Endodontic surgery  are surgical procedures that are done to treat the root lesion that are not amenable to endodontic root canal treatment.

The majority of these surgical procedures will involve resection of the root apex (apicectomy) and retrograde obturation of the root canal to get rid of persistent lesion that has not resolved following an acceptable root canal treatment.

Other surgical procedures on the tooth root, including the repair of resorption defects and root perforations (these procedures are out of the coverage of this lecture).

Pathogenesis of periapical lesions

Pulpal and subsequent periapical disease is caused by microbial contamination. This commonly occurs via a carious lesion and some time occurs due to periodontal disease. As resultant necrosis of the pulpal tissue lead to inflammatory products and pathogens and their byproducts to exit through the apical foramen. This frequently results in the formation of a periapical lesion, mostly an apical granuloma (chronic inflammatory tissue response composed from granulation tissue, containing fibroblasts, epithelial cells, lymphocytes, neutrophils, plasma cells, mast cells, and macrophages, and directly contributes to destruction of the surrounding dentoalveolar bone).

immune response can not manage the periapical lesion if the source of infection (contained within the root canal space) still present. Therefore, the apical lesion will resolved when the origin of infection is treated and the root canal effectively sealed. An apical sealing will prevent egress of any remaining toxins into the surrounding periradicular tissues. Furthermore, an effective coronal seal is essential to prevent reentry of microorganisms from the oral cavity into the root canal.

caries  →  pulp necrosis  →  periapical abscess or granuloma  →  radicular cyst (inflammatory cyst)
Treatment options of tooth with periapical lesion:

1. Extraction if the tooth is unuseful or un restorable.
2. Root canal filling if the tooth restorable and there is some evidence that small periapical cystic lesion may resolved following successful root canal filling.
3. Endodontic surgery, when there is failure of root canal filling or there are some obstacle to do root canal filling.

Indications for endodontic surgery:

- Apical anomaly of root tip (dilacerations, intracanal calcification, open apex)
- Presence of lateral/accessory canal/apical region perforations
- Roots with broken instruments/overfillings
- Fracture of apical third of the root
- Formation of periapical granuloma/cyst
- Draining sinus tract/ non responsive to RCT
- Extension of root canal sealant cement/filling beyond the apex
- Teeth with ceramic crowns
- When patient with chronic periapical infection, will not be available for follow-up.

Contraindications for endodontic surgery:

- Presence of systemic diseases—leukemia, uncontrolled diabetes, anemia, thyrotoxicosis, etc.
- Teeth damaged beyond restoration
- Teeth with deep periodontal pockets and grade III mobility (Pre-existing bone loss)
- When traumatic occlusion cannot be corrected
- Short root length
- Acute infection which is nonresponsive to the treatment
- Root tips close to the nerves, e.g. mental nerve, inferior alveolar nerve or in maxilla close to the maxillary sinus.
Initial clinical assessment for patient with endodontic surgery

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.
4. **radiographical evaluation**: periapical (intraoral) or OPG (extraoral) radiograph should be taken to evaluate;
   - size and extension of the periapical lesion.
   - condition of the roots (if root canal filled, severely curved root, or if there is any foreign body in the periapical area).
   - condition of the alveolar bone and if the lesion is extended to the adjacent roots or vital structures.

**Acute periapical abscess** the radiograph show a slight or no evidence of periapical radiolucency,

**Chronic periapical abscess** the radiograph show break in lamina dura at the apex of the root and periapical radiolucency.

**Periapical cyst and granuloma** look like periapical abscess (break of lamina dura and radiolucency) but with well defined border, cyst usually surrounded by sclerotic border (white line).

The periapical lesion may reach large size without evidence of radiographical radiolucency, because of osteolytic lesions in cancellous bone which is difficult to detect by conventional radiograph, radiolucency appear when there is destruction in the cortical bone.

**Types of apicectomy**;

1. Orthograde (conventional) apicectomy.
2. Retrograde apicectomy.

**Surgical technique for conventional apicectomy**;

1. Asepsis and isolation.
2. Local anesthesia with infiltration technique.
3. Raise the mucoperiosteal flap with periosteal elevator;
**Rules For Flap Design ;**

- The base is wider than the free margin.
- Incision must not be placed over any bony defect (should extend beyond bony defect).
- Incision should be perpendicular to the bone surface to involve the whole mucoperiosteum.
- Size of flap should be large enough (extension of at least one tooth beyond affecting tooth) for good access and decrease tension during reflection.

**Types of mucoperiosteal flap :**

a. **Submarginal** ; It is indicated when the esthetics of the gingival margin cannot be compromised (maxillary teeth with crowns).
   A scalloped incision is made about 2 – 4 mm below the attached gingiva with one or two releasing incisions.
   Contraindication for this flap— periodontal breakdown, large periapical lesion, a short root.

b. **Rectangular (trapezoidal) flap** ; Two vertical releasing incisions and one horizontal intrasulcular incision.
   Advantage ; Good surgical access and excellent wound healing
   Disadvantage ; More difficult to incise & reflect. Possible gingival Recession

c. **Triangular flap** ; One vertical releasing incisions and one horizontal intrasulcular incision, same as for rectangular flap but with limit access due to one releasing incision.

d. **Semilunar flap** ; Full-thickness flap in alveolar mucosa at level of tooth apex.
   Indicated mainly for long teeth or small lesion, rarely used due to poor access & scarring.
4. Retract the flap away.
5. Identify the apex in the intact buccal plate and create a window with surgical bur over the root apex area. Care is taken not to damage the adjoining roots (make bur holes with round bur and then join them with tapered fissure bur).
6. Locate the apex, Section the root tip (not more than one third the length of the entire root).
7. Remove all periapical granulation tissue with angulated curettes.
8. Reaming and irrigation of the root canal then dry the canal and obturate it with gutta percha and sealer.
9. Use hot burnisher to seal the root tip.
10. Periapical cavity then irrigated with normal saline to ensure the area clean and there is no bleeding point.
11. Flap replacement and suturing with 3/0 silk suture.

**Retrograde apicectomy**

Indication for retrograde apicectomy are:
1. Root canal can not adequately cleansed and filled from pulp champer due to:
   a. Presence of pulp stone
   b. Calcified canal
   c. Imperfect root filling (over or under)
   d. Fractured reamer in the canal
   e. The affected tooth covered by crown
2. Persistent post operative discomfort after root canal treatment
3. Limitation of mouth opening preventing access through the crown of the tooth to do reaming and obturation

**Retrograde apicectomy technique**

There is same principle of conventional apicectomy but with preparation of the root apex and filling it, the ultrasonic tip is used for retropreparation. The tip is placed at the apical opening of the canal and guided gently deeper into the canal as it cuts. Once the retropreparation is completed the prepared cavity is inspected. The gutta-percha at the base is recondensed with small 0.5 mm microplugger, the aim of placing root end filling material is to establish an apical seal that inhibits the leakage of residual irritants from the root canal into the surrounding tissues.

A wide variety of retrograde filling materials have been used as; gutta-percha, amalgam, gold foil, titanium screws, glass ionomer, composite resin, etc.
If the defect in the periapical region are large then hydroxylapatite or bone graft can be packed to the cavity to enhance the bony healing.

**Complications of endodontic surgery ;**

*intraoperative*

- Bleeding ; can controlled by using local application of adrenaline pack, pressure pack,Gelfoam or surgical.
- Damage to the neighboring root.
- Entry into sinus/inferior alveolar canal,nasal cavity.

*Postoperative*

- Abscess formation.
- Fenestration, sinus tract formation.
- Increased mobility of the tooth.
- Staining of the mucosa due to amalgam that remained at the surgical field.

**Follow up for endodontic surgery ;**

Healing of the periapical area is checked every 6–12months radiographically, until ossification of the cavity is ascertained. In order to evaluate the result, a preoperative radiograph is necessary, which will be compared to the postoperative radiographs later.
Apicectomy in pictures; step by step

Extensive periapical lesion at maxillary right lateral incisor. Indication for apicectomy

Clinical photograph of case shown in Arrow points to possible location of lesion

Surgical procedure for removal of periapical lesion, together with apicectomy at lateral incisor of maxilla. Incision for creation of trapezoidal flap. a Diagrammatic illustration. b Clinical photograph

Reflection of mucoperiosteum and exposure of labial alveolar plate after elevation of flap. a Diagrammatic illustration. b Clinical photograph

Removal of labial bone covering apical third of root. a Diagrammatic illustration. b Clinical photograph

Removal of periapical lesion with hemostat and curette. a Diagrammatic illustration. b Clinical photograph
Resection of apex with fissure bar and bovuling at a 45° angle. The resection faces the surgeon and is at a distance of 2-3 mm from the root tip.

Preparation of cavity at root tip of tooth using microhead handpiece. a Diagrammatic illustration. b Clinical photograph.

Placement of filling material in cavity of apex using miniaturized amalgam applicator. a Diagrammatic illustration. b Clinical photograph.

Condensing of amalgam with narrow amalgam condenser. a Diagrammatic illustration. b Clinical photograph.

Diagrammatic illustration (a) and clinical photograph (b) showing the apex of the tooth with retrograde filling complete.

Operation site and placement of sutures. a Diagrammatic illustration. b Clinical photograph.