MICROSURGERY : PRECISION IN ACTION

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Introduction: Microsurgery is a minimally invasive method that promotes faster healing and improved patient response. Close inspection is a critical aspect of microsurgery, which is rapidly replacing earlier surgical techniques by adhering to a rigid microsurgical procedure and carefully selecting patients. Almost all endodontic lesions can be successfully treated.

Procedures for Endodontic microsurgery:-

1. Flap Design
2. Osteotomy
3. Root Resection
4. Root end resection : Long bevel vs Short bevel
5. Management of isthmus
6. Root end preparation
7. Root end filling

Flap Design

In previous surgical operations, especially in the maxillary area, the semilunar incision was the most popular design. Due to inadequate access to the surgical area and its association with persistent inflammation and scar formation during recovery, this incision is no longer appropriate.(1) Modern management employs a triangular flap with a single vertical incision, the Luebke-Ochsenbein submarginal flap, and the papilla base incision to preserve the papillae. The latter is the most popular aesthetic flap design, especially in the maxillary anterior region. It is carried out within the attached gingiva zone and causes no postoperative recession of the gum margin or interdental papilla.(2) As a result, crown margin exposure and the creation of a black triangle in anterior teeth, as well as food impaction in posterior teeth, are avoided. In microsurgery, vertical incision should be 1.5 to 2 times longer than traditional teeth, so the flap is away from the light path of microscope and the visibility is not obscured.(3)

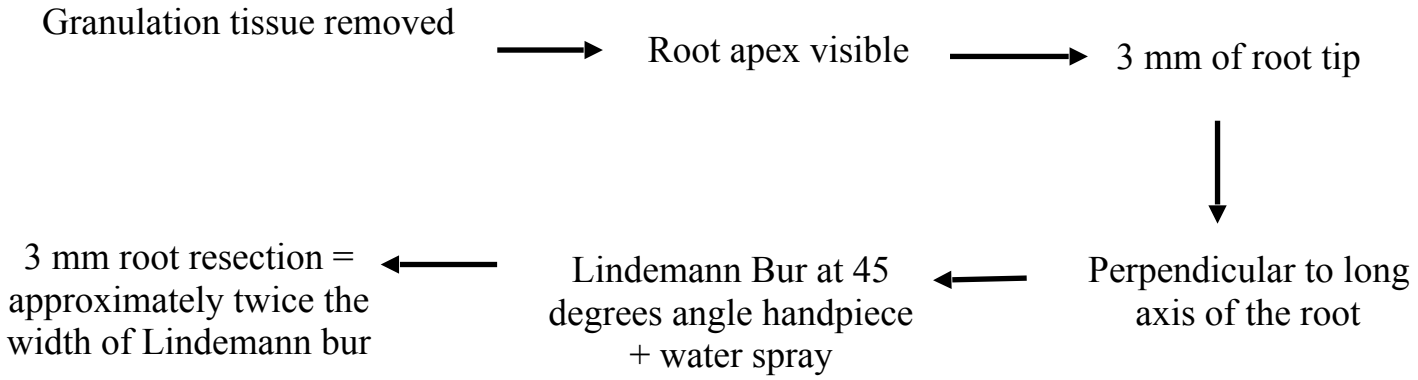
Osteotomy

It is more conservative due to enhanced magnification and illumination.
Diameter should be 3 to 4 mm, just enough to allow 3 mm ultrasonic tip to vibrate freely into the cavity. To prepare small size osteotomy, the exact position of root apex has to be identified.(4)

Guidelines: [5]

- Cortical plate can be perforated and perforation can be identified micro explorer under dental operating microscope. Micro explorer can penetrate through the thin layer of cortical bone underneath the lesion.
- Sound cortical bone measurement of tooth length by CBCT or digital radiograph can give precise estimation of root apex portion.
- If there is a presence of periodontal lesion between both the root, osteotomy from the centre of the lesion safely leads to both medial and distal apex.
- If it doesn't bevel root apex at 2 to 3 mm depth, the placement of radiographic material cortical bone, for eg; Gutta Percha, aluminium foil
- If it doesn't reveal root apex at 2 to 3 mm depth, the placement of radiopaque material on the cortical bone for example, resilon, gutta percha, aluminum foil, and the acquisition of a periapical radiograph is a clinical technique for root apex identification.
- Small size osteotomy directly related to faster healing, less patient discomfort, less post-operative pain.

Root Resection



- After resecting the root end, complete removal of granulation tissue is done.
- Root resection of apical part is indicated in:-

1. Removal of pathologic process.
2. Removal of Endodontic variations like apical delta, accessory canal, severe curve and apical ramifications.
3. Enhanced removal of granulation tissue.

4. Revelation of iatrogenic mishap like ledge, blockage, perforation, separated instrument and strip perforation.
5. Creation and evaluation of apical seal
6. Evaluation of complete or incomplete Vertical root fracture
7. When coronal access is blocked or non surgical re-treatment is not possible, considered time consuming and invasive

A study of root apex revealed that at least 3 mm of root end must be removed to reduce 98% of apical ramification and 93% lateral canals.[4] To verify complete resection of root tip, the root surface has to be stained with methylene blue and inspected under magnification for the presence of PDL. In complete root end resection the PDL appears as uninterrupted circular line.[6]

Root end resection: Long bevel vs Short bevel

The angle of the root end resection was previously advised to be between 45 and 60 degrees from the long axis of the root facing the buccal or facial portion of the root.[7] The steeper the bevel, the more potential for one of the following complication to occur such as damage to or unnecessary removal of buccal supporting bone , incomplete root resection; mainly on roots that extend rather deep lingually, such as mandibular molar, missed anatomy on lingual/ palatal wall, long bevels can be caused by spatial disorientation in relation to the long axis. As a result, there is a greater risk of perforation of the lingual or palatal dentinal wall.[8]

Microsurgery recommends 0 degree bevel perpendicular to long axis of the tooth. High magnification inspection is a critical stage in microsurgery that was lacking in conventional techniques. Magnification range is X14 to X25. [4]

Utilising a micromirror at a 45-degree angle to the resected surface end, the reflected image of the root reveals every anatomical detail. The presence of a gap in the filling is the most prevalent micro finding. Between the root canal filling material and dentinal wall, that area is primarily stained with methylene blue. When a lateral peri-radicular lesion is seen on a radiograph, a complete examination is performed, which includes an inspection of the cut root surface as well as the entire root surface. A vertical root fracture, a perforation, a lateral exit, or an accessory canal may also be discovered. [4]

Management of Isthmus

The isthmus is a small, ribbon-shaped connection between two root canals containing pulp and pulp-derived tissue. It is a component of the canal system, not an independent entity. (9) When performing apical surgery, the clinician should be informed that isthmus is present in premolars and molars in 80-90% of instances at 3 mm from the apex. (10)

Isthmus tissue appears to be 'Achilles Heel' of conventional Endodontic treatment. (11) This is one of the reasons why apical root resection without root end preparation and isthmus filling frequently fails. The first and most crucial step after root end resection is the identification of un-negotiated canals and isthmus. It is crucial to prepare the canal and isthmus entirely to a depth of 3 mm. (12)

Root end preparation

In order to generate a cavity that can be filled, it removes the filling material, irritants, necrotic tissue, and remains from the canals and isthmus. A class I cavity with walls parallel to and inside the anatomic shape of the root canal space, at least 3 mm into the root dentin, is the ideal root end preparation. Using ultrasonic is the pressure during preparation that is feather light touch repeatedly for effective cleaning of canals. A gentle touch improves cutting efficiency, whereas constant pressure like a handpiece reduces it. This is because ultrasonics operates on the vibration, not the pressure, principle. (13)

- Clinical concepts:-

1. The preparation of the root-end begins with the alignment of a selected ultrasonic tip along the root prominence on the buccal plate under low magnification.

2. 4x-8x magnification to ensure long axis preparation.

3. The preparation is carried out under medium magnification (10–12) after the ultrasonic tip has been positioned.

4. Light, sweeping motions are employed when applying ultrasonic tips; quick forward/backward and upward/downward strokes produce efficient cutting action.

5. Strokes that are interrupted are more efficient than ones that are applied continuously to the dentin surface.

- After completing the apical preparation, the gutta percha should be compressed with a micro-condenser, dried, and examined with a micro-mirror.

Root end filling

The final step of the surgery is root-end filling, and it is crucial that there is sufficient hemostasis in the bone crypt and that the root-end cavity is dry. In order to maintain hemostasis and prevent particles of the root-end filling material from falling at the peri-radicular bone or PDL, an epinephrine-impregnated cotton pellet is left at the depth of the osteotomy.

Materials used for root end filling [14]:-

1. Mineral trioxide aggregate (MTA)
2. Amalgam
3. Gold foil
4. Zinc oxide eugenol (ZnO)
5. Glass ionomer cement (GIC)
6. Composite
7. Intermediate restorative material
8. Endosequence repair material
9. Biodentine
10. Bioaggregate
11. Super Ethoxy benzoic acid (EBA)
12. Diaket
13. Root repair putty

MTA is material of choice for root end filling. It was developed in 1990's in Loma Linda University for Endo surgery and now for clinical setting. It demonstrates superior biocompatibility and promotes tissue regeneration when placed in contact with peri-radicular tissues. [14] Root end filling, root repair material and root repair putty are produced as homogenous premixed consistent material. They are dimensionally stable and have high mechanical strength, high pH; radiopacity and hydrophilic. They have similar cytotoxicity as MTA; also similar antibacterial and sealing ability. [15]

Differences between Traditional vs Modern microsurgery [16] :-

	Traditional Surgery	Microsurgery
Suture Removal	7 d postoperative	2–3 d postoperative
Sutures	4 -0 silk	5 - 0, 6 - 0 monofilament
Bevel angle degree	45–65	0–10
Osteotomy size	8–10 mm	3–4 mm
Inspection of resected surface	None	Always
Root-end preparation	Seldom inside canal	Always within canal
Root-end filling material	Amalgam	Mineral trioxide triacetate
Root-end preparation instrument	Bur	Ultrasonic tips
Isthmus identification and treatment	Impossible	Always
Healing success, 1-y follow-up	40%–90%	85%–97%

Microsurgical technique-prognosis/outcome

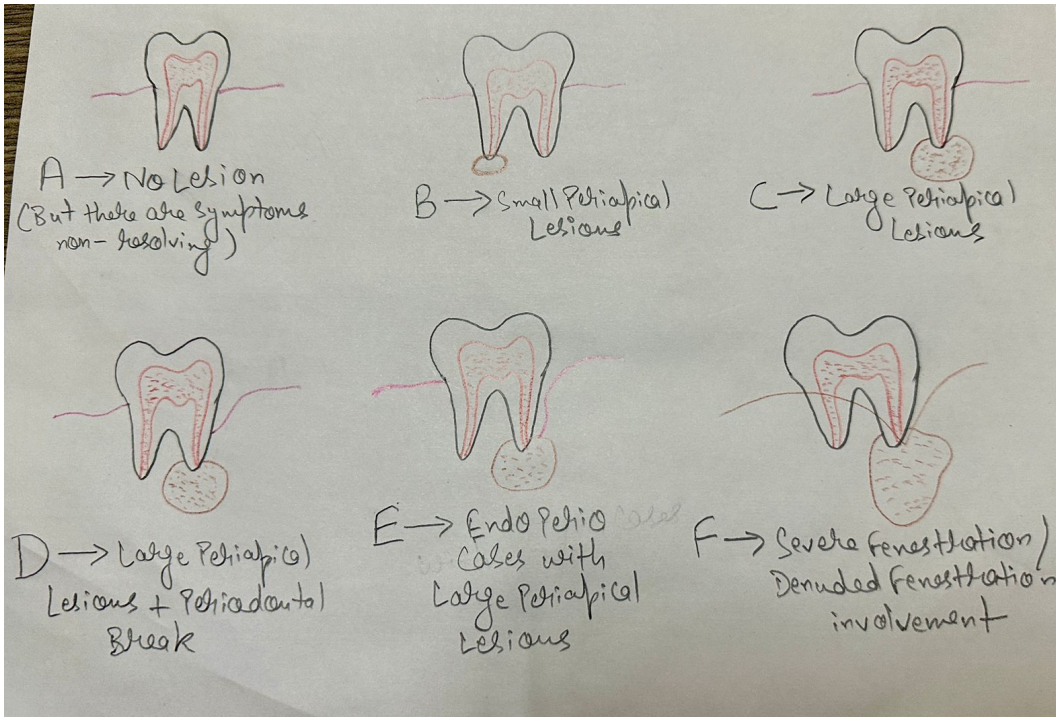
Due to insufficient knowledge it was not practical and reported limited clinical success. [16] Modern microsurgery uses certain technical advances mainly dental operating microscope, ultrasonics, modern microsurgery instruments and biocompatible material has gained increased successful treatment. Also, better illumination, better inspection of surgical site and precise preparation of root end with micro instrument. [17] The clinical success of microsurgery cases are reported as 96.8% and 91.5% at 1 and 7 years respectively. [18]

According to Kim and Kratchman, Classification for proper case selection starts from A to F (Figure 1) :-

I. Classes A to C are primary Endodontic lesions
II. Classes D to F are lesions associated with PDL involvement

Successful outcome in A to C was reported as 95.2% and 77.5% in D to F. (16) Regenerative method such as calcium sulphate and collagen membrane were used in the cases with PDL involvement in pathology. (19)

FIGURE 1: Diagrammatic Representation of Classification For Proper Case Selection Starts From A To F



Conclusion: According to the current evidence, when applicable, microsurgery with regenerative techniques should be provided to the patient as a treatment option and viable solution in the case of scheduled needless extraction and implant installation. MTA remains the preferred material for microsurgery, although emerging bioactive materials like bioceramic appear to be similarly reliable.

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