

## CONCEPTS AND PRACTICE OF MODERN ENDODONTIC SURGERY

Atul Jain<sup>1</sup>, Hema Katheria<sup>2</sup>, Rachana Bahaguna<sup>3</sup>, Mohd. Abbas Ansari<sup>4</sup>, Raj Kumari Victoria<sup>5</sup>, Anjali Sharma<sup>6</sup>

Professor & Head<sup>1</sup>, Post Graduate Student<sup>2</sup>, Professor<sup>3</sup>, Post Graduate Student<sup>4</sup>, Post Graduate Student<sup>5</sup>, Post Graduate Student<sup>6</sup>

1,2-6- Department of Conservative Dentistry & Endodontics, Teerthanker Mahaveer Dental College and Research Centre, Moradabad

3- Department of Pedodontics & Preventive Dentistry, Teerthanker Mahaveer Dental College and Research Centre, Moradabad

### Abstract

Colossal improvements have been seen in the regimen of endodontics in clinical techniques and technology over the gone many years. The space amid biological ideas and capability to attain clinically effective outcomes has reduced by using ultrasonic & microsurgical instruments, dental operating microscope & new retrograde materials. Advantages & disadvantages with modern method for endodontic microsurgery will be discussed and in this article.

### INTRODUCTION

Apical periodontitis can be forestalled by endodontic therapy as it makes an environment where periradicular healing can occur through controlled asepsis or disinfection of the root canal. Despite that, where non-surgical root canal therapy is not feasible or symptoms continues after root canal therapy also, endodontic surgery might be important in rescuing the teeth.<sup>1</sup>

Surgical Endodontics is the part of Dentistry that deals with the diagnosis and treatment of lesions of endodontic source that does not react to traditional endodontic therapy. The 1. motivation behind Surgical Endodontics is to accomplish the 3-D cleaning, shaping and obturation of the apical bit of the root canal system which isn't treatable through an access cavity, but just accessible by means of a surgical flap.<sup>2</sup>

Endodontic microsurgery, including the triad of high magnification, ultrasonic root-end preparation, and biocompatible root end filling materials, was introduced in the 1990s and solidly settled over the previous decade. Endodontic microsurgery is observed as tough as the surgeon frequently estimated the area of anatomical structures like large mental foramen, blood vessels & maxillary sinus. However, harm to these structures is minimal, conventional endodontic microsurgery doesn't have a confident image in the dental career in light of its offensive nature & uncertain outcome. Illumination & magnification given by the microscope and correct utilization of miniature instruments are used so that periapical surgery can be done with exactness & predictability that takes out the suspicions which are inherited with conventional surgical methodologies.<sup>3</sup>

#### **Indications for endodontic surgery-**

1. Rectification of induced faults.

2. Root canal treated teeth where peri-apical pathology has not been resolved.

3. At a point when surgical & non-surgical method both are needed.

4. The necessity of biopsy for exploring apprehensive lesion/where medical examination is needed.

5. Retreatment is impractical/not successful.

#### **Contraindications for endodontic microsurgery-**

1. Tooth which are not restorable, poor periodontal support / insufficient root length.

2. Surgical aspects for example limited opening of mouth.

3. When traumatic occlusion cannot be corrected

4. Acute infection which is nonresponsive to the treatment

5. Patient factors, for example, psychological issues or systemic diseases such as leukemia, uncontrolled diabetes, anemia, thyrotoxicosis, etc.

6. Clinician factors which incorporate the ability, knowledge and availability of suitable apparatus and level of training of operator.<sup>4</sup>

### STAGES OF ENDODONTIC SURGERY

#### PRE-OPERATIVE CONSIDERATIONS

Clinical assessment Prior to endodontic surgical procedure should include;

1. Medical history: general medical condition of the patient, history of MI, angina, hepatitis, infective endocarditis.

2. Dental history: history of trauma, pain, swelling, root canal filling, pus discharge.

3. Clinical examinations:

a. Intraoral: caries, quality of coronal restoration, periodontal status, pocket, mobility, occlusal function of tooth, oral hygiene, tenderness, vitality of affecting teeth and adjacent teeth.

b. Extraoral: by inspection, palpation, auscultation of any swelling or sinus discharge.<sup>5</sup>

4. Radiographical evaluation -A precise fine radiograph is needed prior to starting off surgical endodontics. The radiograph must display all roots, foreign bodies, the whole degree of any related lesion and local anatomical structures, for example, mental foramen, the inferior dental canal, maxillary sinus or incisive canal. Radiographs at two different angles may give additional information.

5. In recent times with the emergence of imaging modalities including digital, densitometry methods, radiography, computed tomography (CT), ultrasound, magnetic resonance imaging (MRI), and cone beam computed tomography (CBCT), variation in density may allow more precise preoperative diagnosis.<sup>6</sup>

6. After two to four hours post-surgery, inflammatory mediators are highest so non-steroidal anti-inflammatory drugs taken pre-operatively over 60-120 minutes of surgery can improve post-operative pain relief. Intake of paracetamol as well as NSAID have proved in providing enhanced control of pain than any single drug used. Due to this reason, the investigators suggest shifting back and forth among ibuprofen and paracetamol four to six hourly 'by the clock' to prevent excessive utilization of any analgesic.<sup>1</sup>

7. Anxiolytics or psycholeptics are drugs causing calming effects, ensuing in sleepiness. These medications might also act in excitability, agitation, depression, anxiety, apprehensiveness neurosis state and psychosis.

8. Pre-operative evaluation foresee & limit healing or technical difficulties. Patient must be informed about the possible dangers, challenges & inconvenience before surgery while taking the consent.

9. To lessen the microbial load in the surgical field, rinsing preoperatively with chlorhexidine gluconate (0.12%) is endorsed because it reduces 85% of bacterial flora in remaining last 4 hrs.

### PERI-OPERATIVE CONSIDERATIONS

#### **ANAESTHESIA**

To do endodontic surgery, significant sedation and desirable haemostasis are crucial. Lignocaine, mixed along with vasoconstrictor, frequently 1:80,000 epinephrine in the LA solution ought to satisfy the above-mentioned targets. The anaesthetic solution must be given inside the connective tissue of alveolar mucosa close to the root apex. Conscious

sedation or general anaesthesia may be required sometimes, apart from local anaesthesia if the surgical procedure is difficult, if the patient is nervous or considerable uneasiness or distress is expected.<sup>7</sup>

#### **SOFT TISSUE ACCESS**

Smile line, periodontal probing depths, local anatomical features like frenal attachments, margins of crown, bony prominences, attached gingivae width, bone level at margins and the probability of recession after surgery should be considered while deciding the incision type.<sup>8</sup>

#### **Flap Design**

The cortical bone should be exposed with the aid of giving incision & full thickness flap reflection including gingival, tissue & mucous membrane while doing endodontic surgery. The previously well-known semilunar flap introduced by Partsch in 1890 isn't suggested or advised anymore, as it doesn't allow sufficient access to the root apex which leads to extreme scarring.<sup>9</sup>



Figure 11: Semilunar flap design.

The full sulcular flap for posterior region & submarginal (Ochsenbein-Leubke) for anterior region are the two flaps designed for apical microsurgery which are advised nowadays.

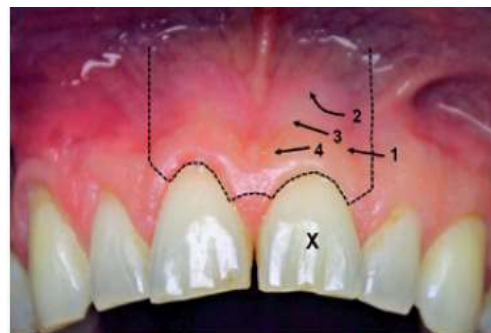


Fig. 9 Flap reflection. Begin at the vertical relieving incision at the level of the alveolar mucosa (1); the flap is slowly undermined (2) and reflected (3, 4)

The full sulcular flap (full thickness marginal flap) incorporates an initial incision inside the gingival sulcus which follows the tooth contour. It is rectangular when there

are two relieving incisions and triangular when single vertical relieving incision is given.



Figure 12: Full sulcular flap design.



Figure 13: Submarginal (Ochsenbein-Leubke) flap design.

Submarginal flap consists of 2 vertical incisions & scalloped horizontal incision inside attached gingiva which follows gingival margin contour (about 3 mm from it). At least 2 mm thickness of attached gingiva is a primary requirement for giving the submarginal flap.

After achieving the access, surgical area must be examined cautiously to analyze the remaining bone size and inspect the root if some fracture outline is present. The tooth should be considered unrestorable and should be extracted if a longitudinal root fracture is been detected.

### HARD TISSUE ACCESS

Sufficient bone ought to be detached to finish the surgical endodontic procedure & reedy boundaries of bone must be rounded to lessen the threat of sequestration. After preparing the cavity, at least 2-3mm of strong undamaged crestal bone must be endured to lessen the threat of recession & give sufficient periodontal backing to teeth.

Root end access is forthright, in case bony dehiscence exists over the apex of root. If this isn't the case, a cavity should be prepared in the bone to gain access to the root end. The position of the root apex must be analyzed by using preoperative radiograph and the local anatomy. Radiographic markers can be advised in some cases.<sup>10</sup>

Air rotors are not advised due to the potential threat so bony crypt should be eliminated by sharp curettes. Immediate granulation tissue elimination would assist in vision & lessen hemorrhage.

### ROOT END MANAGEMENT

- **Resection of root end**

75% of teeth have canal abnormalities in the apical 3 mm of the root, accessory canals are eliminated 93% of the time and canal ramifications are removed 98% of the time so on this ground the apical 3 mm of the root is generally taken out. In

any case, a more length of root can be taken out if there are, separated instruments, anatomical variations, transposed canal apices or where access to a second, more lingually or palatally positioned root is must.<sup>11</sup>

The root tip should be resected perpendicular to the long axis of the tooth giving a 0° bevel. This takes into consideration a 90° cavosurface margin for the root end filling and guarantees that lingual anatomy is obtained. Giving bevel to the root tip isn't suggested, as this undercover greater dentine tubules, which permit the entry of residual extra radicular nutrients and intra-radicular microorganism. If the tooth has received previous apical endodontic surgery, it may not be necessary or possible to remove 3 mm of the root end and nevertheless preserve a sufficient crown to root ratio. Similarly, it could no longer be viable to resect 3 mm of the root end beyond a post and still preserve adequate space for a root end filling.<sup>12</sup>

- **Crypt Management**

The bony crypt needs to be kept dry and clean to permit management and visualization of the root end after doing resection of the root apex and curettage of soft tissue. Sufficient haemostasis limits blood loss, surgical time, and post-operative swelling and haemorrhage. A local anaesthetic consisting a vasoconstrictor need to be used to enhance haemostasis. Electrosurgery / cautery isn't encouraged due to the fact that it may lead to necrosis and defer healing, relying on period of application and the temperature. Curetting the cavity and the bony walls to take off of any remaining adhesive haemostatic agent used and then causing bleeding of the bone, after doing the placement of a root end filling, makes a blood clot which is correct for healing.<sup>13</sup>

- **Root End Preparation**

The apical 3 mm of the root canal system should be set up to encourage a satisfactory apical seal after doing the root end resection. The preparation should follow the anatomical canal space and establish sufficient retention form. It is been found that if there are two canals in a root at the 4 mm level, there gonna be a partial or complete isthmus 100% of the time. If 2 root canals within a root are present, the isthmus between the canal must be prepared to a depth of 3 mm because there are possibly to be communications in this area. So atleast 6 mm of root length apical to a post is needed for acceptable cavity preparation and root resection. For root end cavity preparation, ultrasonic instruments are preferred because they are easy to manoeuvre, small and allow deeper preparation of root end as compared to a round bur.<sup>14</sup>

- **Root End Conditioning**

No proof exists to assist the declaration that smooth root ends encourage improved healing though a smooth surface permits improved evaluation of ramifications and cracks. Elimination of the smear layer by conditioning gives a surface that can be more conducive to cellular mechanisms for growth and attachment as well as for the mechanical because it exposes the collagen matrix and retained biologically active

components like growth factors. Burs which produce a smooth end may be more comfortable for the patient and generally produce less vibration.

A Stropko irrigator can be securely used air and sterile water or with air solitary to clear the retrograde cavity preparation. A 25gauge needle can be used, bent for improved regulator of the spray. The water pressure must be condensed and the air pressure should also be reduced to 4-7 lbs/in<sup>2</sup>.<sup>15</sup>



Fig. 11 Stropko irrigator

### • Root End Fillings

The root end is ready to be sealed once the root is resected and cavity prepared. Increasing the depth of the apical filling lessens leakage. The preparation depth desirable for a satisfactory seal under perfect circumstances enhances with increasing bevel thus the least depth needed for a 0° bevel is 1 mm, that for a 30° bevel is 2.1 mm and for a 45° bevel is 2.5 mm. An apical filling of 3 mm is endorsed.

MTA has been revealed to provision nearly wide-ranging regeneration of the apical periodontal tissues with a new periodontal ligament. The placement of MTA is enabled by the use of an MTA carrier or a Lee block and satisfactory haemostasis. To achieve a homogenous apical seal without voids, ultrasonic activation can be used.<sup>16</sup>



Fig. 21 Lee Block, useful for forming pellets of MTA

New bioactive materials such as Biodentine have newly been marketed as materials with dentine-like properties that may be used as root end filling materials. Claimed advantages comprise, regenerative potential, biocompatibility, comfort of use, antimicrobial properties and long-standing sealing ability.

### POST-OPERATIVE CONSIDERATIONS

#### **CLOSURE OF SURGICAL SITE:**

A radiograph must be taken former to concluding the surgical site to determine the status of the root end filling in addition it guarantees that all foreign objects have been removed. The

crypt must be carefully irrigated with saline to eliminate any packing materials haemostatic agents. The crypt must formerly be scraped with a sharp curette to reassure bleeding and the establishment of a blood clot.

Tension may lead to necrosis at the incision site with successive scarring or recession so the flap must be judiciously changed and sutured without tension. Small diameter sutures (5/0 or smaller) are suggested as they have smaller needles, lead to less thread breaking and trauma. Non-resorbable monofilament sutures are suggested, as they are less supportive of bacterial growth. Mild compression of the flap for 1 minute post closure confirms fibrin adhesion and might avert haematoma development.<sup>17</sup>

Post-operative antibiotics are not regularly prescribed except surgery has been extremely long or the patient is immunocompromised. Removal of sutures at three days post operatively is suggested as epithelial bridging and collagen crosslinking is believed to happen within 21-28 hours.

In most cases where oral surgery has been performed, patient should be counselled to have simple analgesia. Avert additional swelling via ice packs for 1-2 days, CHX gluconate (0.12%) mouthwash should be used twice a day at least for 3 days post operatively & lukewarm saline mouth washes four to five times per day for 7 days & keep decent oral hygiene.

### DISCUSSION

Cases which are not amenable to non-surgical endodontic treatment have to be treated surgically. In this context, endodontic surgical procedures and its concepts, assume importance. Earlier endodontic microsurgery is not considered imperative in endodontist's field which transformed when micro-instruments, ultrasonic tips, microscope & better biologically tolerable filling elements were announced. Simultaneous development of improved techniques has led to greater treatment success, better understanding of the apical anatomy and an added propitious patient response.

Compared to conventional endodontic surgery, micro-endodontic surgery has achieved greater percentage of success. Siqueira J et al stated that endodontic surgery is a characteristic of comprehensive root canal treatment that can handle problems that cannot be removed by nonsurgical methods.<sup>18</sup>

Micro-endodontics endeavors to carry out all the steps, at a lower scale of dimension. The idea behind this concept is that since only the involved area is encroached and operated upon, the healing rate is faster. Since the adjoining healthy tissues are preserved, extended prognosis of the involved teeth is improved.

In the microendodontic surgical procedures, the instruments used are specialized, with the emphasis on instruments that are smaller in size and have easier access to the involved tissues. Magnification is another important

aspect which provides enhanced visualization, thus more precise and focused approach to the area. According to Rubinstein R et al developments in instruments, endodontic equipment and materials have established this procedure, as a state-of-the-art surgical endodontic technique, with a expectable result. One of the main benefits is the use of magnification devices such as dental operating microscopes.<sup>19</sup> This allows better visualization of root apex, resulting narrower resection angles and smaller osteotomies, confirming conservation of surrounding bone, root length and dental structures.

The once popular semilunar flap design and the Luebke-Ochsenbein flap design are no longer recommended. According to Luebke, the wider base of the flap produces a permanent scar across the fiber lines in both muco-gingival flap designs and sulcular full-thickness flap.<sup>20</sup> According to Von A et al flap base and top should be of same width & vertical incisions must follow the position of blood vessels. Scar-free healing is achieved and it also provide sufficient surgical site access. Recession & shrinkage of papilla in sulcular full-thickness flap design are the chief disadvantages.<sup>21</sup>

Usually, endodontic microsurgery process includes buccal bone elimination to precisely find the apex of roots of a diseased tooth, that embrace the intact bone exclusion. After that, pathological peri-radicular tissue is surgically debrided, then root-end resection is eliminated. Atleast 3 mm preparation depth is needed for sealing the additional canals which may be present. In micro-endosurgery removal of bone is partial and more exact thus resulting in improved healing.<sup>22</sup>

Smaller bevel angle is the utmost significant advantage of microsurgery. The steep bevel angle of 45-60° was suggested with the conventional rotary bur. The aim of this steep bevel was simply for visibility and access. According to Creasy, root tip bevelling isn't suggested, because more dentine tubules will be exposed, and that will permit the way to the remaining extraradicular nutrients & intra-radicular bacteria. Shearer J stated that for root end cavity preparation, ultrasonic instruments are preferred as they can be easily managed, small & permit deep root end preparation as compared to rounded bur.<sup>24</sup>

The root end is ready to be sealed once the root is resected and cavity prepared. Amalgam was considered the root-end filling material of choice until the 1990s. Later various materials like Super EBA, IRM, GIC, Retroplast, Geriostore, mineral trioxide aggregate, are used as root-end filling material. Regan J et al stated that new bioactive materials such as Biodentine have been promoted as materials that have properties similar to dentine which can be used as root end filling materials. Claimed advantages comprise, regenerative potential, biocompatibility, comfort of use, antimicrobial properties and long-standing sealing ability. The preparation depth desirable for a satisfactory seal under supreme environments upsurges with increasing bevel. An apical filling of 3 mm is suggested.<sup>25</sup>

Guided tissue regeneration improves and directs cell growth to repopulate specific parts of the periodontium that have been damaged by, tooth diseases, periodontal diseases /trauma. Sculean A et al confirmed that guided tissue regeneration by using membrane barriers and bone grafting materials, induces new attachment of damaged periodontium.<sup>26</sup> Mellonig J et al found alloplast, like hydroxyapatite, beta-tricalcium phosphate, non-ceramic, polymer, or bioactive glass to be only osteoconductive.<sup>27</sup>

Before the advent of microsurgery, 4-0 silk sutures were the standard for endodontic surgery, but they are no longer recommended. Banche et al concluded that smaller width sutures of size 5/0 or smaller have been suggested because it encloses small needles, lead to fewer thread breaking & trauma.<sup>28</sup> Cyanoacrylates are the most hopeful among the various adhesive biomaterial used.

## **CONCLUSION**

Endodontic surgery was considered as a troublesome method in the past as it leads to random consequences. Partial knowledge of diseases of root canal space and treatment fiasco was also the issues for not considering it. It is now an expectable treatment choice to save a tooth with apical pathology that cannot be achieved by conventional, non-surgical endodontics. Following all the above suggested steps and materials, the microendodontic surgery tends to attain a higher success rate resulting in faster and more uniformed healing.

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*CORRESPONDING AUTHOR*

Dr. Hema Katheria  
 Post graduate student  
 Department of Conservative Dentistry and Endodontics  
 Teerthanker Mahaveer Dental College and Research Center, Moradabad. Uttar Pradesh, UP  
 Email- [katheriahema18@gmail.com](mailto:katheriahema18@gmail.com)  
 Contact no- 8273762995

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