

Principles of Flaps, Suturing and Management of difficult extraction

Oral surgery skills can be learned through the knowledge of the basic principles of surgery, knowledge of the anatomy of the region and good practical training. Whenever surgical intervention is considered, the operator must decide if the procedure is necessary weighing its benefits and its risks, and the patient must be made aware of the other possible non-surgical methods of treatment for the given problem. Also, all the short-term and long-term complications of the surgical procedure must be explained to the patient in relation to the known risks.

The main prerequisite for an operator performing surgical procedures is to ensure **Asepsis and Antisepsis**, to prevent pathogenic microbes from entering the body as well as spread of certain infectious diseases from one patient to another. This is accomplished through;

- Sterilization of instruments involving dry heat, moist heat (autoclave) and chemical means of sterilization.
- Preparation of the patient by seating the patient on the dental chair, disinfecting the skin around the mouth and the oral mucosa and covering the patient with sterile drapes.
- Preparation of the operator by disinfecting the hands and wearing the appropriate sterile gown and surgical gloves.

Flap is simply defined as a section of soft tissue that is outlined by surgical incisions, carries its own blood supply, allows surgical access to underlying tissues, can be replaced as required on its original position, maintained with sutures and is expected to heal. Most of the oral surgical procedures require the reflection of a full mucoperiosteal flap incorporating mucosa, submucosa and periosteum to gain access to the area that is the object of surgery.

Incision

It is simply defined as a cut or wound made by cutting with a sharp instrument. The basic principles of incisions in oral surgery include:

- ❖ A blade number 15 is suitable for most oral surgical procedures. Sometimes a blade number 12 is used.
- ❖ A new and sterile blade should be used for each patient and it should be replaced with a new one intraoperatively if its cutting edge becomes blunted when necessary.
- ❖ The scalpel blade is mounted on the scalpel-handle with the help of a needle holder, or hemostat, with which it slides into the slotted receiver with the beveled end parallel to that of the handle.
- ❖ The scalpel is grasped in a pen grasp for maximum control and tactile sensitivity.

- ❖ The incision should be made at a right angle to the underlying bone to ensure good healing when the tissues are re-apposed.
- ❖ The scalpel should move at uniform speed and with sufficient firmness to cut through not only the mucosal surface but also the periosteum overlying the bone. It should be made, ideally, with a single movement, repeated strokes at the same place should be avoided as they may impair healing.

Flap design

The essential points that should be considered include:

- Flap design and incision should be carried out in such a way that injury of anatomic structures is avoided, such as: the mental neurovascular bundle, palatal vessels emerging from the greater palatine foramen and incisive foramen, lingual nerve, submandibular duct, facial artery and vein. So thorough knowledge of the anatomy of the orofacial region is essential.>
- The base of the flap should be wider than its apex (free gingival margin) to ensure adequate blood supply for better healing.
- The flap should be of adequate width for good visualization and accessibility of the operative field without subjecting the flap to tension and trauma during manipulation.
- When planning the flap, the care should be given to the fact that the flap should be wider than the anticipated bony defect after completion of the procedure so that the flap margins, when sutured, should rest on intact and healthy bone to prevent wound dehiscence and poor healing.
- Delicate handling of the flap during the surgical procedure without excessive tension or crushing in order not to compromise the blood supply which leads to delayed healing.
- Vertical releasing incisions should start at the buccal vestibule and end at the interdental papilla which should either be excluded or included in the flap, the incision should always pass to the interdental papilla and not end at the labial or buccal surface of the tooth to ensure the integrity of the gingiva, but it should not pass through the papilla for accurate replacement of the flap.

Vertical releasing incisions are contraindicated in certain sites in the oral cavity:

- ✓ Transverse incisions in the palate: to avoid injury to the greater palatine artery.
- ✓ Lingual surface of the mandible: to avoid injury to the lingual nerve.
- ✓ Canine eminence: because it increases the tension on the suture line which leads to wound dehiscence.
- ✓ In the area of mental foramen, between mandibular first and second premolars: to avoid injury to the mental nerve.

Types of Mucoperiosteal Flaps

❖ Envelope Flaps

This type of flaps is made by a horizontal incision through gingival sulcus for the teeth or through the alveolar mucosa of the edentulous area with no vertical releasing incisions. The envelope flap is used for surgery of incisors, premolars and molars, on the labial or buccal and palatal or lingual surfaces. The **main indications** of this type of flaps include: surgical extraction of impacted mandibular third molars, palatal approach to impacted maxillary canines or removal of mandibular tori.

The **main advantages** of this flap are; easy re-approximation to original position, good blood supply and it can easily modified to two-sided or three-sided flap by adding vertical releasing incisions to either ends of the flap when necessary.

Disadvantages of this flap are the limited accessibility and visualization, difficulty in reflection with greater tension that can result in tearing at the ends of the flap, in addition to defect in attached gingival and the possibility of injury to the greater palatine artery during reflection of palatal flap.

❖ Two-sided Flap (Triangular Flap)

This flap is made with a horizontal incision along the gingival sulcus or alveolar ridge mucosa and a vertical releasing incision. The vertical incision begins approximately at the vestibular fold and extends to the interdental papilla of the gingiva. This flap is performed labially or buccally on both jaws and is **indicated in** the surgical removal of root tips, impacted teeth, small cysts, and apicectomies.

Advantages are; it ensures an adequate blood supply, satisfactory visualization and accessibility, good re-approximation; it can be easily modified to a three-sided flap, or even lengthening of the horizontal incision.

Disadvantages are; limited access, tension when flap is retracted and it may result in defect of attached gingiva.

❖ Three-sided Flap (Trapezoidal Flap)

This flap consists of a horizontal incision along the gingival or alveolar ridge mucosa and 2 vertical releasing incisions, this flap is **indicated** when an extensive surgical field exposure is required especially when two-sided flap is inadequate.

The main **advantages** include; very good accessibility and visualization of the surgical field with minimal tension on the tissue, and good reapproximation of tissue to the original position.

The **disadvantages** are the possibility of producing an attached gingival defect. This flap cannot be lengthened or modified once reflected.

❖ **Semilunar Flap**

This flap is the result of a curved incision, which begins just beneath the vestibular fold and has a bow shaped course with the convex part towards the attached gingiva. The lowest point of the incision must be at least 0.5 cm from the gingival margin, so that the blood supply is not compromised. Each end of the incision must extend at least one tooth over on each side of the area of bone removal. The semilunar flap is used in apicoectomies and removal of small cysts and root tips.

Advantages of this flap are small incision, easy reflection, no attached gingival defect especially around prosthetic appliances (crowns and bridges) and easy oral hygiene.

Disadvantages of this flap are limited accessibility and visualization of the surgical field, re-approximation may be difficult due to the absence of reference points, tendency to tear due to excessive tension on reflection and the possibility that the flap may be made over defective bone as a result of inadequate planning or underestimation of the size of the bony defect so that the margins of the flap will not rest on intact bone leading to collapse of the flap and wound dehiscence.

❖ **Other types of flaps**

- A flap with a **Y-shaped incision**. This flap is used in surgical procedures of the palate, mainly for removal of exostoses (torus palatinus). The first flap consists of an incision along the midline of the palate with 2 anterolateral incisions made anterior to the canines, additional posterolateral incisions can be added to improve accessibility indicated in large tori, but care should be taken not to sever the greater palatine vessels. The **major disadvantage** of these flaps is that they can easily tear as the mucosa overlying palatine tori can be fairly thin.
- Flaps that are used for closure of oroantral fistula or communication include; **Buccal Advancement Flap** which is in essence a three-sided flap that after reflection the periosteum is transversely incised so that the flap remains pedicled only by the mucosa allowing it to be advanced and sutured to the palatal tissues. The other flap is the **Palatal Transpositional Flap** that incorporates the greater palatine vessel, it is rotated and sutured to the buccal tissues.

Flap reflection

The mucoperiosteal flap is reflected from the underlying bone using periosteal elevators. There are many any types of mucoperiosteal elevators like Howarth, Ash, the no.9 Molt, Seldin, or Freer types. The elevators should be firmly pushed at approximately 30-45° to the surface of the bone such that the periosteum is stripped from it. It is important to try to raise both mucosa and periosteum in one layer and this requires a considerable force to be applied.

Reflection of the flap begins at the papilla; the periosteal elevator is pushed underneath the papilla in the area of the incision and is turned laterally to pry the papilla away from the underlying bone. This technique is used along the entire extent of the free gingival incision. If it is difficult to elevate the tissue at any one spot, the incision is probably incomplete, and that area should be re-incised. A dry, sterile swab can be interposed between the periosteal elevator and the bone.

The elevator may also be used for holding the flap after reflecting, facilitating manipulations during the surgical procedure.

Oftentimes two elevators can be used to advantage one working and the other aiding retraction in the subperiosteal plane. Adequate undermining of the wound margins is required in order to mobilize the flap. Generous reflection is the key to adequate vision, and wide exposure reduces traction trauma to the wound edges.

Suturing

After completion of the surgical procedure, thorough irrigation of the surgical field using sterile normal saline follows. Then the flap is repositioned to its original position and held in place using sutures to protect the underlying tissues from infection and irritating factors and prevent postoperative hemorrhage. Sutures are also used to repair soft tissue lacerations, ligation of vessels and control of bleeding, immobilization of flaps in their new position, and stabilization of drains in place. Suture diameters vary from **0.02 to 0.8 mm**. This corresponds to **10/0 to 5** on the British Pharmacopoeia (BP) system. The finest suture that will hold the wound secure, without it breaking should be chosen. The amount of suture material used should be kept to a minimum, particularly when braided, to reduce bacterial colonization. Suture material can be a nidus for infection, and knots can be the focus of a persistent and chronic inflammatory reaction (suture knot sinus).

Suture Materials

Suture materials are classified as either **absorbable** or **non-absorbable** material depending on whether the body tissues will degrade the suture material and absorb it over time. Absorption takes place either by Hydrolysis or by proteolytic enzymatic degradation depending on the material used. They can also be classified as **monofilament** or **multifilament**.

❖ Absorbable Sutures

They are used in suturing of deep layers of wounds when multilayered suturing is required, they are also used in children, mentally handicapped patients and in patients who cannot return to the clinic to have their sutures removed. They can cause inflammatory tissue reaction that can impede tissue healing. Some of the popular absorbable sutures include:

- ❖ **Plain Catgut:** it is made from collagen derived from healthy sheep or cattle intestine, its tensile strength is lost within 7-10 days, its absorption is through phagocytosis and enzymatic degradation which occurs within 7-10 days producing high tissue reaction. It is used for suturing subcutaneous tissues that do not require prolonged support. **It is not suitable for suturing in oral surgery.**
- ❖ **Chromic Catgut:** it is made from collagen derived from healthy sheep or cattle intestine tanned with Chromium salts to facilitate handling and resist tissue degradation. Its tensile strength is lost within 18-21 days, its absorption is like that of the plain Catgut but it takes longer time and with moderate tissue reaction. It has the same indication as for the plain Catgut and it is **not suitable in oral surgery.**
- ❖ **Polyglactin (Vicryl)**
Synthetic suture made of copolymer of lactide and glycolide coated with polyglactin and calcium stearate.
It is **braided multifilament** suture, 60% of its tensile strength remains for 2 weeks, and about 30% for 3 weeks.
Its absorption is through hydrolysis with complete absorption taking place within 60-90 days, it induces mild tissue reaction. This suture is widely used in surgical practice but it is not advised for use where prolonged approximation under tension is required.
- ❖ **Polydioxanone (PDS)**
Supplied as **monofilament** dyed or undyed, it is made of polyester polymer, 70% of its tensile strength remains at 2 weeks, 50% at 4 weeks and 14% at 8 weeks. Absorption occurs through hydrolysis which is complete in about 180 days, it is used when slight longer wound support is required.
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❖ Non-absorbable sutures

These sutures remain in the tissues and are not absorbed, but have to be cut and removed about 7 days after their placement. Commonly used sutures include:

- **Silk:** it is made of raw silk from silkworms, and it is supplied as braided or twisted, dyed or undyed, coated with wax or silicon or uncoated. 80%-100% of its tensile strength is lost within 6 months. Fibrous encapsulation occurs in the body within 2-3 weeks, it causes moderate to high tissue reaction. It is used in ligation and suturing when long term tissue support is needed. Silk sutures are the easiest to use and the most economical, and have a satisfactory ability to make a secure knot.
- **Nylon**
it is made of polyamide polymer and it is supplied usually as monofilament. It loses 15%-20% of its tensile strength per year. It causes mild tissue reaction and it is used mainly for skin, in plastic surgery, neurosurgery, and ophthalmic surgery. Know it is more widely used in oral surgery.

One of the most commonly used suture for the oral cavity is 3/0 black silk. The size 3/0 has the appropriate amount of strength; the multifilament nature of the silk makes it easy to tie and well tolerated by the patient's soft tissues. The color makes the suture easy to be seen when the patient returns for suture removal. However, because of the multiple filaments, they tend to "wick" oral fluids along the suture to the underlying tissues. This wicking action may carry bacteria along with the saliva. Sutures that are holding mucosa together usually stay no longer than 5 to 7 days, so the wicking action is of little clinical significance.

Needles

Needles are usually made of stainless steel which is strong and flexible material. There are different shapes, sizes and cross sections of needles. Needles of 18-26 mm in length are suitable for use in oral surgery.

There are two basic needle types: Those that have the hole at the suture side of the needle and that need to be threaded with suture are "**eyed.**" Conversely, those that have the suture attached to the needle are "**eyeless**" or "**swaged.**" The advantages of the swaged needles include:

- The eyeless needle is composed of a single use needle and suture. This avoids the loss of sharpness that occurs with reusable needles.
- There is only a single strand of suture that is pulled through the tissues, and the gap that is created by the needle is fully plugged by the suture. This reduces potential leakage through the suture line.
- There is no re-threading of an eyeless needle, and its use is more time efficient.

As compared to a regular circle, needles are either; 1/4 circle, 1/2 circle, 3/4 circle, 3/8 circle, or 1/8 circle or they can have different shapes like straight needles, J needles, or compound curve needles.

The most common needle shapes used for oral surgery are the **three-eighths and half-circle cutting needles.**

According to the cross section of the needles, there are:

- ✓ **Needles with round or oval cross section** which are considered atraumatic and are mainly used for suturing thin mucosa. Their disadvantage is that great pressure is required when passing through the tissues, which may make suturing the wound harder. They are used in oral surgery especially in areas of thin mucosa they are also used in suturing of peritoneum, bowel, muscles and fat.
- ✓ **Needles with triangular cross section;** these are either cutting or reverse cutting needles. The difference is that in addition to the two cutting edges of the triangle, cutting needles have a third cutting edge on the inside of the curvature while the reverse cutting needles the third cutting edge is on the outer convex curvature of the needle. These designs allow minimal soft tissue trauma during needle insertion as they cut a path through the soft tissues and do not therefore require excessive force on the part of the operator.

The passage of a needle through tissue should follow its curvature. This minimizes tissue damage and the appropriate size and shape of cutting, or round-bodied atraumatic needle, needs to be chosen for the least traumatic passage through tissue.

Instrument for Suturing includes:

- **Needle Holder**

These instruments come in a variety of sizes and design. In general, they have a locking handle allowing the needle to be locked into the beaks of the instrument. They resemble Hemostats but with few differences:

- ✓ The beaks of the hemostat are longer and thinner than that of the needle holder.
- ✓ The internal surface of the short beaks of the needle holder is grooved and crosshatched, permitting a firm and stable grasp of the needle, while the short beaks of the hemostat have parallel grooves which are perpendicular to the long axis of the instrument.

- **Tissue Forceps**

Sometimes known as dissecting forceps, the important requirement is that they hold the soft tissues atraumatically so avoiding crushing and with little chance of slippage. This is achieved by a toothed design in the form of a wedge-shaped projection or tooth on one side, and a receptor on the other, which fit into each other when the handles are locked, although possibly causing tiny puncture points, is ideal for the purposes of suturing and holding soft tissues generally. The use of non-toothed forceps will result in crushing of the tissues as, to prevent tissue slippage from grasp, the instrument must be held too tightly.

- **Suture Scissor**

Principles of suturing

- ❖ Suturing should be undertaken using a no-touch technique to reduce the risk of a needle-stick injury and the fewer the number of sutures used to produce the desired result, the better. Insertion of too many sutures tears the tissue unnecessarily, and the resulting tangle of suture thread tends to accumulate plaque and promote inflammation.
- ❖ Before the sutures are inserted the non-flap side of the incision should be undermined to facilitate the insertion of the needle.
- ❖ When re-approximating the flap, the suture is passed first through the mobile (usually facial) tissue, the needle is re-grasped with the needle holder and is passed through the attached tissue of the lingual papilla. But if the two margins of the wound are close together, the surgeon may be able to insert the needle through both sides of the wound in a single pass. However, for better precision it is better to use two passes in most situations.

- ❖ The tissue of the flap should be held firmly by the tissue forceps and the needle passed through the mucoperiosteum about 3 mm from the margin, more if the flap is friable because of chronic infection. The needle is then pushed through the corresponding tissue on the other side of the incision, again about 3-5 mm from the margin. The needle should enter the surface of mucosa at right angle, and the passage of the needle should follow its curvature to prevent tearing of the flap.
- ❖ After the needle passes through both wound edges, the suture is pulled, so that the needle-bearing end is longer. Afterwards, the long end of the suture is wrapped around the handle of the needle holder twice. The short end of the suture is grasped by the needle holder and pulled through the loops. The suture is then tightened by way of its two ends, thus creating the first double-wrapped knot. Then a single-wrap knot is created, in the counterclockwise direction, which is named a safety knot (Surgeon knot).
- ❖ Where possible, the knots should be drawn to lie to one or other side of the line of incision. Over-tightening of the suture, manifested by blanching of tissue, must also be avoided, it runs the risk of tissue necrosis and wound dehiscence. Overlapping of wound edges when positioning the knot should also be avoided.
- ❖ Sutures placed intraorally are normally removed 5-7 days postoperatively. In the removal of sutures, normal dental tweezers should grasp the free ends of the thread and the suture should be cut by sharp scissors. The suture should then be pulled through in its entirety. The suture is better cut just as it enters the tissue to avoid pulling a contaminated suture through the tissue.

Suturing Techniques

■ Simple Interrupted Suture:

This is the simplest and most frequently used type, and may be used in all surgical procedures of the mouth. The needle enters from the margin of the flap (mobile tissue) and exits at the same distance on the opposite side. The two ends of the suture are then tied in a knot. The advantage of the interrupted suture is that it is simple to execute and when sutures are placed in a row, inadvertent loosening of one or even losing one will not influence the rest.

■ Continuous Suture:

This is usually used for the suturing of wounds that are long, e.g., for re-contouring of the alveolar ridge in the maxilla and mandible. This technique for the **continuous simple (or nonlocking) suture** is as follows: after passing the needle through both flap margins, an initial knot is made just as in the interrupted suture but only the free end of the suture is cut off. The needle-bearing suture is then used to create successive continuous sutures at the wound margins. The last suture is not tightened, but the loop created actually serves as the free end of the suture that is used to tie the knot.

The **continuous locking suture** is a variation of the continuous simple suture. This type of suture is created exactly as described above, except that the needle passes through every loop before passing through the tissues, which secures the suture after tightening. Suturing continues with the creation of such loops, which make up parts of a chain along the incision. These loops are positioned on the buccal side of the wound, after being tightened.

The **advantage** of the continuous suture is that it is quicker and requires fewer knots, so that the wound margins are not tightened too much, thus avoiding the risk of ischemia of the area. Its **disadvantage** is that if the suture is inadvertently cut or loosened, the entire suture becomes loose.

■ **Mattress Suture:**

This is a special type of suture and is described as horizontal and vertical. It is indicated in cases where strong and secure re-approximation of wound margins is required. The main indication for use of vertical mattress sutures is to evert the skin edges, the technique permits greater closure strength and better distribution of wound tension. The horizontal suture also allows eversion of the wound edges and is used in cases which require limiting or closure of soft tissues over osseous cavities, e.g., post-extraction tooth sockets. In the mattress suture the needle passes through the wound margins at a right angle, and the needle always enters and exits the tissues on the same side.

■ **Figure of Eight suturing**

Figure-of-eight suture occasionally placed over top of socket to aid in hemostasis, it is usually performed to help in maintaining a piece of oxidized cellulose in tooth socket after tooth extraction.

Management of difficult extraction

Difficulties may be encountered during extraction of teeth for a variety of reasons and any oral surgeon should never ignore any warning of the possibility that such difficulties may be encountered during any proposed tooth extraction especially when the patient indicates that such difficulties have been experienced in previous occasions. These difficulties can be diagnosed through clinical examination and a good radiograph that shows the root morphology of the tooth and the surrounding and supporting structures which should be taken before extraction whenever possible.

Surgical or open extraction

The surgical or open extraction technique in some situations may be more conservative, cause less operative morbidity, and be quicker to perform compared with a closed extraction. Forceps extraction techniques, which require great force, may result in removal not only of the tooth but also of large amounts of adjacent bone and occasionally the floor of the maxillary sinus. The bone loss may be less if a soft tissue flap is reflected and a proper amount of bone is removed; it may also be less if the tooth is sectioned (cut into smaller sections).

The main indications for surgical extraction of teeth are:

- ✓ **Retained roots and root tips.**
- ✓ Teeth with **root morphology that is unfavorable** for simple tooth extraction, such as teeth with large bulbous roots due to hypercementosis or those with dilacerated roots or root tips
- ✓ When there is possible need for excessive force to extract a tooth that will probably result in a fracture of bone, a tooth root, or both examples:
 - Patient has thick or dense bone especially in older patients
 - Patient with history of bruxism, who has very short clinical crowns with evidence of severe attrition. The teeth are surrounded by dense, thick bone with strong periodontal ligament attachments.
- ✓ Teeth that have crowns with **extensive caries**, especially root caries, or that have large amalgam restorations.
- ✓ Teeth with **ankylosed roots**.
- ✓ Teeth that are **fused with adjacent** teeth or roots.
- ✓ Maxillary posterior teeth that are **closely associated with maxillary sinus** due to pneumatization of the sinus into the alveolar process or when there is an increased risk of fracture of maxillary tuberosity during simple extraction.
- ✓ Unerupted or partially erupted **impacted teeth**.
- ✓ Teeth or retained roots with **periapical lesions** whose removal in entirety is not possible through curettage alone after simple extraction.

Retained roots and root tips that are deeply buried in the alveolus and are asymptomatic are not indicated for surgical extraction especially in older individuals with poor general health, or when there is a risk of serious local complications or damage to vital structures like the inferior alveolar nerve, lingual nerve or maxillary sinus.

Steps of surgical extraction

Surgical extraction of teeth is preceded by proper preparation and disinfection of the patient, and administration of local anesthesia then the surgical procedure proceeds as follows:

1. Creation of a **full mucoperiosteal flap**, this could be envelope, two-sided or three-sided flap based on the anticipated difficulty and the need for better accessibility.
2. For **single rooted teeth** and after reflecting the flap the operator may attempt to re-seat the forceps under direct visualization for better mechanical advantage. The other options include; grasping a bit of buccal bone under the buccal beak of the forceps so that a small piece of buccal bone is removed with the tooth, application of an straight elevator, pushing it toward the apex in the periodontal ligament space of the tooth. In some cases, a purchase point is made in the root where the elevator is applied and the root extracted.

3. **Bone removal** using surgical hand piece and round burs to expose an adequate part of the tooth or root (The **width of buccal bone** that is removed is essentially the same width as the tooth\root in a mesiodistal direction. **In a vertical dimension**, bone should be removed approximately one-half to two-thirds the length of the tooth root. This amount of bone removal sufficiently reduces the amount of force necessary to displace the tooth and makes removal relatively straightforward) to facilitate the application of the forceps or the elevator.. Whenever possible the oral surgeon should be conservative by removing bone to allow the creation of a point of application for the elevator for luxation or sometimes removing only a small window of bone overlying the broken apex of roots to allow their retrieval through the socket.
4. In **multi-rooted teeth**, the teeth may be divided with a burr to convert a multirouted tooth into two or three single-rooted teeth so that they can be extracted with same surgical technique used for single rooted teeth (However Cryer elevator may be used).
5. After the tooth and all the root fragments have been removed, the flap is repositioned and the surgical area is palpated for **sharp bony edges**. If any sharp edges are present, they are smoothed with a bone file or a handpiece and bur. The wound is thoroughly irrigated and debrided of loose fragments of tooth, bone, calculus, and other debris.
6. The **flap is repositioned again and sutured** in the usual fashion.

Indications for leaving root fragments

When a root tip has fractured and approaches of removal have been unsuccessful, and when the open surgical approach may be excessively traumatic, the surgeon may consider leaving the root in place. As with any surgical approach, the surgeon must balance the benefits against the risks of surgery. In some situations, the risks of removing a small root tip may outweigh the benefits.

The conditions that must exist for a tooth root to be left in the alveolar process are:

- The root fragment must be **small**, usually no more than 4 to 5 mm in length.
- The **root must be deeply embedded** in bone and not superficial, to prevent subsequent bone resorption from exposing the tooth root and interfering with any prosthesis that will be constructed over the edentulous area.
- The tooth involved must **not be infected**, and there must be no radiolucency around the root apex. This lessens the likelihood that subsequent infections will result from leaving the root in position.
- The root should **not be mobile**.

If the surgeon elects to leave a root tip in place the **patient must be informed** that, in the surgeon's judgment, leaving the root in its position will do less harm than surgery. In addition, radiographic documentation of the presence and position of the root tip must be obtained and retained in the patient's record, the patient should be recalled for follow-ups to track the fate of this root.

The **patient should be instructed** to contact the surgeon immediately should any problems develop in the area of the retained root.

Multiple Extractions

If multiple adjacent teeth are to be extracted at a single session the surgeon should determine if there is need for interim partial immediate dentures, any type of soft tissue surgery, such as tuberosity reduction or the removal of undercuts or tori in critical areas. If dental implants are to be placed later, it may also be desirable to limit bone trimming and socket compression. In some situations, dental implants may be placed at the same time as the teeth are removed, which would require the preparation of a surgical guide stent to assist in aligning the implants appropriately.

Extraction sequencing

Maxillary teeth should usually be removed first for several reasons:

- ❖ Infiltration anesthetic has a more rapid onset and also disappears more rapidly. This means that the surgeon can begin the surgical procedure sooner after the injections have been given.
- ❖ Surgery should not be delayed because profound anesthesia is lost more quickly in the maxilla.
- ❖ During the extraction process, debris such as portions of amalgams, fractured crowns, and bone chips may fall into the empty sockets of the lower teeth if the lower surgery is performed first.
- ❖ Maxillary teeth are removed with a major component of buccal force. Little or no vertical traction force is used in removal of these teeth, as is commonly required with mandibular teeth.

A single minor disadvantage for extracting maxillary teeth first is that if hemorrhage is not controlled in the maxilla before mandibular teeth are extracted, the hemorrhage may interfere with visualization during mandibular surgery but this is usually not a major problem because hemostasis should be achieved in one area before the surgeon turns attention to another area of surgery, and the surgical assistant should be able to keep the surgical field free from blood with adequate suction.

Posterior teeth are extracted first, this allows for the more effective use of dental elevators and forceps to extract the teeth.

The **tooth that is the most difficult to remove—the canine—should be extracted last.** Removal of the teeth on either side weakens the bony socket on the mesial and distal sides of these teeth, and their subsequent extraction is made more straightforward.

For example, if teeth in the maxillary and mandibular left quadrants are to be extracted, the following order is recommended:

(1) maxillary posterior teeth; (2) maxillary anterior teeth, leaving the canine; (3) maxillary canine; (4) mandibular posterior teeth; (5) mandibular anterior teeth, leaving the canine; and (6) mandibular canine.

After the extractions are completed, the buccolingual plates are pressed into their preexisting position with firm pressure unless implants are planned. The soft tissue is repositioned, and the surgeon palpates the ridge to determine whether any areas of sharp bony spicules can be found. If a removable partial or complete denture is planned, undercuts should be identified. If any sharp spicules or undercuts exist, the bone rongeur is used to remove the larger areas of interference, and a bone file is used to smooth any sharp spicules. The area is irrigated thoroughly with sterile saline or sterile water.