues, and thorough cleaning and sealing of the root canal system. The efficacy of these procedures hinges on the appropriate application of periapical surgery and the precise indications for apical surgery.

Conclusion: Recent advancements in surgical practices prioritize minimally invasive techniques, supported by innovations like three-dimensional imaging and conservative surgical approaches. Across medical and surgical disciplines, the overarching goals remain patient well-being, reduced surgical risks, and expedited recovery periods.

KEYWORDS: endodontic therapies, periapical surgery, apicectomy, cystectomy, and dental pulp.

INTRODUCTION:

The terminal portion of the root, also known as the apical foramen of the tooth, is the apex of the tooth. A tooth has a crown and a root; the lower molars have two roots, the upper molars three, and the incisors, canines, and premolars have one. The morphology and anatomy of tooth roots might differ despite this. The dental pulp's entrance into the periapical areas is known as the tooth's apex. This aperture is used by the blood vessels and nerve terminals that supply the tooth's dental pulp. Any dental pulp pathology may impact tissues attached to the tooth apex. Even when known

anatomical reference data are available, the structure of premolar teeth is heterogeneous and differs from patient to patient. The dentist must employ various techniques to provide the most accurate approximation of the root structure of the tooth that must be treated when doing endodontic treatment (Mukherjee et al., 2023).

The inability to reach the working length is caused by variations in the location of the apical hole and the distance from the anatomical apex. For this reason, in addition to electronic techniques like the apex locator, radiographic techniques like parallelism and the Clark technique must be used to obtain an additional tooth dimension. When there is a dental pulp infection that has the potential to spread to the apex and result in an abscess in the periapical area of the tooth, endodontic therapies are administered. Surgical treatment is sometimes necessary when root canal therapy and subsequent pharmaceutical therapy do not resolve infections. This study must describe the surgical procedures performed on the dental apex, such as apicectomy or endodontic surgery, as well as the use of the cystectomy treatment in cases of persistent infectious complications that result in fistulas, periapical cysts or granulomas (Stefania et al., 2022).

METHODOLOGY:

This descriptive bibliographic study aims to present the theoretical and technical ideas that define peripheral surgical procedures known as apicectomy and cystectomy. These ideas were taken from books, scholarly publications, scientific articles, and specialized websites. Descriptors like "Dental Apex," "Periapical Surgery," "Apicectomy," and "Cystectomy" were used to gather information by inserting them into scientific production banks and search engines like Google Academic. After enough data has been collected, it is condensed and examined until an extract that fulfills the stated goal is included in the following findings (Azadi et al., 2022).

RESULT:

To promote healing through healthy tissues and healed wounds, periapical surgery techniques attempt to surgically clean the tooth's apex (the root's end) and remove any type of tissue of infectious and chronic inflammatory origin present in the area. Permits the removal of a periapical lesion in situations where traditional root canal therapy is ineffective while maintaining the affected tooth. These chronic inflammatory or cystic tissues do not necessarily indicate that the prior endodontic treatment, if any, was done incorrectly. These tissues could result from anatomical abnormalities in the root canal system, residual pathology before the endodontic treatment, or something else entirely. To achieve the periapex tissues' regeneration. To prevent infectious recurrences, the entire periapical lesion must be removed by curettage and resection of the root apex (Matteo et al., 2022).

The root canals must also be isolated with a sufficient apical seal that inhibits filtration and the presence of irritating materials. Several classifications have evolved to decide which cases are suitable for periapical surgery and which situations are suitable for an attempt at root canal retreatment. The author provided four primary indications for periapical surgery based on the guidelines set forth by the European Society of Endodontics (ESE) in 1994. These indications were taken from the research paper by Cervera et al. (Baaij et al., 2024).

When there is radiographic evidence or clinical symptoms, and the root canal is clogged (and repeat endodontics is not an option). Pronounced curvatures are the most common source of blockage in root canals (Segura-Egea et al., 2021).

- Calculations
- Breaks in the instruments (lenticular or files) within the canal.
- Prosthetic restorations are challenging to remove because they are prosthetics placed on extensive and challenging restorations and because there is a chance that the ceramic crowns would shatter (Baharin & Omar, 2021). When there is radiological evidence or clinical complaints along with overextension of the filling material, the apical hole deepens when the endodontic file passes over the apex, and cement or gutta percha will likely escape the canal. This spilling material can occasionally cause the periapical tissues to become irritated and react inflammatory to the foreign

matter. Still, other times, it can be tolerated by the tissues without causing symptoms. When endodontic therapy is not successful, new endodontic procedures are not warranted. Bacteria in the duct system and at the extraarticular level is the only explanation for this failure. The causes of chronic infection stem from the clinical shortcomings of root canal therapy, which include iatrogenic mistakes, untreated or inadequately shaped and irrigated canals, inadequate three-dimensional obturation, and treatment-related problems (Krstl et al., 2022).

In situations where an orthograde treatment is not feasible due to radiographic evidence of root perforations or clinical complaints. A technique error could result in a direction deviation when prepping the canal and drilling the root. Non-surgical techniques can be used to instrument and obturate perforations, such as treating an auxiliary duct. If they are in the apical third, apicectomy removes the perforated fragment as part of periapical surgery treatment (Duncan, 2022).

Additional clues

The best course of action for endodontically treated horizontal root fractures with apical fragment involvement manifesting as symptoms is surgical excision of the latter and apical surgery of the coronary fragment. Large radiolucent periapical lesions larger than 8–10 millimeters in diameter are another sign that apical surgery is necessary. This prevents the lesion from becoming an undetected malignant lesion by removing it and enabling a histological evaluation. A proper medical history and a physical examination of the teeth and soft tissues support the presumptive diagnosis. The radiographic examination of the tooth, periodontium, and periapical lesion forms the basis of the presumed diagnosis. A CT scan of the jaws is typically only necessary in extreme circumstances; intraoral periapical and extraoral panoramic radiography is usually adequate (Sacha et al., 2020).

As more precise diagnostic methods, some procedures employ digital radiography or radiovisiography. Following the procedure, the presence of the periapical granulation tissue will be verified, and the histological examination will accurately identify the kind of lesion and provide a specific diagnosis. The removal of the apex To access and treat a persistent dental infection, dental apicoectomy, also known as root canal surgery, entails cutting off the apex of the tooth. Specialized dental equipment and a microscope are used to accomplish the surgery. Despite this, it is the very least intrusive option for tooth preservation. A dental professional must do so because of the treatment's deliberate complexity. This is why speaking with a periodontist is crucial; only they are qualified to do an apicoectomy because they have received additional, specialized training in treating periodontal tissue problems (Wei et al., 2024).



Figure 1: Apicoectomy

An apicoectomy is advised to remove accessory canals, enhance curettage and access to the posterior portion of the root, and provide a sufficient root surface to prepare the retrograde cavity. Moreover, an apicoectomy must be done until the isthmus is located and filled in when dealing with roots that have two canals (Nagendrababu et al., 2023).

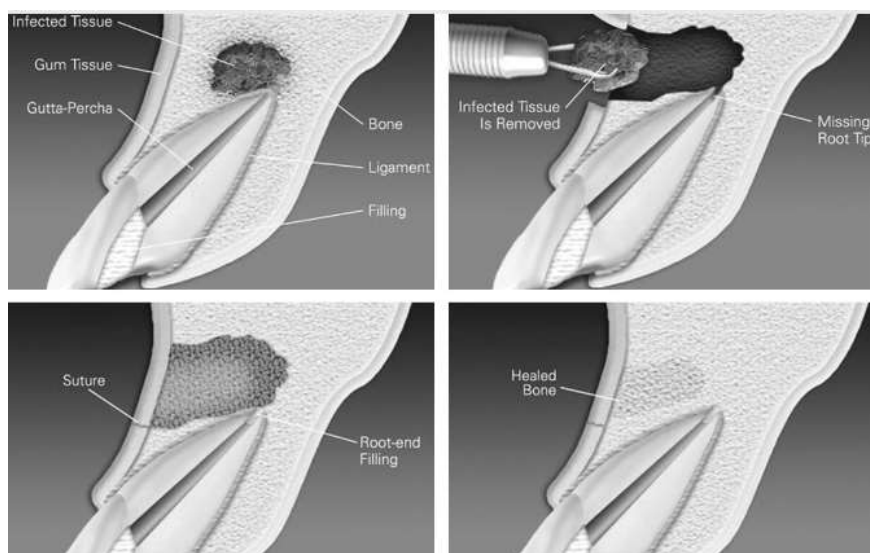


Figure 2: Apicectomy with bone transplant

A fracture or split in the tooth's roots, an anatomical abnormality, or a blocked or inaccessible canal could be the cause. Usually, this technique is suggested following the failure of one or more root canal treatments. This issue typically arises close to the root's apex; hence, the process is frequently successful in treating a persistent infection (Pirani & Camilleri, 2023).

Procedure for apicoectomy

This is not the case because root canal surgery is typically performed under local anesthesia, such as a numbing injection. Feel nothing except pain. Initially, the infection at the tooth's root is made visible by a little incision in the gum. The diseased tissue is removed along with a few millimeters of the root tip. A stain may be used to make any cracks or fractures easier to view, and if the tooth is damaged, it may be desirable to extract it at that time rather than complete the apicoectomy. Next, a microscope and light are used to inspect the tiny tubes. They are cleaned with an ultrasonic device, filled with inert material, and sealed with some fill. To complete the treatment, a small bone graft can be inserted in the afflicted region, and the gum covering the root can be closed with sutures (Fransson & Dawson, 2023).

X-rays may also be taken as the end of the process approaches. You will then be given post-operative care instructions and will return home. Most apicectomies last roughly 30-90 minutes. After the operation, you may suffer swelling and soreness in the treated area. Over-the-counter nonsteroidal anti-inflammatory medicines (such as ibuprofen) are often all needed to control potential discomfort. You'll likely return to your typical activities the next day, although we recommend avoiding eating hard or crunchy foods and brushing aggressively for a few days. If your sutures are not dissolvable, you will be asked to return to the office in about a week to have them removed. A radicular cyst (Semerjyan & Susanyan) is defined as a connective-epithelial sac, lined with epithelium on the side facing the lumen of the cyst and with connective tissue on the outside, with liquid or semi-liquid contents inside and which are often found encapsulated (Jiang et al., 2021).

Their growth is always slow and expansive, not infiltrative, due to an increase in internal pressure and not due to tissue proliferation. Thus, they are not considered actual tumors or neoplasms, although they can sometimes turn malignant. It is generated by the stimulation of the epithelial remains of Mallassez, originating from the epithelial sheath of Hertwig connected with the propagation of inflammation of a necrotic tooth, where a granuloma is formed as a defensive reaction against an inflammatory stimulus. The inflammatory radicular cyst is the most prevalent odontogenic cyst in the jaw. It is generally located in the anterior section of the upper jaw. However, it can arise in any tooth (Sethapanichsakul et al., 2023).

In most cases, especially in the early stages, according to (McEvoy et al., 2021), they are asymptomatic unless they become infected. In case of infection, local tension or genuine pain arises, and in cases where one of the bone walls vanishes completely, it can become fistulized with purulent secretion. Donado (2014) explains that the emergence of pain and inflammation gives a diagnostic orientation between cysts and tumors. Furthermore, the growth of the cyst occurs in a single direction, while a tumor grows in all directions. As the cyst expands, it displaces adjacent structures and organs as the tumor invades them. The choice of any surgical procedure depends on clinical behavior and radiological assessment. Cystotomy and cystectomy This traditional technique, now extensively used, was proposed by Partsch at the beginning of the last century (Ekdale & Deméré, 2022).

There are numerous approaches to deal with cystic lesions of the jaw; the most prevalent are marsupialization, decompression, and enucleation of the cyst after lowering its size or, if possible, direct cyst's enucleation (cystectomy). The strategy to select depends on the size, type of cyst, and anatomical location. Marsupialization to eradicate cysts is a procedure utilized quite frequently as it is a lesion covering critical anatomical sites such as the inferior alveolar nerve or the maxillary sinus. This entails the opening of the cyst, producing a decompression window, which causes the growth of the cyst to cease and, consequently, its gradual reduction in size and, at the same time, the bone to mend. The above requires the patient's appropriate hygiene of the cyst cavity to prevent infections and generally requires a second procedure to enucleate the cyst reduced in size or rebuild the defect (Sybaite et al., 2020).

Enucleation is the most radical method for cysts, entirely eradicating the lesion in a single procedure and allowing the bone to recover for secondary purposes. The above has an advantage since no inconvenience of postoperative care prolongs the recovery to months (daily washing of the cystic cavity), and the settlement of the problem occurs in a single surgery. The best method will depend on the cyst's size, kind, and anatomical placement. Since the lesion covers significant anatomical areas, including the maxillary sinus and inferior alveolar nerve, marsupialization is routinely performed to remove cysts. This entails opening the cyst to create a decompression window, which stops the cyst's growth and leads to a progressive reduction in size while also allowing the bone to mend (Rathi et al., 2022).

To prevent infections, the patient must maintain proper hygiene in the cyst cavity. Reconstruction of the defect or enucleation of the smaller cyst typically necessitates a second procedure. The most severe treatment for the cyst is enucleation, which removes the lesion entirely in a single process and permits secondary intended healing of the bone. One advantage of the aforementioned is that the problem is solved in a single procedure, and there is no difficulty of postoperative care that can take months to recover from (daily washing of the cystic cavity). But occasionally, the approach to the cystic cavity involves removing a significant amount of bone, necessitating the implantation of membranes or bone grafts to prevent or minimize the bone defect (Bazzani et al., 2023).

Failing to do so runs the risk of creating bone depression, which results in aesthetically pleasing changes to the alveolar process. Similarly, dentistry and oral surgery have contributed to the drive toward minimally invasive medicine by developing novel restorative materials and refining methods for maintaining impaired dental organs. Maxillofacial surgery has advanced by introducing new technologies like piezoelectric instruments, maxillary sinus augmentation procedures, and even the extraction of retained third molars. Conservative surgical techniques like the one (Shimada et al., 2021) described for treating cysts have also been adopted. Ultimately, the goal is to enhance the patient's diagnosis and therapy to facilitate a quicker and more thorough recovery (Umalkar et al., 2022).

Table 1: Benefits and drawbacks of cyst treatment	
Enucleation	
Advantages	Disadvantages
Decreased healing times	Risks associated with nearby tooth devitalization
Resolution in a single operating session	High biological expenses when there are large cysts that involve dental apices
	Iatrogenic jaw fracture risk
Marsupialization	
Advantages	Disadvantages
Reduced risk of fracture or injury Neurovascular	An accessory cavity that is difficult to clean
No loss of vitality of neighboring pieces	Slow resolution of the pathology
Executive simplicity	

Dental cystectomies have very low risks, which can be further minimized with careful planning and an excellent preventative study (which is what we usually do in our clinic because there is no other option). Bone fractures, hemorrhages, soft tissue damage, nerve injury, damaged equipment, or harm to surrounding components are among the possible complications. Analgesic-anti-inflammatory medicines (NSAIDs), local antibiotics, and antiseptics would be the standard post-operative medical care. The overall recovery prognosis for periapical surgery ranges from 82% to 91%. An efficient apical seal is the key to success in a tooth with a sufficient orthograde canal filling. There is a maximum two-year follow-up period following surgery for these patients, with three clinical and radiographic examinations per year. Suggestions for the patient following any oral surgery, standard precautions, and oral hygiene (Cosson, 2020).

Bone Renewal:

According to (Schuez & Alt, 2022), bone loss is a consequence of restorative dental procedures since restoring the patient's desired aesthetics is nearly difficult. As a result, alternative bone regeneration therapies, such as bone grafts, have emerged in modern dentistry. Restitution and integration are the only tissues in the body that can heal and restore themselves following an injury, indicating that the damaged tissue has fully recovered from the pathology. (Al-Khanati et al., 2022) State that the regeneration process takes place right after an injury or pathology. In response to this injury, the organism replaces the damaged tissue with an original tissue that functions and has the same properties as the original tissue, with no discernible differences from the surrounding tissue. Bone defects following a cystectomy are categorized as non-critical or critical (Yeung et al., 2020). The former are those that do not regenerate independently and have large dimensions (3 mm) for which it is appropriate to consider using grafts or osteoinductive materials. The more non-critical ones have small dimensions (2 mm or less) where spontaneous regeneration occurs naturally. For these cases, adequate irrigation is required, as well as stabilization of the clot containing the osteogenic cells and maintenance of the cavity to allow for cell proliferation (Torres et al., 2021).

CONCLUSION:

Three months after the lesion is enucleated, bone tissue regeneration can occur without requiring a bone graft, according to case studies and literature analysis. When dealing with cysts, it is preferable to carry out a periapical procedure to prevent the pathology from returning. When it comes to surgically treating periapical cysts, enucleation of the lesion is always more convenient since it ensures that the entire cystic capsule is removed. Using marsupials is only appropriate in specific situations. The two most crucial elements of a successful bone regeneration treatment are adhering to strict sterility standards throughout the entire process and keeping an eye out for the creation of clots to confirm that new bone is growing in the affected location. The foundation of periodontal and root surgery is the proper care of the treated teeth, occlusal and periodontal tissues, and the proper cleaning and sealing of the root canal system.

The key elements that dictate the effectiveness of these procedures are the appropriate use of periapical surgery and the indications for apical surgery. The use of magnifying glasses, ultrasonic preparation of the retrograde cavity, and sufficient contrast material closure of the cavity are critical success factors. A successful diagnosis will depend on the absence of symptoms, ongoing clinical supervision, and observation of increasing radiographic ossification.

For the past several decades, all branches of surgery have focused on the trend toward less invasive surgical practices. This influences the development of new technology, such as three-dimensional imaging, and the introduction of innovative, conservative surgical methods. All medical and surgical professions aim to preserve patient integrity by decreasing surgical morbidity, lowering surgical and postoperative risk, and expediting recovery times.

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