

Surgical aids to orthodontics

Surgery in the orthodontic patient will often be an integral part of a treatment plan. Surgical interventions that may be required in orthodontic treatment include: extraction of erupted teeth, management of impacted, supernumerary and dilacerated teeth, corticotomy and excision of labial frenum.

The dental and medical history, clinical examination, radiographs and consultation with the orthodontist are necessary for preoperative assessment and surgical treatment plan.

The most conditions which require surgical aids prior to orthodontic treatment are:

1. Management of Impacted teeth

Impacted tooth is one that has failed to erupt into normal functional position beyond the time usually expected for such appearance.

It occurs where there is prevention of complete eruption due to:

- Lack of space in the dental arch (main cause).
- Obstruction by another tooth.
- Development in abnormal position.
- Dense overlying bone.
- Thick fibrous tissue.
- Odontogenic cysts or tumors.

The mandibular third molar is the most commonly impacted tooth in the mouth followed by maxillary third molar, maxillary canine, mandibular canine, mandibular second premolar, maxillary second premolar and second molars.

Impacted third molars

The prevalence rate of third molar impaction varies from one population to another ranging from 16% to 68%. The presence of impacted third molars may interfere with orthodontic treatment.

The most frequently required option of treatment in orthodontic patients is surgical extraction of impacted lower third molar.

Clinical examination

After taking a thorough medical and dental history, with a special consideration to the age since it may significantly influence the management of impacted third molars, the clinical examination includes general assessment of the size and the build of the patients, patient's attitude is important as this reflects the way they will respond to the stress of surgery. General fitness is essential.

Intraoral examination should include: the mouth opening, oral hygiene, examination of the third molar, if it is visible or not, carious, the condition of the soft tissue over the impacted tooth is noted; if there are signs of pericoronitis treatment will be required before the operation, the position and the condition of the upper third molar is checked and its relationship with the lower third molar.

Radiographic examination

The radiographic examination should demonstrate:

- ✓ The whole impacted tooth.
- ✓ The investing bone.
- ✓ The adjacent tooth.
- ✓ The inferior dental (alveolar) canal.
- ✓ The anterior border of the ascending ramus.
- ✓ The relation of the maxillary third molar with the maxillary sinus

Periapical radiograph offers the highest definition and it should be used whenever possible, but the film should be positioned with care.

Orthopantomogram (OPG) is regarded as the radiograph of choice, its main advantages are; the low radiation exposure and its ability to demonstrate the entire dental arch.

Occlusal films are used in difficult cases especially in unerupted teeth in conjunction with another view at right angle, this is necessary to understand the problem in 3 dimensions.

Cone beam CT (CBCT) is indicated when on OPG there is a suggestion of a relationship between the roots of the impacted tooth and the inferior alveolar canal or the maxillary sinus or when the impacted tooth is associated with pathology.

In radiographic assessment the following features should be considered:

- Angulation of the impacted tooth.
- The depth of the impacted tooth.
- Crown features.
- Root morphology, e.g. fused roots, curved roots ...etc.
- Bone density.
- Any associated pathology like cysts or tumors.
- The state of the second molar (root morphology, caries, restoration or resorption ...etc.)

Surgical extraction of impacted third molars

Surgical extraction of impacted third molars is commonly done under L.A., other choices include L.A. with sedation and G.A. access is achieved either by an envelope flap or a triangular flap, which is an envelope flap with a vertical releasing incision. After flap reflection bone removal with or without tooth sectioning is needed to extract the tooth. After tooth removal any debris and the remaining follicular tissue are cleaned out, sharp bone smoothed, copious irrigation of the socket and underneath the flap is carried out and the flap is repositioned and sutured.

Complications

- Pain, edema and trismus.
- Postoperative hemorrhage.
- Infection and abscess formation.
- Alveolar osteitis (dry socket).
- Localized osteomyelitis.
- Temporal or permanent nerve dysfunction of the inferior dental nerve and lingual nerve; this is manifested as anesthesia, paraesthesia or dysesthesia. Recovery of normal sensation may take few days to several months.
- Fracture mandible, uncommon, due to applying excessive force during extraction.
- Loss of the tooth or the root into the lingual space.
- Oroantral fistula which should be repaired as soon as possible.
- Displacement of tooth or root into the maxillary antrum or infratemporal fossa.
- Fracture of tuberosity.

Impacted maxillary canine

Maxillary canines are impacted in about 1%-3.5% of the population; the rate among female patients is twice as high as that in males.

If the maxillary canine fails to erupt by the age of 13 years, its position should be investigated, the orthodontist should be consulted to determine if the tooth can be brought to normal occlusion. The impacted maxillary canine can be located; palatally, buccally, within the alveolar ridge, or located labially and palatally; crown on one side and the root on the other side. It can also be horizontally, vertically or semivertically oriented.

Clinical examination

The position of the tooth may be obvious by the presence of a bulge either palatally or buccally. The palatal impaction is more common than the buccal one. Palpation of the maxilla through the labiobuccal sulcus may reveal the presence of the bulge buccally. The lateral incisor may be proclined due to the presence of the canine labial to the root or may be retroclined if the canine is palatal.

Radiographic examination and assessment

The radiographic views that can be used include; periapical, occlusal, OPG, lateral skull view cone beam CT (CBCT) can also be used.

The periapical radiograph provides a detailed view of the tooth, surrounding bone, root formation, the presence of root resorption of the adjacent lateral incisor or the presence of any pathology.

Localization of the canine is important especially when it cannot be determined clinically. Methods of localization include:

- ❖ **Buccal object rule (parallax method, tube shift technique);** in which two periapical films are taken, shifting the tube horizontally distally between exposures, if the unerupted tooth moves in the same direction in which the tube is shifted it is localized palatally, if it moves in opposite direction it is buccally located, in a rule called SLOB (Same Lingual Opposite Buccal).
- ❖ **Vertex occlusal projection;** which produces an axial view of the incisors, will demonstrate the buccopalatal localization of the canine.
- ❖ **Periapical-occlusal method;** uses a standard periapical view and an occlusal view to give two different views of the impacted tooth.
- ❖ **OPG;** can be used to localize impacted canine on the basis that palatally impacted canine appear magnified. It can also demonstrate the vertical angulation and its height.
- ❖ **Lateral skull view or cephalometric.**
- ❖ **CBCT.**

Options of treatment

1. Retention or leave in situ; indicated when:

- ✓ The canine is asymptomatic and its extraction may lead to damage to the adjacent teeth.
- ✓ There is absence of any pathology like infection, abnormal widening of the follicle, resorption of the adjacent roots or any other associated pathology.
- ✓ Aesthetically acceptable.

The patient should be kept under annual review to verify that these complications have not arisen, the opinion of an orthodontist is important.

2. Surgical exposure and orthodontic traction; is the procedure that allows natural or orthodontically guided eruption of the impacted teeth, an active collaboration with an orthodontist is essential for planning this procedure. Certain criteria must be fulfilled:

- ✓ There should be adequate space in the arch to accommodate the tooth.
- ✓ There should be an unobstructed path of eruption.
- ✓ After eruption the tooth should be in near to normal position in all planes.
- ✓ The timing of the procedure should be as close as possible to the normal eruption time.

The approach is through a palatal envelope flap, extending from the first molar to the first molar on the other side in bilateral impaction cases, or from the first molar to the first premolar on the other side in unilateral impaction cases.

Buccally impacted teeth are approached through a 3-sided buccal flap, depending on its location.

After reflection of a full mucoperiosteal flap, the crown is exposed conservatively taking care not to expose the cemento-enamel junction (CEJ) as this may result in increased incidence of external root resorption.

In palatally positioned canine, a window is excised in the soft tissue before replacing the flap, if the bracket is not attached at the same operation the window is packed with a suitable pack until it epithelializes for 2-3 weeks. In buccal approaches it is more appropriate to suture the flap above the crown (apically repositioned flap) and the area below covered with a pack to ensure that the tooth will erupt into an area of keratinized mucosa.

3. Transplantation; in this procedure the canine is carefully extracted and transferred to a surgically prepared socket in the dental arch with minimum delay. The transplanted tooth should be splinted in its new position for about a month with an orthodontic appliance.

It is essential to have sufficient space to accommodate the crown of the canine.

Success rate is increased when the unerupted teeth still have open apex and when the handling of the root is kept to minimum to ensure the viability of the cementum and periodontal membrane.

Endodontic treatment should be performed as soon as possible after surgery (about 6-8 weeks), periodic follow up is required to allow early detection of root resorption which is common.

4. Removal; surgical extraction maybe performed when the other options are unavailable. The main indications include:

- ✓ Before construction of a dental prosthesis.
- ✓ To permit orthodontic alignment of other anterior teeth.
- ✓ When there is resorption of the roots of adjacent teeth.
- ✓ When a follicular cyst has developed.
- ✓ Infection although uncommon.

Extraction can be performed with retention of the primary canine with restorative procedures to improve esthetic contour, extraction can also be accompanied with extraction of the primary canine and orthodontic closure of the space by the first premolar. Implant supported crown can also be used to close the space created by extraction of the impacted canine and the primary canine.

Palatally positioned teeth are approached through palatal envelope flap, while buccal teeth are approached through buccal flap.

Occasionally tooth sectioning is required after bone removal and the tooth is extracted in segments.

Possible complications include:

- Palatal hematoma formation, this can be prevented by an acrylic splint to support the soft tissue.
- Perforation into the floor of the nose, but it rarely causes a problem.

Impacted mandibular canines

These are less frequently impacted than maxillary canines (about 0.3% of population) and are mostly buccally located, partially erupted teeth can be removed easily using elevators or forceps.

Localization of the unerupted teeth is by periapical film, OPG, occlusal view or CBCT.

Consultation with orthodontist is mandatory when considering treatment.

Surgical extraction is by raising a buccal mucoperiosteal flap with care to avoid damaging the mental nerve, bone removal and the tooth is extracted wholly or after sectioning.

Deeply impacted teeth or those located lingually can be left in situ if they do not cause any damage to the adjacent roots or not associated with other pathologies.

Surgical exposure is either through a flap or sometimes through excision of the overlying soft tissue when the tooth is only covered by soft tissue. It is noteworthy to say that orthodontic traction is difficult since impacted mandibular canines are frequently in horizontal position near the roots of the adjacent teeth, also due to the dense bone in the region as well as the buccal position of the impacted teeth.

Impacted lower premolars

It occurs mostly due to loss of space by drifting forward of the first permanent molar after early extraction of the second deciduous molar.

Localization is by periapical film, OPG with occlusal view to demonstrate the buccolingual position or CBCT.

Removal is by raising a buccal flap, with preservation of the mental nerve, bone removal, sectioning of the tooth if needed and extraction of the tooth. Consultation with orthodontist before extraction is essential.

Impacted maxillary premolars

It is usually impacted with its crown palatally, or it may be within the arch between adjacent roots. It can be partially erupted, completely buried or the crown may be wholly exposed, in the latter case extraction is easy with an elevator or forceps. Completely impacted teeth require a palatal envelope flap extending from the second molar to the lateral incisor on the same side, bone removal and extraction of the tooth.

Buccal approach is needed in cases where the tooth is within the arch between the standing teeth, sectioning of the tooth is needed when the root is curved. Care is taken not to damage the adjacent teeth.

Impacted first and second molars

These are uncommonly impacted, their management consist of surgical extraction through a buccal flap, bone removal avoiding damage to the inferior dental nerve that may cross buccal to the neck of the teeth, sectioning of the tooth may be necessary.

Another line of treatment is the surgical uprighting, especially of the impacted second molar. This is done through buccal approach, the tooth is exposed carefully without exposing the CEJ, if the third molar is present it needs to be removed, if not, bone posterior to the second molar is removed, followed by tipping the tooth slightly posteriorly and superiorly, and the tooth can be allowed to erupt spontaneously.

This procedure is better carried out when 2/3 of the roots of the impacted second molar are developed. Teeth with fully developed roots have poor prognosis for this procedure.

Usually there is no need for fixation but RCT may be needed 6-8 weeks after surgery, also there should be no occlusal forces on the tooth in the postoperative period. Follow up for about 2 years is necessary.

2. Buried deciduous molars

These are usually ankylosed and should be removed surgically through buccal approach, bone removal and tooth sectioning if necessary.

3. Supernumerary teeth

These are more in the males than in the females, they can be present in the primary dentition as well as in the permanent dentition, 50% of the cases in primary dentition will have supernumerary teeth in the permanent dentition. Supernumerary teeth can be classified according to their position into:

Mesiodens; is situated in the premaxilla in the midline and it is commonly conical, it can have a horizontal or inverted position. Supplemental teeth may also occur in the anterior maxillary region.

Paramolar; appear in the premolar or molar region and is situated buccally to the teeth, they can be conical or supplemental.

Distomolar; appear as a fourth molar usually distal to the standing molars and they are either normal or smaller in size.

According to the shape they can be either; **conical (peg-shaped)** or **supplementary**; which have the shape and size of a normal tooth or they can have conventional shape with smaller or larger size.

Supernumerary teeth can have no effect on other standing teeth or they can cause failure of eruption of the other teeth, crowding, malposition or misalignment, resorption of the roots of the adjacent teeth or they can be associated with other pathologies (e.g. cysts).

Erupted supernumerary teeth are extracted easily especially if they are conical in shape.

If they need removal they should be localized accurately using periapical films (buccal object rule may be applied), vertex occlusal view or CBCT. OPG is needed to determine the vertical position of the tooth and its position in relation with the floor of the nasal cavity or maxillary sinus.

They are approached palatally through palatal flap or buccally, bone removal and tooth sectioning may be needed, sometimes combined palatal and buccal approach is necessary.

4. Dilacerated incisors

Trauma to the deciduous incisors especially in the 2-3 years of age can cause damage to the underlying permanent incisor tooth germ causing root development to take place at an angle.

Exposure and orthodontic traction can be performed if possible, but if not, these teeth should be removed and the lateral incisors allowed filling their space.

It is essential to seek the opinion of an orthodontist.

5. Corticotomy-assisted orthodontic treatment

It can be defined as a linear cutting technique in the cortical plates surrounding the teeth to produce accelerated tooth movement. This process differs from the osteotomy, in which cortical and cancellous bone is cut for the purpose of repositioning blocks of bone with associated teeth.

The biological mechanism behind the acceleratory effect of corticotomies has been suggested to occur due to **regional acceleratory phenomenon** in which an injury to bone results in the acceleration of all processes involved in healing which allows teeth roots to move rapidly through the alveolar bone. The reported rate of acceleration of tooth movement in human patients has been suggested to be up to 3 times the normal rate of tooth movement, but this acceleratory effect has a finite period which is reported to range from 1 to 4 months.

Indications

Corticotomy is used to facilitate orthodontic tooth movement and to overcome some shortcomings of conventional orthodontic treatment, such as the long required duration, limited tooth movement and difficulty of producing movements in certain directions. Some of the clinical applications include:

- ✓ Treatment of crowding.
- ✓ Canine Retraction after Premolar Extraction.
- ✓ Enhance post orthodontic stability.
- ✓ Facilitate eruption of impacted teeth.
- ✓ Facilitate orthodontic expansion.
- ✓ Molar intrusion and open bite correction.

Corticotomy is contraindicated in patients with active periodontal disease or gingival recession.

Surgical procedure

Various surgical interventions have been described:

- The traditional corticotomy procedure entails raising full-thickness buccal or buccal and palatal/lingual mucoperiosteal flaps and performing vertical linear interradicular corticotomy cuts (about 0.5 mm in depth), with or without joining horizontal subapical corticotomy cuts, or by drilling multiple holes that penetrated the cortical plate instead of linear cuts.
- More conservative techniques involved making vertical interproximal soft tissue incisions without raising soft tissue flaps and making corticotomy cuts through these incisions using piezosurgical instrument or a hard tissue laser.
- Grafting material may be added on the cut alveolar bone in some cases especially where alveolar bone is considered thin.

After surgery orthodontic force can be applied either immediately or within 2 weeks after surgery.

Complications

Possible complications include:

- ❖ Adverse effects on periodontium.
- ❖ Adverse effect on vitality of the pulp.
- ❖ Root resorption.

6. Labial frenectomy

A frenum is a small band or fold of mucosal membrane that attaches the lips and cheeks to the alveolar process and limits their movement. The maxillary midline frenum connects the mucosa of the maxillary alveolar process and central incisors to the upper lip. Histologically it contains elastic fibers and collagen tissue components. It is a dynamic structure that changes in shape, size and position during growth.

Histological studies show that collagen fibers of labial frenum disrupt the trans-septal periodontal fibers of the central incisors which is related to midline diastema.

Management of diastema is by orthodontic treatment, in some cases labial frenum is hypertrophic inhibiting orthodontic closure necessitating surgical removal before the end of orthodontic therapy, although surgical removal of the frenum before orthodontic treatment is reported to lead to a more rapid crown approximation but it is believed that abundant granulation tissues may complicate diastema closure.

Frenectomy is the total removal of the frenum. Various surgical techniques have been proposed:

- The simple excision technique.
- The Z-plasty technique.
- Localized vestibuloplasty with secondary epithelialization.
- The laser-assisted frenectomy

The simple excision technique

It is performed under local anesthesia; a narrow elliptical incision around the frenal area down to the periosteum is completed. The frenum is then sharply dissected from the underlying periosteum and soft tissue, and the margins of the wound are gently undermined and reapproximated.

Placement of the first suture should be at the maximal depth of the vestibule and should include both edges of mucosa and underlying periosteum at the height of the vestibule beneath the anterior nasal spine to allow for adaptation of the tissue to the maximal height of the vestibule. The remainder of the incision is closed with interrupted sutures. The excision closest to the alveolar ridge crest may require periodontal dressing and will undergo secondary epithelialization. The advantage of this technique is that it is easy to perform while its main disadvantages are scar tissue formation and relapse.

The Z-plasty technique

The excision of the frenum is done as in the previous technique, after excision of the frenum, two oblique incisions are made in a Z fashion, one at each end of the previous area of excision. The two flaps are then undermined and rotated to close the initial vertical incision horizontally, it is a more demanding procedure and more aggressive but it results in less scar formation.

Localized vestibuloplasty with secondary epithelialization

It is indicated in case of wide frenal attachment, an incision is made through mucosal tissue and underlying submucosal tissue. A supraperiosteal dissection is completed by undermining the mucosal and submucosal tissue, the edge of the mucosal flap is sutured to the periosteum at the maximal depth of the vestibule and the exposed periosteum is allowed to heal by secondary epithelialization.

The laser-assisted frenectomy

Frenectomy can be performed by laser. Diod laser, Nd:YAG laser, Er:YAG laser and CO₂ Laser have been reported. The main advantages of laser are; less bleeding during surgery, no need for suturing or periodontal dressing, with minimal postoperative swelling and discomfort.