Review Article

Apicectomy: A Review

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Abstract

Periapical endodontic surgery (apical osteotomy, apicoectomy, apicectomy, and root excision) is used to treat apical periodontitis when orthograde endodontics has been completed. Surgery is an important element of endodontics since it allows us to keep our natural teeth for as long as feasible. Not all periapical lesions are truly endodontic in nature and can be treated non-surgically. The indications for doing the procedure have evolved as new devices and techniques have been developed. Clinicians must be aware of these peculiarities when dealing with patients who have a diverse medical history or anatomical variances. They should be prepared to deal with discomfort and problems during and after surgery. Furthermore, the use of microsurgical techniques in apical surgery, such as mild incision and flap elevation, the creation of a tiny osteotomy, and the use of sonic- or ultrasonic-driven microtips, results in less trauma to the patient and faster postsurgical healing. A critical step in apical surgery is identifying potential leaking spots at the cut root face and ensuring proper root-end filling. Only periapical healing with a good long-term prognosis is possible with a tight and persistent apical obturation. The current indications, procedures, and outcomes of apical surgery are discussed in this paper.

Keywords: Apical osteotomy, Orthodontic, Periapical lesions, Retrograde, Treatment.

Introduction

Although the terms "apicoectomy," "apicoectomy," "apicectomy," and "root resection" are still used in the literature, they only represent a small portion of all manipulations that are carried out. Although Partsch C (1896–1899) is credited with providing the methodological description of "root-end-resection" or "Wurzelspitzenresektion"[1] and defining apicectomy as "a bold act, which removes the entire cause of disease and which will lead to a permanent cure which may not be the best in the end, the most humane," the term was first used by Farrar JN in 1880.[2]

When a tooth has a periapical or periradicular lesion that cannot be treated with an orthograde endodontic procedure, the procedure is referred to as apical surgery. When traditional endodontic retreatment is not an option or poses therapeutic risks, apical surgery is frequently used as a last effort to save a tooth.[3] When a tooth has a large periapical lesion that cannot be repaired with traditional endodontic retreatment, this is the standard endodontic surgical approach. Root-resection, also called apicoectomy, or the amputation of the root's apex, was first used in the early 1980s to treat dente-alveolar abscesses.

Apicectomy, also known as root resection or root amputation, is the removal of the apices of pulpless teeth in which satisfactory root or pulp canal therapy has been performed. This operation is performed to remove known or unknown infection, granulation tissue, or cystic areas that involve these teeth; yet retaining the majority of the roots *in situ*.[4] According to Black, the root-resection technique, that is, amputation of the root apex, has originated as a treatment for "pyorrhea alveolaris" complicated by a dental abscess in the late 19th century as a valid alternative to a dental extraction.

Three crucial procedures are involved in periradicular surgery to eradicate endodontic infections that linger: (1) Root-end excision (apicoectomy) through surgical means, (2) retrograde root canal obturation (root-end filling), and (3) surgical debridement of diseased periradicular tissue.[5]

Cause

Apical periodontitis, which may be asymptomatic or chronic, has six main causes, according to research: Chronic intraradicular infection, actinomycosis-related

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intraradicular infection,[2] foreign body reaction brought on by a root-obturating substance, endogenous cholesterol crystal accumulation,[3] genuine cystic lesions, and tissue produced after therapy (scar).[4] Kim and Kratchman claim that cholesterol crystals are a major factor in the enlargement, durability, and ineffectiveness of treatment of lesions.[3]

Apical surgery is performed to surgically preserve a tooth that has an endodontic lesion that is not treatable with traditional endodontic therapy. Root-end resection, root-end cavity preparation, and a bacterial-tight closure of the root-canal system at the cut root end with a retrograde filling should all be used to accomplish this goal.

Indications

Indications for apical surgery have been updated in the past by the ESE (European Society of Endodontology, 2006) and it includes the following:

1. Radiological findings of apical periodontitis and/or symptoms associated with an obstructed canal (the obstruction proved not to be removable, displacement did not seem feasible or the risk of damage was high).
2. Extruded material with clinical or radiological findings of apical periodontitis and/or symptoms continuing over a prolonged period.
3. Persisting or emerging disease following root-canal treatment when root canal re-treatment is inappropriate.
4. Perforation of the root or the floor of the pulp chamber and where it is impossible to treat from within the pulp cavity.[7]

According to Weine, indications for tooth resection are as follows: [8]

1. Severe vertical bone loss involving only one root of multi-rooted teeth
2. Through and through furcation involvement
3. Unfavorable proximity of roots of adjacent teeth
4. Preventing adequate hygiene maintenance in proximal areas
5. Severe root exposure due to dehiscence.

Contraindications

1. Tooth has no function (no antagonist, no strategic importance serving as a pillar for a fixed prosthesis)
2. Tooth cannot be restored, the tooth has inadequate periodontal support, or the tooth has a vertical root fracture
3. Uncooperative patient or a patient with a compromised medical history for an oral surgical intervention.

Flap Design

A few of the flaps used in apical surgery include the papilla-based incision flap, the submarginal mucoperiosteal flap (Luebke-Oschenbein), and the full buccal/palatal mucoperiosteal flap. In endodontic surgery, the semilunar flap is no longer advised due to the unpredictable nature of the periapical lesion's size and the technique's significant scarring.[9]

Location for Osteotomy

The apex may be easily located in certain situations where the cortical bone is thin or where the lesion has penetrated the buccal plate. If this is not the case, though, a measurement of the tooth's length and axis must be taken before any bone removal can begin. A curette can be used to remove a thin plate of cortical bone, but a round bur in a slow-speed miniature handpiece is needed in sites where a substantial amount of bone is present.[10]

Osteotomy size should be maintained as large as required to complete the surgical procedure, but no larger than that which is practical. An osteotomy of 4–5 mm is sufficient to perform the necessary instrumentation when using microinstruments. It is recommended to use a round bur in a straight, slow hand piece with water irrigation to gain access to the apical area. A high-speed dental surgical 45° hand piece should be used instead of high-speed handpieces to prevent the development of surgical emphysema. The healing process would speed up with a smaller osteotomy window. For example, a lesion smaller than 5 mm would typically heal in 6.4 months, a lesion between 6 and 10 mm would require 7.25 months, and a lesion larger than 10 mm would require 11 months.

Consequently, the osteotomy should be as small as feasible while still being as large as required to achieve the intended clinical outcome. Curettage is used to remove the soft tissue that is present in the periradicular area. It is necessary to submit the tissue taken from the periapical region for histopathological examination.[11]

Root End Resection

To remove the apical delta and make room for the retrograde filling material to be placed, root-end resection is performed. Three millimeters of apical tissue should be excised. This raises the possibility of removing the lateral canals and apical ramifications. For improved access, apical resection should be performed with a fissure bur at 90° or a bevel of no more than 10°.

Root-end Preparation

The goal is to be sufficiently cantered, incorporate all of the fins, and maintain anatomical isthmus to maintain an appropriate wall thickness. The development of sonic or ultrasonic driven microtips (retrotips) was a significant advancement in apical surgery and has significantly simplified the technique of root-end cavity preparation. Previously, the method involved using a small round bur or an inverted cone bur in an angled micro-hand piece, which had limitations regarding the direction and depth of the retrocavity.

Root-end preparation now frequently uses ultrasonic tips. In contemporary practice, micro-hand pieces are not the preferred option. Nevertheless, access is very challenging, and this

technique increases the risk of lingual wall perforation in the root-end cavity. All irritants and leftover root-fill material must be removed. To hold the filling material in place, the cavity needs to be 3 mm deep and its walls need to be parallel. When using ultrasonic tips instead of burs in a micro-hand piece, less bone must be removed to obtain access for root-end preparation. This makes it easier to follow the canal's long axis during preparation, and it also makes debridement of isthmuses easier.

To lessen the chance of root cracking, the tips should be used gently and at low power. Water or sterile saline should be used as a coolant during root-end preparation. To keep the surgical site dry and improve visibility, hemostasis is required during the process.[4] It is accomplished by applying pressure (bone wax, gauze packs, etc.) or by first using the vasoconstrictor in the local anesthetic and then using small non-cotton fiber gauze strips soaked in a 1:1000 adrenaline solution. Additional coagulants such as gelfoam and ferric sulfate are also available.[12]

Retrograde Filling

The root-end cavity should be checked for debris, including previous root filling materials. The root-end preparation should be kept separate from bodily fluids such as blood. The bony crypt should be filled with a suitable hemostatic agent, and the root end cavity should be dried. To ensure a dense fill, the root-end filling material should be compacted into the cavity with a small plugger. On the resected root face, there should be no excess material. The goal of retrograde filling is to choose a biocompatible material that can form a hermetic seal, preventing residual irritants and oral contaminants from exiting the root canal system, and entering the periradicular tissues.

Many different materials have been developed in the past for root-end filling purposes. Apical surgery eventually made use of almost every material that was introduced in operative and restorative dentistry as a temporary (Super-EBA, IRM, Cavit, etc.) or permanent (gold, amalgam, resin composite, glass ionomer cement, compomer, etc.) restoration material.[6]

Until the 1990s, amalgam was the preferred root-end filling material; however, it is no longer advised. According to the Royal College of Surgeons of England's guidelines, amalgam is not advised for this use. However, as far as root-end filler goes, mineral trioxide aggregate (MTA) seems to have taken the place of gold. Many of the qualities that make MTA the perfect filler material for the root end have been proposed. MTA is a powder made up of silicate oxide, tricalcium oxide, tricalcium aluminate, and fine hydrophilic particles. Small amounts of additional mineral oxides are also present, which alter the material's chemical and physical characteristics. The aggregate has been made radio-opaque by the addition of bismuth oxide powder.

MTA has been shown in numerous clinical comparative studies to have greater success rates than any other material; however, these differences were not found to be statistically significant. 23 (MTA) have demonstrated superior biocompatibility and sealability compared to amalgam. 24-Research has demonstrated that MTA promotes periradicular tissue regeneration as opposed to repair. Eighteen studies conducted *in vivo* have demonstrated its ability to stimulate the formation of bone, periodontal ligament, and cementum as a root-end filling material. Because MTA produces a high pH environment and releases hydroxyl ions, it may also have bactericidal effects. MTA's capacity to set in the presence of moisture is another benefit. A pH 12.5 gel is created by combining the powder with water in a 3:1 ratio; the gel solidifies in three to four hours. According to Torabinejad and Chivian, the MTA is applied with a carrier and condensed endosonically. To remove the excess MTA from the root tip, use a dampened cotton pellet.[13]

Biodentine (Septodont), a biocompatible material with a tricalcium silicate core that has better handling qualities and comparable biocompatibility to MTA, is another intriguing biocompatible root-end material. Further, extended-duration research is required to definitively establish the attributes of this substance. Biodentine's decreased radio-opacity, which makes it challenging to evaluate on a post-operative radiograph, is one of its potential disadvantages.

Following retrograde filling, a post-operative radiograph should be obtained to evaluate the apical restoration at the surgical site before the wound is closed. This radiograph will serve as a guide for evaluating the healing process in the future.[14]

Wound Closure

Before wound suturing, the surgical field is carefully examined and rinsed. The resulting elevated flap is accurately and precisely approximated using single interrupted sutures, ideally with fine suture material (5-0, 6-0, 7-0). It is advised to apply mild gauze compression to bring the periosteal tissue into contact with the bone. Resorbable and non-resorbable are the two categories into which suture materials can be separated. Resorbable materials have the potential to irritate tissue until they are eliminated or metabolized.

To prevent the formation of epithelial tracts along the suture line, non-resorbable materials are advised when suturing gingival wounds because they cause less inflammation and stop after the sutures are removed – as long as they are removed within a few days. After surgery, sutures are typically taken out 3 to 5 days later. Antibiotic prescriptions have not been shown to be beneficial for speedy post-operative healing.[15]

Effect of Laser in Apicoectomy

Gouw-Soares *et al*. demonstrated that the Nd: YAG laser may lead to dentinal tubule sealing and bacterial reduction in an effort to raise the success rate of endodontic surgical procedures. There was no pain, minimal surgical site contamination, and no smear layer after using the Er: YAG laser. However, the Ga-Al-As laser

results in better healing.[16] In apical surgery, Friedman *et al*.[17] investigated CO_2 laser and various retrofilling materials. The best results were achieved when amalgam or varnish was used to retrofill roots; composite resin produced the worst results, by a large margin. The outcomes of apical surgery were unaffected by the use of a CO_2 laser. In an *in vitro* study, Bodrumlu *et al*. showed that Er: YAG laser for apicoectomy in different pulse durations can be used with an acceptable safety for apical resection in the presence of sufficient water.[18]

Treatment Outcome

It is important to evaluate the apical surgery treatment outcome both clinically and radiographically. There is no clinical benefit to reporting apicoectomized tooth survival rates without doing routine radiographic re-examinations. Today, the only accepted method for determining the success of apical surgery is the combination of clinical and radiographic healing criteria. Practically speaking, healing is assessed a year after surgery, though minor periapical defects (<5 mm) may heal in a few months.[19]

The absence of symptoms such as pain, sinus tract, swelling, apico-marginal communication, and tenderness to palpation or percussion is the basis for clinical healing. Complete healing, incomplete healing (also known as "scar tissue formation"), uncertain healing (partially resolved postsurgical radiolucency), and unsatisfactory healing (no change or increased postsurgical radiolucency) are the standard radiographic healing classes. This categorization is founded on seminal investigations that compared radiographic observations with the histologic results of the periapical tissues of teeth that required extraction following apical surgery.[20]

Conclusion

1. In cases where traditional root canal therapy is ineffective, apicoectomy is a quick surgical procedure.
2. For the treatment of young permanent and permanent teeth trauma, this periradicular surgery constitutes an essential component of pediatric endodontics.
3. From its origins to its current advancements, this review provides a comprehensive understanding of the apicoectomy process.
4. Nowadays, apical surgery is thought to be a reliable course of treatment for teeth with apical pathology that traditional, non-surgical endodontics is unable to treat. Using a surgical microscope or other magnification and illumination, along with applying microsurgical principles, are essential prerequisites for successful results following apical surgery.

References

1. Gutman JL. Surgical endodontics: Past, present, and future. Endod Top 2014;30:29-43.
2. Locurcio LL, Leeson R. A case of periradicular surgery: Apicoectomy and obturation of the apex, a bold act. Stomatol Dis Sci 2017;1:76-80.
3. Kim S, Kratchman S. Modern endodontic surgery concepts and practice: A review. J Endod 2006;32:601-23.
4. Seldin SD. Apicoectomy. Am J Orthod Oral Surg 1947;33:B301-8.
5. Von Arx T, Walker WA 3rd. Microsurgical instruments for root-end cavity preparation following apicoectomy: A literature review. Endod Dent Traumatol 2000;16:47-62.
6. Von Arx T. Apical surgery: A review of current techniques and outcome. Saudi Dent J 2011;23:9-15.
7. European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European society of endodontology. Int Endod J 2006;39:921-30.
8. Weine FS. Endodontic Therapy. 6th ed. United States: Mosby Inc; 2004. p. 423-51.
9. Von Arx T, Salvi GE. Incision techniques and flap designs for apical surgery in the anterior maxilla. Eur J Esthet Dent 2008;3:110-26.
10. Fahey T, O'Connor N, Walker T, Chin-Shong D. Surgical endodontics: A review of current best practice. Oral Surg 2011;4:97-104.
11. Soujanya E, Swathi A, Ananad S, Raju A. Endodontic microsurgery: An overview. Dent Med Res 2015;3:31-7.
12. Gilheany PA, Figdor D, Tyas MJ. Apical dentin permeability and microleakage associated with root end resection and retrograde filling. J Endod 1994;20:22-6.
13. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate. J Endod 1999;25:197-205.
14. Pop I. Oral surgery: Part 2. Endodontic surgery. Br Dent J 2013;215:279-86.
15. Lindeboom JA, Frnken JW, Valkenburg P, Van den Akker HP. The role of preoperative prophylactic antibiotic administration in periapical endodontic surgery: A randomized, prospective double-blind placebo-controlled study. Int Endod J 2005;38:877-81.
16. Gouw-Soares S, Stabholz A, Lage-Marques JL, Zezell DM, Groth EB, Eduardo CP. Comparative study of dentine permeability after apicectomy and surface treatment with 9.6 microm TEA CO_2 and Er: YAG laser irradiation. J Clin Laser Med Surg 2004;22:129-39.
17. Friedman S, Rotstein I, Mahamid A. *In vivo* efficacy of various retrofills and of CO_2 laser in apical surgery. Endod Dent Traumatol 1991;7:19-25.
18. Bodrumlu E, Keskiner I, Sumer M, Sumer AP, Telcıoglu NT. Temperature variation during apicectomy with Er: YAG laser. Photomed Laser Surg 2012;30:425-8.
19. Rubinstein RA, Kim S. Short-term observation of the results of endodontic surgery with the use of a surgical operation microscope and Super-EBA as root-end filling material. J Endodont 1999;25:43-48.
20. Rud J, Andreasen JO, Jensen JE. Radiographic criteria for the assessment of healing after endodontic surgery. Int J Oral Surg 1972;1:195-214.