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Research Article

PERIRADICULAR SURGERIES (APICECTOMY)

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Abstract

Background: Periradicular surgeries have been in practice as long as the mid-1800's. During the last 20 years, periradicular surgeries have evolved and is now used with the non-surgical root canal therapy. With the development of modern instruments and new materials, there is better understanding of the anatomy of the root canal and the root apex along with the process of healing of the wound, thus making root end surgeries more feasible.

Aim of Work: The aim of this study was to give an insight into the various aspects of periradicular surgeries.

Materials and methods: This review is comprehensive search of PUBMED, MEDLINE, and EMBASE from year 1993 to 2018. The following search items were used: periradicular surgery, apicectomy, flaps in endodontics, root end cavity preparation, root end filling materials, surgical outcomes of apicectomy.

Conclusion: According to the literature reviewed for this article, periradicular surgeries when planned properly with modern techniques like the use of microscopes and ultrasonics, yield a high rate of success. The outcome of periradicular surgery depends on the entire protocol of treatment including the flap design, the root end preparation and the root end filling material. When all the aspects of the surgery are taken into account, a successful outcome can be achieved which will help retain teeth with persistent pathosis which would otherwise had been extracted.

Keywords: Periradicular Surgery, Apicectomy, Root End Cavity Preparation, Root End Filling Materials, Management Of Patients Post Surgery, Post Surgical Outcomes.

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INTRODUCTION:

Periradicular surgeries have been in practice as long as the mid-1800's. During the last 20 years, periradicular surgeries have evolved and is now used with the non-surgical root canal therapy.[1] Even though nonsurgical treatment has been reported to show a good success rate in most of the cases, teeth which have a persistent periapical pathosis do not respond well to it and are a true indication for periradicular surgery.[1] With the development of modern instruments and new materials, there is better understanding of the anatomy of the root canal and the root apex along with the process of healing of the wound, thus making root end surgeries more feasible. A typical endodontists practices 3-10% surgeries on an average, out of which root canal surgeries are done 78% by endodontists, 15.5% by general dentists and 6.6% by other speciality dentists.[2-4] An increasing rate for periradicular surgeries has been seen in the last two decades.[5] The purpose of this review is to give an insight into the various aspects of periradicular surgeries.

METHODOLOGY:

Data Sources and Search terms

This review is comprehensive search of PUBMED, MEDLINE, and EMBASE from year 1993 to 2018. The following search items were used: periradicular surgery, apicectomy, flaps in endodontics, root end cavity preparation, root end filling materials, surgical outcomes of apicectomy.

Data Extraction

Two reviewers have independently reviewed the studies, abstracted data, and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

The study was approved by the ethical board of King Abdulaziz University Hospital.

Indications of Periradicular surgeries.

The most important indication of periradicular surgery is a periapical pathology which is persistent in nature and is not responding to non-surgical endodontic treatment. The indications of periradicular surgeries are as follows: [6]

1. Periapical pathology associated with a developmental or iatrogenic defect makes non-surgical endodontic treatment not feasible.
2. In teeth which are root canal treated but have not responded well to the treatment and the lesion is still present and re RCT cannot be done due to the presence of posts or a full coverage restoration which may harm the core underneath it, during removal. Such cases pose a high risk of

root fracture.

3. Case which require biopsy tissue from the periradicular area.
4. In cases of iatrogenic error like perforation or fracture of the root where it becomes necessary to visualise the periradicular area.
5. When the patient is not ready to comply with a prolonged treatment with non-surgical endodontics. [6]

Contraindications of periradicular surgery:

There are not a lot of contraindications to periradicular surgeries but following are points which tend to complicate the periradicular surgeries and should be kept in mind;

1. If the patient or the patients' health does not cooperate in the surgery because of a systemic or psychological disorder.
2. The various factors of the tooth that complicate periradicular surgery and are contraindicated are;
 - a. Unfavourable anatomy of the root and the bone.
 - b. Visibility for periradicular surgery is less.
 - c. Proximity to the nerves and vessels present in that area.
 - d. Severe loss of bone and supporting tissue.
3. Patients with poor oral hygiene.
4. Unskilled operator who does not have a good training or facilities for the surgery. [7]

Diagnosis of a periradicular lesion for surgery

Before commencing any periradicular surgery, a radiograph is a must to see the extent and size of the periapical lesion and its relationship to the neighbouring structures. A periapical radiograph is a 2D representation of the 3D structures that are present and hence does not give a clear picture of the lesion and the surrounding area due to overlapping and superimposition of the anatomic structures surrounding the lesion.[8] The CBCT scanners take images of multiple slices simultaneously, this leads to a reduced time and radiation exposure for the patients. [9] Patel *et al.* [10] mentioned the diagnostic importance of cone beam computed tomography (CBCT) in periradicular surgeries and said that periapical lesions with their true extent and size are detected early using CBCT and the it may also be useful in assessing the quality and quantity of alveolar bone surrounding the lesion thus simplifying periradicular surgeries. [10]

Flap designs and Soft Tissue Management in Periradicular surgery:

The flaps that are generally used in periradicular surgery are: muco-gingival flap, sulcular full

thickness flap with vertical releasing incisions. [11] Both these flap design provide a base as wide as the top which improves the flow of blood in the flap and the vertical releasing incision should be placed in line with blood vessels which are aligned vertically which helps in a scar free healing of the tissue after the surgery. After the flap has been raised, its retracted and care should be taken to rest the flap retractor on sound bone structure so as to provide better hold to the flap. [11]

Preoperative management of the patient for periradicular surgery.

Table 1: Different local anaesthesia available classified according to mechanism of action. [15]

Mechanical agents	Bone wax
Chemical agents	Vasoconstrictors (epinephrine) Ferric sulphate
Biological agents	Thrombin
Resorbable agents	Calcium sulfate Gelfoam Absorbable collagen Microfibrillar collagen Surgicel

MAGNIFICATION:

Magnification is an important aspect during periradicular surgery. The use of a microscope helps in increasing the visualisation which leads to a better control of the area of the surgery. [16] In a recent article by Setzer *et al.*, he concluded that the use of microscope has a positive influence on the outcome of the endodontic surgery. [17]

Management of the hard tissue during periradicular surgeries.

Osteotomy

The size of the osteotomy plays an important role in the healing of the lesion. in a study conducted by Boyne *et al.* [18] he stated that the smaller size of the periapical defect lead to complete healing of the lesion. The larger size of the lesion also showed healing but with fibrous tissue s compared to complete regeneration of bone in the smaller lesions. [19] another study showed that the smaller the size of the osteotomy was kept the healing ogf the leion was faster. They stated that if lesion was smaller than 5mm would take approximately six months to heal and when the size was 6-10mm in size of the lesion, it took 7 months o heal. Lesions larger than 10mm took almost a year to heal completely. [20] The heat generated during the osteotomy should also be kept

Chlorhexidine can be used by the patients pre-operatively, which helps in reducing the bacterial load of the mouth. [12] NSAID can be administered to the patient before commencing the treatment to reduce the pain following surgery. [13] Local anaesthesia should be the choice of anaesthesia administration. The local anaesthesia administered should contain epinephrine, as it causes immediate vasoconstriction which helps in haemostasis and pain control and also has minimal chance to get absorbed systemically making it safer for the patients.[14] According to the various mechanism of action the different local anaesthesia is classified into different groups. [15]

into account as any excess heat might char the tissues and affect the healing negatively. [21] A light shaving motion with bur is advices to gently remove the bone and generate less heat. For the lower molar teeth, the removal of bone is done using the bony lid technique. [21]



Figure 1: Size of the osteotomy lesion should be kept as 5m or less than 5mm. [5]

PERIRADICULAR CURETTAGE:

Once the osteotomy is done, the next step is to remove all the soft tissues and inflamed tissues

present in the surgical area by the process of curettage. This helps in a better visual access of the sight and removal of inflamed area which might be a cause of reinfection later. [7] if the entire inflamed tissues have been removed with granulation tissue, then the remaining periapical soft tissue can be left behind specially in cases where there is close proximity to anatomical structures. [22] As soon as the inflamed tissue is removed, any tissue with suspicious origin should be sent for histological examination. [23]

Resection of the root end

Resection angle

The angle of root resection has been a controversial topic, earlier it was said that a bevel of 45 degrees should be given while resection. [24] Recent literature suggests that the angle of resection should be perpendicular to the root surface that is 90 degrees. It has been seen that the increased degree of angulation given for the root end causes more dentinal tubules to get exposed and irritants from within the canal may hamper healing of the lesion. [25] The stress force that is seen in the apical region also gets evenly distributed and decreases the chances of fracture of the root when the resection angle is 90 degrees. [26]

Extent of the resection

In an anatomical study done previously, the apical 3mm of the root should be removed. [24] In a study conducted by Mauger *et al.* [27], he revealed that the maximum number of lateral canals and canal ramifications are seen in the apical 3mm of the root and it should be removed in order to prevent any reoccurrence of the lesion due to presence of pathogens in the canals. [24] The resection of 3mm of the root also leaves behind almost 7 mm of intact root behind thus maintaining the crown root ratio. [5]

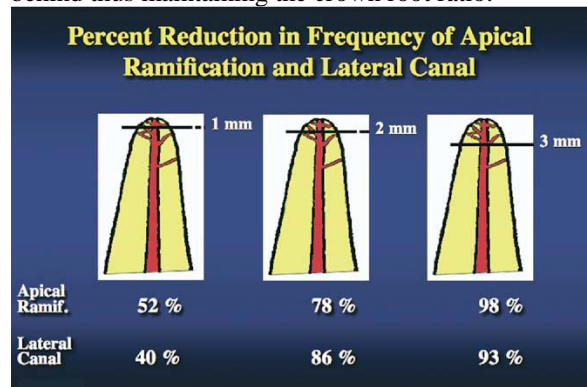


Figure 2: maximum ramifications and lateral canals seen in the apical 3mm of the canal. [24]

Root end cavity preparation

The preparation of the root end cavity is very crucial for the success of the outcome of the surgery. The cavity formed should be able to incorporate the filling material and also avoid any damage to the root surface. The ideal cavity preparation for the root end is a class I cavity with the minimum depth of 3mm and the walls should be parallel to the long axis of the root. [28]

The recent literature advocates the use of ultrasonics over the traditional handpiece and bur for root end cavity preparation. [29-31] The ultrasonic tips reduce the amount of bone that is removed to reach the root end and a more conservative cavity can be formed at the root end which remains in the centre of the root canal and also parallel to the long axis of the root. Ultrasonics also reduce the risk of perforation of the root because of the increased manipulation and tactile control. Ultrasonics help in reducing the bevel required at the root end and form a smooth consistent deep cavity and the amount of smear layer that is formed is also less compared to the traditional technique. [29,31-33]

Root end filling material

The root end cavity should be filled with an appropriate root end filling material. The main aim of the root end filling material is to provide a hermetic seal and seal the contents of the canal within the canal preventing any outflow of bacteria or the bacterial by products into the periapical area hampering the healing of the tissue. The requisite of any root end filling material is that it should be biocompatible, should not be resorbed and should be dimensionally stable over time. [34] Various root end filling material have been developed over time as mentioned below.

Table 2: Various Root end filling materials [34]

Amalgam	
Zinc oxide eugenol based material	Intermediate restorative material (DENTSPLY/Caulk, Milford, DE) Super EBA (Bosworth Company, Skokie, IL)
Glass Ionomer Cements	
Resin based materials	Diaket (ESPE GmbH, Seefeld, Germany) Retroplast Resin Ionomer Suspension- Geristore Compomer- (Dyract)
Mineral Trioxide Aggregate	
Biodentine	

Amalgam has been used traditionally as a root end filling material and is even used in present times. The past decade has seen the development of zinc oxide eugenol based materials like IRM and Super EBA which have proven to be better than amalgam when the biocompatibility and sealing property of the materials is taken into account. [35-38]

Mineral Trioxide aggregate was developed in the late 1990 by Torabinajed and has proved to be very effective as a root end filling material. [39] Various studies have been carried out to check the sealing and biocompatibility of MTA as compared to the previously developed root end filling materials. [40-42] MTA provided equivalent or better sealing properties as compared to zinc oxide and resin based root end filling materials. [41,42] The sealing properties of MTA is not affected by the presence of moisture and hence it proves to more potent as a root end filling material as the area is flooded by blood during the surgery. [43] In a study conducted by Torabinajad *et al.* [44] where they compared the physical properties like setting time, solubility, radiopaque properties and compressive strength of MTA with IRM, Super EBA and amalgam found that MTA was more radiopaque than IRM and Super EBA and less than amalgam and had the longest setting time and high compressive strength. When biocompatibility of MTA was compared to other materials it proved to be the least cytotoxic. [45] The main advantage of MTA over other root end filling materials is the formation of hard tissue. This property of MTA is attributed to the tricalcium oxide present in MTA which when comes in contact with the tissue fluid forms calcium hydroxide leading to formation of hard tissue. [46]

Wound closure and suture placement

Once the root end filling material has been placed, the surgical site is visualised and examined for any foreign body materials. Irrigation is done at the surgical site to remove any remaining haemostatic agents or filling material that must be remaining. The flaps are repositioned, and before closure of the flap, one X-ray is taken to confirm that all foreign bodies are removed, and the root end filling material has been placed properly. [7] Following this, sutures are placed at the surgical site considering the flap design that has been chosen. A single interrupted and sling suture tied using a surgeon's knot is generally used in periradicular surgeries. Cases where submarginal flap design is chosen are sutured using the continuous locking suture. [47] Once the suture is placed, a cold moist gauze piece is placed over the suture site for 5 minutes which helps in stabilizing the initial clot and helps in haemostasis. [7] Sutures should be removed within 48-96 hours in order to avoid any wicking effect which is generally seen in multi filamentous sutures and hence the choice of suture is synthetic monofilament sutures. [47,48]

Post-operative Considerations:

The various post-operative factors that must be kept in mind are:

Post-operative pain

NSAIDs should be administered to the patient post-surgery to avoid any pain. A local anaesthesia which is long lasting in nature also helps in reducing the post-operative pain. [50,51]

Post-operative swelling

Patient should be advised a chlorhexidine mouthwash post-operative which reduces the bacterial load, hence preventing swelling. If any swelling occurs post operatively, a cold compression of the site is

helpful. [51]

The patient should be given clear post-operative instructions to be followed and the dentists should be in constant touch telephonically and personally to assess the outcome of the surgery. [7]

Surgical outcome

Radiographs should be taken at particular time intervals to assess the outcome of the surgery. [7] The surgical outcome may be classified into successful, incomplete, uncertain and unsuccessful. The studies conducted to assess the success and failure rates of the periradicular surgery should be done very meticulously, as the outcome for every surgery largely depends on the methodology and the treatment plan. [52] The success rate of periradicular surgery as reviewed by Torabinejad at the end of 2-4 years is 77.8% and at the end of 4-6 year is 71.8%. [53] Zuolo *et al.* stated the success rate of periapical surgery as 91.1% in his cases when followed for one to four years. [54]

CONCLUSION:

According to the literature reviewed for this article, periradicular surgeries when planned properly with modern techniques like the use of microscopes and ultrasonics, yield a high rate of success. The outcome of periradicular surgery depends on the entire protocol of treatment including the flap design, the root end preparation and the root end filling material. When all the aspects of the surgery are taken into account, a successful outcome can be achieved which will help retain teeth with persistent pathosis which would otherwise had been extracted.

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