Apicoectomy is the surgical resection of the root tip of a tooth and its removal together with the pathological periapical tissues. Accessory root canals and additional apical foramina are also removed in this way, which may occur in the periapical area and which may be considered responsible for failure of an endodontic therapy.

### 13.1 Indications

The indications for apicoectomy include the following cases:

1. Teeth with active periapical inflammation, despite the presence of a satisfactory endodontic therapy.
2. Teeth with periapical inflammation and unsatisfactory endodontic therapy, which cannot be repeated because of:
   - Completely calcified root canal.
   - Severely curved root canals.
   - Presence of posts or cores in root canal.
   - Breakage of small instrument in root canal or the presence of irretrievable filling material.
3. Teeth with periapical inflammation, where completion of endodontic therapy is impossible due to:
   - Foreign bodies driven into periapical tissues.
   - Perforation of inferior wall of pulp chamber.
   - Perforation of root.
   - Fracture at apical third of tooth.
   - Dental anomalies (dens in dente).

In the above cases, if after the apicoectomy the apex has not been completely sealed, then retrograde filling is required, which is described further down. The purpose of retrograde filling is to obstruct the exit of bacteria and the by-products of nonvital pulp, which remained in the root canal.

### 13.2 Contraindications

The contraindications for apicoectomy are as follows:

- All conditions that could be considered contraindications for oral surgery concerning the age of the patient and general health problems, such as severe cardiovascular diseases, leukemia, tuberculosis, etc.
- Teeth with severe resorption of periodontal tissues (deep periodontal pockets, great bone destruction).
- Teeth with short root length.
- Teeth whose apices have a close relationship with anatomic structures (such as maxillary sinus, mandibular canal, mental foramen, incisive and greater palatine foramen) and if causing injury to these during the surgical procedure is considered probable.

### 13.3 Armamentarium

The following instruments are necessary for performing an apicoectomy:

- Microhead handpiece (straight and contra-angle) and microbur (Fig. 13.1).
- Special narrow periapical curette tips for preparation of the periapical cavity (Fig. 13.2).
- Apical retrograde micro-mirror and micro-explorers (Fig. 13.3).
- Local anesthetic syringe and cartridges.
- Scalpel handle.
- Scalpel blade (no. 15).
- Mirror.
- Periosteal elevator.
- Cotton pliers.
- Small hemostat.
- Suction tips (small, large).
- Irrigation receptacle.
- Needle holder.
- Retractors.
• Periodontal curette.
• Periapical curette.
• Appropriate burs (round, fissure, inverted cone).

Fig. 13.1. Microhead handpiece compared to a conventional handpiece. With this handpiece, preparation of the periapical cavity is greatly facilitated in areas with limited access.

Fig. 13.2. Special narrow periapical curette tips that may be adapted to an ultrasonic device. They are used for preparation of the periapical cavity in areas with limited access.

Fig. 13.3. Apical retrograde micro-mirror and micro-explorers for determining the dimensions of the created periapical cavity.

• Miniaturized amalgam applicator for retrograde fillings (Figs. 13.4, 13.5).
• Narrow amalgam condensers (Fig. 13.6).
Fig. 13.4. Miniaturized amalgam applicator for retrograde fillings, with a knob that controls amalgam increment size

Fig. 13.5. Miniaturized amalgam applicator compared to a standard amalgam carrier

Fig. 13.6. Instruments and materials for retrograde filling. Amalgam capsule (top left). Miniaturized amalgam applicator (top right). Narrow amalgam condensers, with tips appropriately shaped so that they may enter narrow areas easily (bottom)

- Scissors, needles and no. 3–0 and 4–0 sutures.
- Metal endodontic ruler.
- Gauze and cotton rolls/pellets.
- Syringe for irrigating surgical field.
- Saline solution.
13.4 Surgical Technique

The procedure for apicoectomy includes the following steps:
1. Designing of flap.
2. Localization of apex, exposure of the periapical area and removal of pathological tissue.
3. Resection of apex of tooth.
4. Retrograde filling, if deemed necessary.
5. Wound cleansing and suturing.

Designing of Flap. Flap design depends on various factors, which mainly include position of the tooth, presence of a periodontal pocket, presence of a prosthetic restoration, and the extent of the periapical lesion.

There are three types of flaps principally used for apicoectomy: the semilunar, triangular, and trapezoidal. The semilunar flap is indicated for surgical procedures of limited extent and is usually created at the anterior region of the maxilla, which is where most apicoectomies are performed. In order to ensure optimal wound healing, the incision must be made at a distance from the presumed borders of the bony defect, so that the flap is repositioned over healthy bone. If there is an extensive bony defect, especially towards the alveolar crest, then the triangular or trapezoidal flap is preferred. It must be noted that the pathological lesion, which has perforated the bone and has become attached to the periosteum, must be separated from the flap with a scalpel. In case of a fistula, the fistulous tract must also be excised near the bone, because, if it is excised at the mucosa, then there is risk of even greater perforation, resulting in disturbances of the healing process.

When the apicoectomy is performed at the anterior region (e.g., maxillary lateral incisor) and there is an extensive bony defect near the alveolar crest (Figs. 13.7, 13.8), the surgical procedure is performed using a trapezoidal flap. The incision for creating the flap begins at the mesial aspect of the central incisor and, after continuing around the cervical lines of the teeth, ends at the distal aspect of the canine. With a periosteal elevator, the mucoperiosteum is then carefully reflected upwards (Figs. 13.9, 13.10).

Localization and Exposure of Apex. The next step after creating a flap is localization and exposure of the apex. When the periapical lesion has perforated the buccal bone, localization and exposure of the root tip is easy, after removing the pathological tissues with a curette. If the buccal bone covering the lesion has not been completely destroyed, but is very thin, then its surface is detected with an explorer or dental curette, whereupon, due to decreased bone density, the underlying bone is easily removed and the apex localized. When the buccal bone remains completely intact, then the root tip may be located with a radiograph. More specifically, after taking a radiograph, the length of the root is determined with a sterilized endodontic file or metal endodontic ruler. The length measured is then transferred to the surgical field, determining the exact position of the root tip. Afterwards, with a round bur and a steady stream of saline solution, the bone covering the root tip is removed peripherally, creating an osseous window until the apex of the tooth is exposed (Fig. 13.11). If the overlying bone is thin and the pathological lesion is large, the osseous window is enlarged with a blunt bur or a rongeur. Enough bone is removed until easy access to the entire lesion is permitted. A curette is then used to remove pathological tissue and every foreign body or filling material, while resection of the root tip follows (Fig. 13.12).

Resection of Apex of Tooth. The apex is resected (2–3 mm of the total root length) with a narrow fissure bur and beveled at a 45° angle to the long axis of the tooth (Fig. 13.13). For the best possible visualization of the root tip (Fig. 13.14), the beveled surface must be facing the dental surgeon. After this procedure, the cavity is inspected and all pathological tissue is meticulously removed by curettage, especially in the area behind the apex of the tooth. If the entire root canal is not completely filled with filling material or if the seal is inadequate, then retrograde filling is deemed necessary.

Retrograde Filling. After beveling of the apex and curettage of periapical tissues, gauze impregnated with adrenaline to minimize bleeding is placed in the bony defect. A microhead handpiece with a narrow round microbur is then used to prepare a cavity approximately 2 mm long, with a diameter slightly larger than that of the root canal (Fig. 13.15). The cavity may be enlarged at its base using an inverted cone-shaped bur to undercut the preparation for better retention of the filling material (Fig. 13.16). During preparation of the cavity, the dentist must pay careful attention to the width of the cavity, which must be as narrow as possible, because there is a risk of weakening the root tip and causing a fracture (which may not even be perceived) during condensing. After drying the bone cavity with gauze or a cotton pellet, sterile gauze is packed inside the bone deficit and around the apex of the
Apicoectomy with Trapezoidal Flap

Fig. 13.7. Extensive periapical lesion at maxillary right lateral incisor. Indication for apicoectomy

Fig. 13.8. Clinical photograph of case shown in Fig. 13.7. Arrow points to possible location of lesion

Fig. 13.9 a, b. Surgical procedure for removal of periapical lesion, together with apicoectomy at lateral incisor of maxilla. Incision for creation of trapezoidal flap. a Diagrammatic illustration. b Clinical photograph

Fig. 13.10 a, b. Reflection of mucoperiosteum and exposure of labial alveolar plate after elevation of flap. a Diagrammatic illustration. b Clinical photograph
Fig. 13.11 a, b. Removal of labial bone covering apical third of root. a Diagrammatic illustration. b Clinical photograph

Fig. 13.12 a, b. Removal of periapical lesion with hemostat and curette. a Diagrammatic illustration. b Clinical photograph

Fig. 13.13 a, b. Resection of apex with fissure bur and beveling at a 45° angle. The resection faces the surgeon and is at a distance of 2–3 mm from the root tip
Fig. 13.14 a, b. Diagrammatic illustration (a) and clinical photograph (b) showing beveled root of lateral incisor.

Fig. 13.15 a, b. Preparation of cavity at root tip of tooth using microhead handpiece. a Diagrammatic illustration. b Clinical photograph.

Fig. 13.16 a, b. Cavity created (inverted cone-shaped) where filling material is to be placed. a Diagrammatic illustration. b Clinical photograph.
Fig. 13.17 a, b. Placement of filling material in cavity of apex using miniaturized amalgam applicator. a Diagrammatic illustration. b Clinical photograph

Fig. 13.18 a, b. Condensing of amalgam with narrow amalgam condenser. a Diagrammatic illustration. b Clinical photograph

Fig. 13.19 a, b. Diagrammatic illustration (a) and clinical photograph (b) showing the apex of the tooth with retrograde filling complete
tooth, in such a way that only the prepared cavity of the root end is exposed. Splattering of amalgam is thus avoided at the periapical region. The amalgam is placed inside the cavity with the miniaturized amalgam applicator and is condensed with the narrow amalgam condenser (Figs. 13.17, 13.18). The excess amalgam is carefully removed and the filling is smoothed with the usual instruments (Fig. 13.19).

Wound Cleansing and Suturing of Flap. After placement of the amalgam, the gauze is carefully removed from the bony defect and, after copious irrigation with saline solution, a radiographic examination is performed to determine if there is amalgam splattering in the surrounding tissues. The flap is repositioned and interrupted sutures are placed (Figs. 13.20, 13.21). Healing of the periapical area is checked every 6–12 months 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.

When apicoectomy is performed in the anterior region (e.g., maxillary central incisor) and the size of the lesion is small, and when there are esthetic crowns on the anterior teeth, the semilunar flap is preferred.

The procedure in such a case is similar to that of the previously mentioned surgical procedure employing the trapezoidal flap (Figs. 13.22–13.35).

1) Amalgam is the most commonly used retrograde filling material. Recently, though, IRM and Super-EBA cement have been considered choice materials, with preparation of the cavity being performed in exactly the same way as that for amalgam.
Apicoectomy with Semilunar Flap

**Fig. 13.22.** Radiograph of maxillary central incisor, showing periapical lesion and unsatisfactory filling of the root canal

**Fig. 13.23.** Clinical photograph of the case shown in Fig. 13.22

**Fig. 13.24 a, b.** Surgical procedure for apicoectomy at maxillary left central incisor. Semilunar incision made for flap.  
  *a* Diagrammatic illustration.  
  *b* Clinical photograph

**Fig. 13.25 a, b.** Reflection of flap and retraction with broad end of periosteal elevator.  
  *a* Diagrammatic illustration.  
  *b* Clinical photograph
**Fig. 13.26 a, b.** Removal of bone covering apex of tooth. *a* Diagrammatic illustration. *b* Clinical photograph

**Fig. 13.27 a, b.** Exposing periapical lesion and apex of tooth together after removal of respective buccal bone. *a* Diagrammatic illustration. *b* Clinical photograph

**Fig. 13.28 a, b.** Removal of periapical lesion with hemostat and periapical curette. *a* Diagrammatic illustration. *b* Clinical photograph
Fig. 13.29 a, b. Resection of apex of tooth at a 45° angle. a Diagrammatic illustration. b Clinical photograph

Fig. 13.30 a, b. Preparation of cavity at apex with microhead handpiece. a Diagrammatic illustration. b Clinical photograph

Fig. 13.31 a, b. Diagrammatic illustration (a) and clinical photograph (b) showing prepared cavity ready for placement of filling
Fig. 13.32 a, b. Placement of filling at root tip with miniaturized amalgam applicator. a Diagrammatic illustration. b Clinical photograph

Fig. 13.33 a, b. Condensing amalgam at periapical cavity with narrow amalgam condenser. a Diagrammatic illustration. b Clinical photograph

Fig. 13.34 a, b. Operation site after placement of sutures. a Diagrammatic illustration. b Clinical photograph
Complications

The most common perioperative and postoperative complications that may occur during and after the surgical procedure, respectively, are:

- Damage to the anatomic structures in case of penetration of the nasal cavity, maxillary sinus and mandibular canal with the bur.
- Bleeding from the greater palatine artery during apicoectomy of palatal root.
- Splattering of amalgam at the operation site, due to inadequate apical isolation and improper manipulations for removal of excess filling material (Fig. 13.36).
- Staining of mucosa due to amalgam that remained at the surgical field (amalgam tattoo) (Figs. 13.37, 13.38).
- Healing disturbances, if the semilunar incision is made over the bony deficit (Fig. 13.39) or if the flap, after reapproximation, is not positioned on healthy bone.
- Dislodged filling material due to superficial placement, as a result of insufficient preparation of apical cavity (Fig. 13.40).
- Incomplete root resection, due to insufficient access or visualization and misjudged length of root (Fig. 13.41). As a result, the apical portion of the root remains in position and the retrograde filling is placed improperly, with all the resulting consequences.
Bibliography


Fragiskos F (1990) Study of the support of a special designed endodontic implant in preserving teeth demonstrating indications for extraction. (Experimental study in dogs). Research monography, Athens


Fig. 13.39. Wound dehiscence, as a result of improper design of semilunar incision

Fig. 13.40. Malpositioned retrograde obturation material, due to insufficient preparation of apical cavity

Fig. 13.41. Periapical radiograph showing unsatisfactory apicoectomy at maxillary second premolar, due to failure to define root before resection