Endodontic Surgery
(Apicoectomy)

Inflammation of the pulp and *septic* necrosis of the dental pulp arise most commonly from: carious lesion penetrating the pulp chamber, fracture of the tooth crown, traumatic exposure during cavity preparation. While inflammation of the pulp and *sterile* necrosis of the dental pulp may result from: thermal irritation, chemical irritation or from trauma to the tooth. A necrotic pulp which initially was sterile may become infected as a result of microorganisms reaching it via the gingival crevice or via the veins and lymphatic in the periodontal membrane.

The infected necrotic pulp tissue will produce periapical irritation through the apical foramen. The body attempts to combat this irritation by an inflammatory response. If the microorganisms are virulence will cause acute infection, while if the microorganisms are non virulence or the host has good defense mechanism which will cause chronic infection of the periapical area. Chronic periapical infection may be a subsequent to acute periapical infection, and there is acute exacerbation of chronic infection. Chronic periapical lesion reveals as periapical abscess, periapical granuloma or periapical cyst.

**Preoperative assessment**

The preoperative assessments for the patient who have a non vital tooth which is indicated for apicoectomy are:

1- Careful dental history should be taken about the chief complain, the history of present illness, the cause which makes nonvital tooth whether trauma or caries, the history of pain, swelling or pus discharge if present, history of previous RCT of the affected tooth.

2- Careful medical history should be taken.

3- Clinical examination:
   * Extra oral examination:
     For inspection and palpation if there is any swelling or skin sinus present.
   * Intra oral examination:
     The tooth should be examined to decide whether the tooth is useful and restorable, the infection is acute or chronic, the presence of chronic sinus (gum boil) on the gingiva, the oral hygiene, discoloration of the tooth, tenderness, mobility and periodontal disease, check the vitality of the affected tooth and the adjacent teeth.

4- Radiographical examination:
   Intra oral periapical x-ray film or extra oral OPG should be given to evaluate the size and extension of the periapical lesion, the condition of the roots, if it is root canal filled or severely curved root, or if there is any foreign
body in the periapical area, and the condition of the alveolar bone and if the lesion is extended to the adjacent roots or vital structures.

In acute periapical abscess the x-ray film reveals a slight or no evidence of periapical radiolucency.

In chronic periapical abscess the x-ray film reveals a break in lamina dura at the apex of the root and there is irregular periapical radiolucency.

In granuloma and periapical cyst there is also loss of the lamina dura and the apex is surrounded by rounded radiolucency. Sometimes there is a white line encircle the radiolucent area in cystic lesion.

The periapical lesion may be large without showing radiographic evidence of bone destruction. This is because osteolytic lesions in cancellous bone cannot be detected very well in conventional radiograph. It is appear when a portion of cortical bone is destroyed that the radiograph can demonstrates it.

**Treatment**

Modalities for the treatment of non vital tooth:

1. Extraction if the tooth is un restorable.
2. Treated by root canal therapy (RCT) if the tooth is restorable and there is some evidence that small periapical lesion may resolve following successful RCT.
   Chronic periapical inflammation may undergo acute exacerbation. The treatment of acute phase consist of drainage via the access opening to the pulp chamber and removing the necrotic pulp tissue and pus from the canal using file and reamer. If the drainage by this route is inadequate an incision of the soft tissue (intra oral or extra oral incision) for drainage may necessary, and prescribes antibiotic and analgesic to the patient. When the acute phase has been subsided, RCT should be done.
3. In some cases there are failures of previous RCT or there are some obstacles to do RCT, so we must do Endodontic Surgery which is apicoectomy and/or periapical curettage.
   Periapical curettage means the enucleation of the pathological lesion present in the periapical region by means of surgical curettage by the use of curettes and excavators.
   Apicoectomy means the amputation or resection about 2-3 mm from the root apex. The resections of a portion of the apex are to:
   a. Facilitates the complete curettage and removal of the pathological lesion present in the periapical area.
   b. The removal of the apical accessory canals.
   c. Enables the operator to check and ensure that the apical end of the pulp canal is effectively sealed under direct vision.
For these reasons apicoectomy is still preferred by most oral surgeon at the present time.

There are two types of Apicoectomy:
1- Conventional or Orthograde Apicoectomy.
2- Retrograde Apicoectomy.

**Indications of conventional apicoectomy**
1- Severely curved root apex.
2- If there is a continuous drainage from a periapical cyst which prevent effective apical seal.
3- Perforated root by wrong instrumentation technique. The site of perforation should be explored by surgical means and filled.
4- Fractured apical third of the root which when removed will leave a sufficient length of remaining root to support the tooth.
5- Incompletely formed root and not closed apex due to trauma and death of the tooth prior to complete closure of the apical area (wide apical opening).
6- When the patient can't come for many visits and one visit RCT may fail.

**Indications of Retrograde Apicoectomy**
The indications of retrograde apicoectomy are the same as conventional apicoectomy with the addition of:
1- The root canal can't be adequately cleansed and filled via the pulp chamber due to:
   a- Presence of pulp stone.
   b- Calcified canal due to calcific degeneration of the pulp.
   c- Imperfect obturates root canal by silver point or gutta percha (over extension or under extension root canal filling).
   d- Fractured reamer.
   e- The affected tooth is covered by a crown or a bridge.
2- Persistent postoperative discomfort after RCT or there is no obvious healing of periapical granuloma or small cyst fail to regress after RCT.
3- Limitation of mouth opening (trismus, submucous fibrosis, scleroderma) preventing access through the crown of the tooth to do reaming and obturation.

**Contraindications of Apicoectomy**
1- Presence of acute infection.
2- Tooth with more than grade 1 mobility due to periodontitis or severe bone destruction, because there is insufficient bony support after apicoectomty which need resection of the root apex (reduce root length) and need bone removal for good access which leads to more mobility of the tooth postoperatively. However, in some cases we can do fixation of such a tooth to neighboring healthy tooth for three weeks, or may add synthetic bone graft if the
The labial surface of the root is exposed and not covered by cortical bone due to periodontal disease.

3- Unrestorable badly carious tooth or deeply fractured under the gingiva.
4- If the surgical operation may cause trauma to the adjacent teeth or vital structures such as nerves, nasal cavity or maxillary antrum.
5- Medically compromised patient.

**Surgical technique of Orthograde Apicoectomy**

1- Anaesthetize the area for the width of two teeth either side of the affected tooth or teeth.
2- Do access opening on the cingulum of the non vital tooth and do reaming and filing of the canal until reaching a sufficient size according to the width and length of the root canal.
3- Design the mucoperiosteal flap whether semi lunar, two-sided or three-sided flap.

The principles of the ideal flap:

a- Broad base for good blood supply.

b- The incision should involve the interdental papillae, in free gingival flap type.

c- The size of the flap should be large enough for good access and no tension on it during reflection.

d- The incision should be sharply made perpendicular to the bone surface that to involve the whole mucoperiosteum.

e- The flap should be extending well beyond the bony defect, so that the flap edges will be supported by bone when it is replaced.

4- The mucoperiosteal flap is reflected carefully well above the apical area of the teeth by the use of mucoperiosteal elevator.

5- The labial cortical plate near the apex of the nonvital tooth should be explored; a perforation may be present in the cortical plate over the periapical area, or we explore the bony defect with the sharp end of cumine to locate the defect by penetrating the thin layer of cortical bone over it, or we must make a small window with round surgical bur under copious saline irrigation over the estimated site of the apex on the labial cortex, then the bony cavity is gradually enlarged until the apex is exposed, but we should be careful not to damage the apices of the adjacent roots.

6- Enucleate the periapical lesion with curette and excavator. The convex side of the curette should be towards the lesion and the concave side towards the bone for complete enucleation of the lesion especially if it is cystic lesion.

7- The root apex is exposed and resected about 2-3 mm. with a fissure surgical bur. The cutting of the apex is oblique towards the labial surface to provide good visualization of the apical seal and to survive a maximum amount of the bony support for the tooth because we don't shorten too much from root length.
8- Reaming and irrigation of the root canal through the access opening and to see the tip of the reamer extend out of the root apex by direct inspection, then dry the root canal with paper point and finally obturate the root canal with gutta percha and sealer, also to see the tip of the gutta percha extend out of the root apex by direct inspection, then with a hot ash cut and condense the gutta percha from the access opening, then cut the extended end of the gutta percha apically and seal the apex, then smooth the bony edge and the root end with surgical bur.

9- The periapical bone cavity should be irrigated with saline after careful curettage and apicoectomy to ensure the area is clean and there are no bleeding areas.

10- The mucoperiosteal flap is then replaced and sutures inserted to the papillae and the vertical incisions to hold it in place by the use of 3/0 black silk suture.

11- Give the patient postoperative instructions:
* Ask the patient to apply cold pack extraorally apposing to the surgical area for the first 8 hours after the surgical operation.
* Prescribe antibiotic, anti-inflamatory, analgesic and mouth wash.
* Tell the patient that the area may bruise and swell. It may be more swollen the second day after the procedure than the first day.
* Instruct the patient to avoid brushing the area or rinsing vigorously. Also, don't smoke or eat hard foods. Do not lift his lip to examine the area. This can loosen the stitches and disrupt formation of a blood clot that is needed for healing.
* The patient may have some numbness in the area for days or weeks after the surgery. The numbness usually goes away with time.
* The stitches will be removed 7 days after the procedure. All soreness and swelling are usually gone within 14 days.

**Surgical technique of Retrograde Apicoectomy**

The results of retrograde approach to obturate the root canals are less satisfactory than those obtained when an orthograde approach is employed.

The surgical steps are the same as in Conventional or Orthograde apicoectomy with the exception of not making access opening in the tooth crown, and after the curettage and resection of the apex in oblique line labially we must do:

1- Create an undercut class 1 cavity for about 2-3mm depth in the apical opening by the use of low speed angle hand piece and a small round bur. There is a special angle hand piece with a miniature head makes both access and vision easier or prepare the cavity by the use of ultrasound tips.

2- The bone cavity is packed with gauze or cotton and the prepared cavity in apical end is inspected to see that it is clean and dry.

3- Fill the prepared cavity with a zinc-free amalgam, use special amalgam carrier, condenser and burnisher. Any excess amalgam is
scraped away and remove the gauze or cotton from the bony cavity then irrigate and sucked out the cavity taking special care not to spread the amalgam into the cancellous bone or under the mucoperiosteal flap which leads to postoperative amalgam granuloma or amalgam tattoo. Recently the prepared apical cavity filled with a new material which is Mineral Trioxide Aggregate (MTA) or calcium enriched mixture (CEM), which are better than amalgam as a retrograde filling materials.

Apicoectomy of the upper teeth
1- Apicoectomy of the upper anterior teeth is easy because the access to the root apices is easy, however, the root apex of the upper lateral incisor directed slightly palataly.
2- Apicoectomy of the upper premolar; the access to both roots should be obtained via a buccal approach. It is necessary to sacrifice a greater length of buccal root to provide access to the palatal root. Small perforation of the maxillary antrum may be ignored.
3- Apicoectomy of the upper first molar ; if possible, it is preferable to do RCT of the palatal root by conventional means and do apicoectomy to the buccal roots and the access should be obtained via the buccal approach. Small perforation of the maxillary antrum may be ignored.

Apicoectomy of the lower teeth
1- Apicoectomy of the lower incisors are slightly difficult than upper anterior teeth because the roots are usually sited deep lingually in the bone, so both vision and access are limited.
2- Apicoectomy of the lower premolars; the apices are relatively deeply placed in dense bone and the presence of the mental nerve limits access.
3- Apicoectomy of the lower first molar is difficult because of the difficult access, the thickness of the buccal plate of the alveolus, the buccolingual width of the roots and the approximation of the inferior dental nerve.

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