

17. Management of Skeletal Deformities

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INTRODUCTION

- Management of Skeletal deformities in cleft lip and palate patients can be a formidable challenge.
- According to Ross, around 25% of the patients with operated on cleft lip palate will have some degree of maxillary hypoplasia.
- A thorough planning is essential before attempting these surgeries as it may have a very significant impact on the functional and aesthetic outcomes of the patient.
- A multidisciplinary team comprising of Plastic/ Maxillofacial Surgeon, Orthodontist, Speech Language pathologist, and psychologist should be involved in the planning the surgery as well as outcome.
- The three most important objectives of Orthognathic surgery are function, esthetics and stability.

Typical Clinical Features:

- The midface appears concave rather than convex.
- This decreases the nasal base projection and tends to make the ala splayed.
- The upper lip is poorly supported and there is often inadequate dental show.
- The mandible may appear protruding and a thorough cephalometric analysis has to be done in order to confirm whether this is true mandibular prognathism or pseudo- appearance due to maxillary hypoplasia.
- The zygoma may also be hypoplastic further reducing the projection of the midface, giving a senile appearance.



Figure 17-1. Clinical pictures showing typical facial characteristics of maxillary hypoplasia and class III dental occlusion in patient with operated cleft lip and palate. Photos by G Deshpande.

Typical Dental Characteristics:

- Class III malocclusion
- Dental rotations and crowding
- Dental compensations, especially in lower incisors.
- Collapsed arches
- Edge to edge bite
- Paucity of vestibule, especially in bilateral cleft lip/ palate patients.
- Alveolar cleft with/without bone graft.



Figure 17-2. Typical dental characteristics in patient with surgically repaired cleft lip and palate. Photos by G Deshpande.

PRESURGICAL PLANNING:

The important steps in presurgical planning are:

- A thorough medical and Dental history.
- Clinical examination of the face, oral cavity, and the temporomandibular joints. This is done in both static and dynamic (functional) phases.
- Clinical photographs with frontal, lateral, Oblique and worms views.
- Dental casts capturing all the teeth with a bite plane to gauge the current occlusion.
- Lateral cephalogram for analysis and prediction tracing.

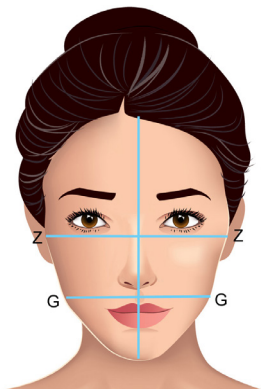


Figure 17-3. The bigonial width should be roughly 30% less than the bizygomatic dimension. © 2017 A Campbell, C Restrepo

Physical Examination:

- The patient should be examined with the head in natural position and teeth in centric occlusion. This has profound effect on the position of chin, the chin- throat angle and the chin-throat length.
- The lips should be in relaxed position to accurately evaluate the relationship of soft tissues to hard tissues.
- In the frontal analysis, the facial form, transverse dimension, facial symmetry and the relationship between the upper, middle and the lower third is established.
- Facial form: the ratio of facial height to width should be 1.3:1 in females and 1.35:1 in males. The bigonial width should be roughly 30% less than the bizygomatic dimension.
- Transverse Dimension: The face can be divided from helix to helix in five equal parts, each equal to the width of the eye. Also, vertical lines drawn from the inner canthus should coincide with the ala of the nose and the medial margin of iris should coincide with the corner of the mouth.

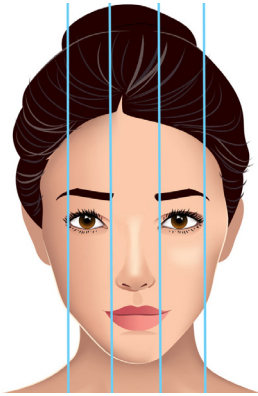


Figure 17-4. The face can be divided into fifths in the transverse dimension. Typical dental characteristics in patient with surgically repaired cleft lip and palate. © 2017 A Campbell, C Restrepo.

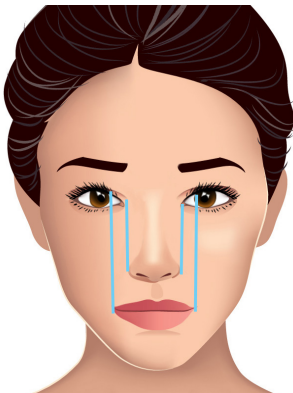


Figure 17-5. Vertical lines drawn from the inner canthus should coincide with the ala of the nose and the medial margin of iris should coincide with the corner of the mouth. © 2017 A Campbell, C Restrepo.

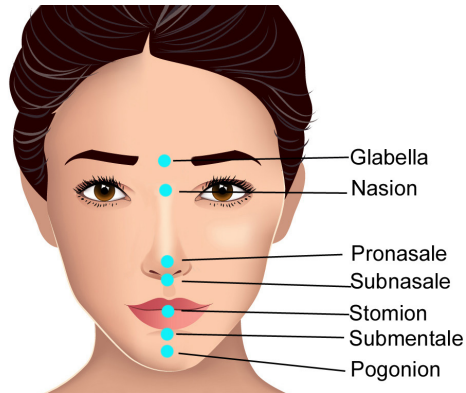


Figure 17-6. Facial symmetry is assessed between the two halves of the face. © 2017 A Campbell, C Restrepo.

- Facial symmetry: to assess the facial symmetry, an imaginary line is drawn from the patient’s soft tissue glabella, pronasale, philtrum

of the upper and lower lip and the soft tissue pogonion. The two halves of the face should then be accessed from top to bottom, covering the rest of the face. This also can be used to find whether the dental midline coincides with the facial midline.

- The vertical relation: the face can be divided into upper, middle and lower third. The upper third is from the hairline to the glabella, the middle third is from glabella to subnasale and the lower third between the subnasale till menton. Discrepancy between each of the three parts and in between each part should be noted. For example in cleft patients the middle third appears deficient than the other two. Also the lower third appears more prominent.

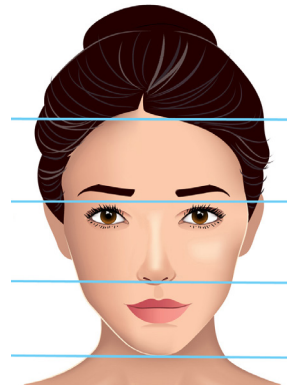


Figure 17-7. Facial thirds in the vertical dimension. © 2017 A Campbell, C Restrepo.

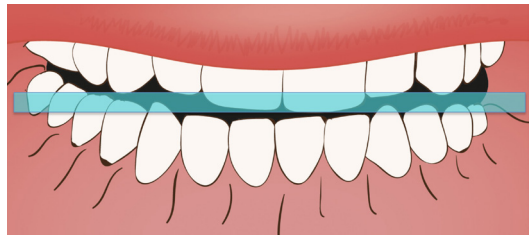


Figure 17-8. Occlusal cant. © 2017 A Campbell, C Restrepo.

- Occlusal Cant: It is very important to record the occlusal cant. This is done by placing a tongue spatula between the occlusal plane and asking the patient to lightly bite on it. Any deviation from horizontal is noted, as this needs to be corrected by differential movement of the jaws during the surgery or orthodontic phase.
- Other areas of face like eyes, nose, cheeks, ears, lips and chin are individually evaluated to record deviations from normal that may need additional surgery.

Orthodontic Phase:

- The Orthodontic phase typically begins at least 1 year before the surgery, if not already commenced during the mixed dentition phase.
- It comprises of dental alignment with correction of all the rotations, compensations and crowding to get a stable dental occlusion after surgery.

- The inclination of the incisors with respect to the bone is very important as they affect the lip support after the surgery.
- In case of missing teeth, which is fairly common in cleft population, the Orthodontist may prefer to maintain space for future prosthetic replacement.
- The orthodontic appliance also serves as anchorage to place elastics during the operative and post-operative phase.

Dental Photographs and models:

- It is imperative to capture high quality clinical and dental photographs for the planning of Orthognathic surgery.
- The views advised are frontal, lateral, oblique and worms views.
- For dental photographs, a cheek retractor is used to clearly note the occlusion and dental arrangement.
- The dental views are frontal, left and right oblique and bird's eye view to determine the negative overjet in case of class III malocclusion.
- Atleast three sets of dental casts should be made. One out of which is made in dental plaster and the other two in dental stone. Plaster casts are used for planning as it is easy to cut plaster. For model surgery however, it is advisable to use dental stone cast as plaster can easily chip and break. The third set is for security!
- Patients bite is registered using modelling wax and is confirmed in the mouth.
- A face bow transfer is made for orienting the maxilla to the skull base, in case a bi-jaw surgery is planned.
- The casts are mounted on the articulator using the face-bow transfer and bite. An adjustable articulator with TM joint function is preferable, although not mandatory.

Radiology and Cephalometrics:

- A thorough examination of oral cavity is complimented by a thorough radiographic examination.
- This includes an orthopantomogram (OPG) to view both jaws to-

gether and to figure out impacted teeth. It also gives a good view of both the TMJs.

- A lateral and frontal cephalogram for planning and prediction tracing.
- All these radiographs should be recent, no more than two months before the surgery.
- There are various analysis that determine the dental, skeletal and soft tissue relations. The choice depends on the orthodontist and the surgeon.
- The prediction tracing can be done on butter/ acetate paper. The jaws are drawn on separate sheets using the lateral cephalogram and cut-outs prepared. These can be moved as per the recommendations from the cephalometric analysis, model surgery and clinical examination.
- It is to be noted that the movement in cleft patients will differ greatly from normal individuals due to scarring and hypoperfused tissues. For this reason, extraordinary movements are avoided.

3D Planning Softwares:

- With the advancement of cone beam CT and advanced computer programs, it had become very convenient to perform the planning of patient.
- These advanced software like Dolphin, Maxilim and others use the 3D reconstruction of the face with hard and soft tissue simulation.
- It has provision to perform the cephalometric analysis and perform virtual surgery to instantly get the final results after the surgery with soft tissue simulation.
- The advantage of these system is that it is very convenient and time saving and the patient can appreciate the changes immediately.
- The drawbacks are the cost and errors due to artefacts caused by metallic fillings and orthodontic appliances.

Model Surgery:

- This is one of the most important step in successful orthognathic surgery.

- The dental casts are mounted on a semi-adjustable articulator. If bi-jaw surgery is required, then an orientation relation guides the casts onto the articulator.
- If only maxillary surgery is planned, then the casts can be mounted by using a hinge articulator and the wax bite.
- Generally the maxillary surgery is performed before the mandible. So even during the model surgery, this is followed. In case of Bi-jaw surgery, an intermediate splint is prepared after the maxillary cast is repositioned into the desired position using sub-apical cuts.
- Generally the bite is opened slightly posteriorly with maxillary impaction in the posterior region.
- In the situation where only maxillary surgery will be performed a splint is prepared (final splint) after the casts are in the planned positions.
- In case of bi-jaw surgery, this will be an intermediate splint.
- Then mandibular cast is repositioned in the final position by performing sub-apical cuts and the final splints are made.
- After the splints are hardened, they are trimmed to get a wafer thin splint. These are immediately immersed into water and then into antiseptic solution.

ORTHOGNATHIC SURGERY:

A significant number of patients treated with cleft lip/ palate will have maxillary hypoplasia requiring Lefort I osteotomy with or with mandibular surgery to achieve facial harmony.

Lefort I Osteotomy:

- The first report of complete mobilization of the maxilla so that the repositioning can be accomplished without tension was given by Obwegeser in 1965.
- Before the surgery is attempted, the model surgery should be done with all necessary markings on the models with measurements as per the cephalometric analysis.
- These measurements should be transferred onto the surgical site.
- This will help the surgeon to accurately move the jaws as per planning.

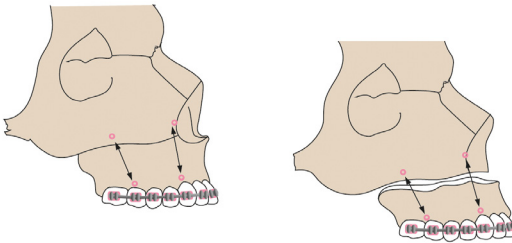


Figure 17-9. LeFort I osteotomy. © 2017 A Campbell, C Restrepo.

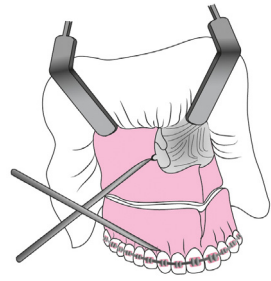


Figure 17-10. Precise movement of maxillary segment.
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Incision and Exposure:

- The exposure of the anterior, lateral and posterior maxilla can be accomplished by placing the incision from first molar to molar in the gingivo-buccal sulcus, above the attached gingiva. It is important not to place the incision in attached gingiva, as it will be tedious to close the wound after surgery.

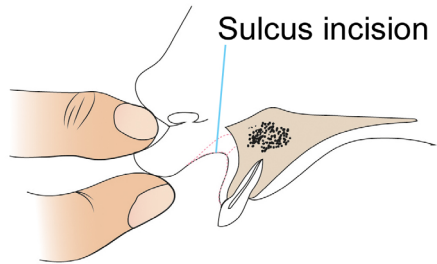


Figure 17-11. Upper gingiva-buccal sulcus incision designed with mucosal cuff. © 2017 A Campbell, C Restrepo.

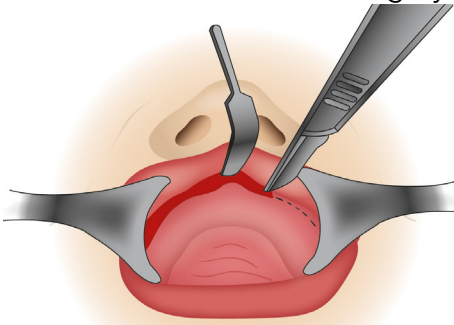


Figure 17-12. Upper gingiva-buccal sulcus incision.
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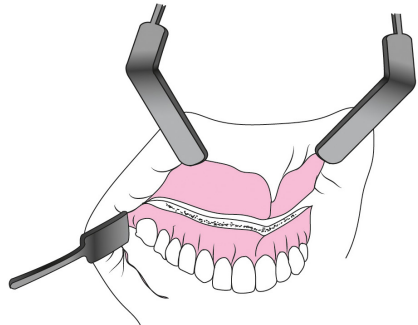


Figure 17-13. Exposure maxilla through upper gingiva-buccal sulcus incision. © 2017 A Campbell, C Restrepo.

- In case of unilateral clefts, the maxilla is two piece if bone graft was not done. In this case the above mentioned incision can be used. The blood supply for the segments is maintained by a posterior mucosal flap.
- In case of bilateral cleft, without bone grafting, the maxilla is three

piece and the incision is not connected keeping behind an anterior mucosal flap.

- After placing the incision, the superior tissues are reflected by subperiosteal dissection, first at the piriform aperture margins.
- Progressively more superior exposure lateral to the nasal aperture will expose the infra-orbital nerve exiting from its foramen.
- Posterior reflection proceeding from the delineated infra-orbital foramen reveals the zygomaticomaxillary suture, zygomatic buttress, and the most anterior aspect of the zygomatic arch.
- Inferiorly, with subperiosteal tunnelling, the lateral aspect of the maxillary tuberosity and its junction with palatine bone and pterygoid plates of the sphenoid bone are identified.
- A curved retractor is placed near the pterygomaxillary junction to facilitate exposure.
- Once the labial incisions are complete, the nasal mucosa is elevated, again maintaining the subperiosteal plane to prevent mucosal tears.

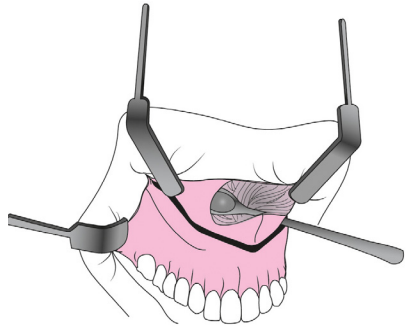


Figure 17-14. Raising nasal mucosa. © 2017 A Campbell, C Res-

Osseous Surgery:

- The cuts for Lefort I begins by placing the tip of oscillating saw just in front of the pterygomaxillary junction and bringing it forward, cutting through the anterolateral wall of maxilla, as planned during the model surgery.
- The same procedure is performed on the other side.
- The septum is divided by using a two-pronged protected osteotome.
- After the osteotomies are made, the pterygoid plates are separated from the maxillary tuberosity. This is done using curved ptery-

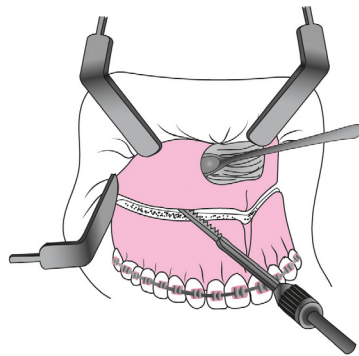


Figure 17-15. Lefort I osteotomy. © 2017 A Campbell, C Restrepo.

goid chisel. It is very important to hold one finger palatal and posterior to maxillary tuberosity as the cut is being made to control the force.

- After all the cuts are made the down fracture of the jaw is done. Each segment is down fractured separately.

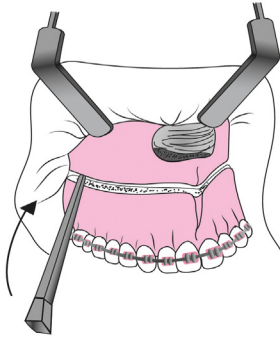


Figure 17-16. Pterygoid chisel used to separate pterygoid plates from maxillary tuberosity. © 2017 A Campbell, C Restrepo.

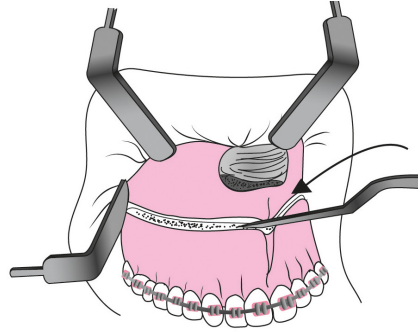


Figure 17-17. Downfracture of maxilla after LeFort I osteotomy. © 2017 A Campbell, C Restrepo.

- The two segments can be manipulated to place each in the optimum position, guided by the occlusal splint.
- After the segments are stabilized to the splint, bone graft can be placed that is harvested from the iliac crest between the segments.

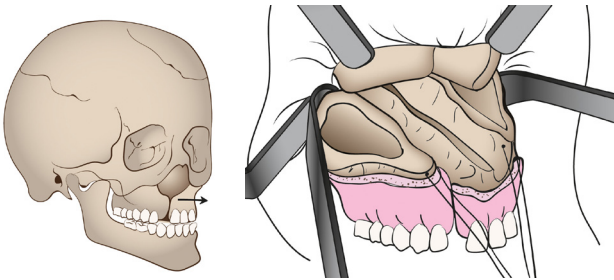


Figure 17-18. Forward movement of segments after LeFort I osteotomy.

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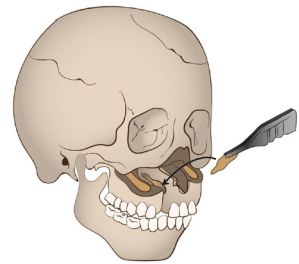


Figure 17-19. Bone graft placed between segments. © 2017 A Campbell, C Restrepo.

- After the bone grafts, the segments are secured using four 'L' plates, two on each side.
- An alar cinch suture is placed to prevent splaying of the alae. This can be accomplished by placing a figure of eight suture which is passed from lateral to medial through the fibroadipose tissue of one

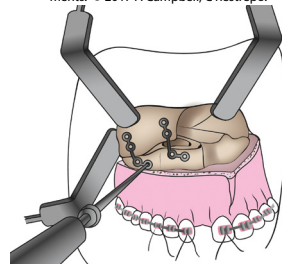


Figure 17-20. Segments secured with two "L" plates each side. © 2017 A Campbell, C Restrepo.

side and is repeated on the other side. The suture is then tied at predetermined width of the ala.

- The closure of the wound can be performed in continuous fashion.

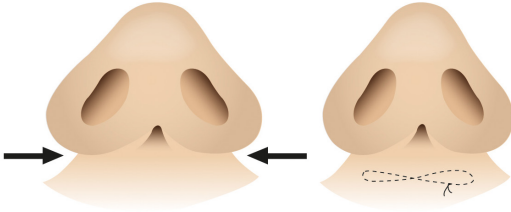


Figure 17-21. Alar cinch suture placed to prevent splaying of alae.

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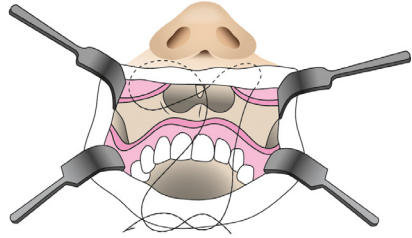


Figure 17-22. Wound closure.

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Speech Outcomes:

- The primary aim of cleft palate surgery is to close the palate without complications and restore a normal velopharyngeal function.
- Multiple surgeries on palate leads to scarring which in turn restricts the normal growth of maxilla, leading to a class III malocclusion.
- In order to restore form and function, a LeFort I osteotomy is performed to advance the maxilla forward.
- Since the muscles of soft palate are attached to the back of the hard palate, any anterior movement will pull the muscles forward which may cause a velopharyngeal incompetence.
- Logically, the more the movement, the more should be the incompetence leading to hypernasal speech. But, multiple studies have failed to prove this relation.
- The patients that are most affected are the patients with already existing incompetence or with borderline incompetence.
- The patients need to be counseled about the possibility of hypernasal speech after maxillary advancement.
- In case the hypernasal speech is exaggerated after the surgery, corrective speech surgery can be performed to improve the length of the palate and correct the velopharyngeal incompetence.

Complications:

- Hemorrhage
- Non union

- Dental and periodontal injuries.
- Alteration in nasal form.
- Unanticipated maxillary fractures

Mandibular Surgery:

Bilateral Sagittal Split Osteotomy (BSSO)

- In patients with severe class III malocclusion, it may not be possible to correct the deformity by performing surgery on one jaw. If the planning indicates the need of two jaw surgery, a bilateral sagittal split osteotomy is performed for mandibular set-back.
- Schuchardt is given credit for the use of intra-oral incision for a step osteotomy of vertical ramus.
- Obwegeser along with Trauner in 1955 described the sagittal split osteotomy.
- A major modification was given by DalPont who suggested that the vertical cut through the lateral cortex behind the second molar. But he also suggested the use of a medial cut that extends just past the lingual so that the posterior split would occur in the mylohyoid groove instead of back at the inferior border.

BSSO Technique:

- Patient is in supine position with naso-tracheal intubation. The tube is fixed to the septum by a 2-0 silk suture or similar sturdy suture to prevent dislodgement during the surgery.
- Ample local anesthesia solution with epinephrine is injected near the area of incision.
- Bilateral inferior alveolar nerve blocks with lingual and long buccal

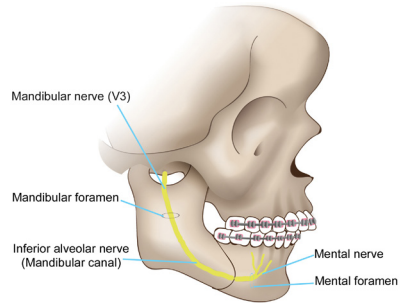


Figure 17-23. Bilateral sagittal split osteotomy.
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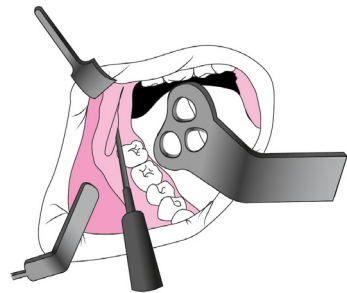


Figure 17-24. Mucosal incision for BSSO from anterior border mandibular ramus along external oblique line. © 2017 A Campbell, C Restrepo.

nerve blocks can be placed using long acting bupivacaine solution.

- Electro cautery with Colorado tip is used to place incision along the anterior border of the ramus, extending anteriorly on the external oblique ridge until the first molar. The length of this incision depends on the amount of setback required.
- Sub-periosteal dissection is done to expose the inferior border of mandible anteriorly and till the posterior border lingually.
- A bifurcated periosteal elevator is used to strip the periosteum along with the muscular attachments on the anterior border of the ramus towards coronoid process.
- A bifurcated retractor now replaces the bifurcated elevator, which is slowly removed and the retractor slipped in place simultaneously.
- The lingula is identified by a right angle dental instrument to be sure of the nerve entering the foramen.
- A 'J' shaped retractor can be placed to the posterior border of the ramus above the lingula. This will not only retract the tissues, but also protect the nerve and posterior soft tissues during the osteotomy. Alternatively, a lighted ramus and medial retractor can be used for better visualization.
- If the anterior border is to concave, a large round bur is used to make a groove in the anterior border for better visualisation of the medial surface.
- The medial corticotomy is carried out using a thin fissure bur or an oscillating saw above the lingula and below the sigmoid notch. It is imperative to be just above the lingula and not too close to the sigmoid notch to prevent condylar fracture.
- This corticotomy is carried throu-

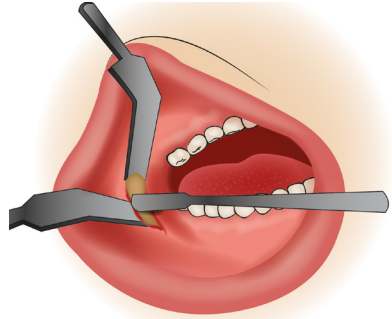


Figure 17-25. Sub-periosteal dissection is done to expose the inferior border of mandible anteriorly and till the posterior border lingually. © 2017 A Campbell, C Restrepo.

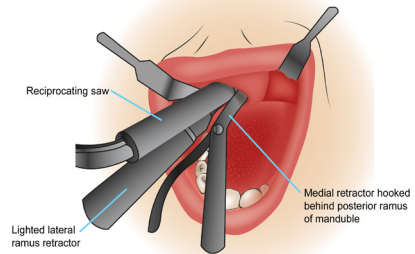


Figure 17-25. Sub-periosteal dissection is done to expose the inferior border of mandible anteriorly and till the posterior border lingually. ©

gh the inner cortical table of ascending ramus to its anterior border above the nerve.

- The medial retractor is removed and a mandibular lower border retractor is placed.
- Now, the anterior border is split by placing the saw on the inner surface of the outer table.
- The corticotomy continues from the anterior border to the body of the mandible. The saw blade cuts through the inner surface of the cortex.
- The osteotomy is completed by sawing through the inferior border of the mandible.
- The split is carried out by placing a thin osteotome in the medial cut and is gently tapped. This osteotomy is extended at least till the back of lingula to avoid bad split.

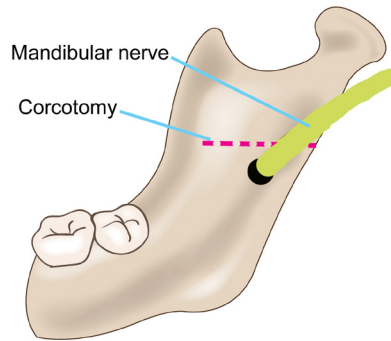


Figure 17-26. Medial corticotomy is carried out above the lingula and below the sigmoid notch. © 2017 A Campbell, C Restrepo.

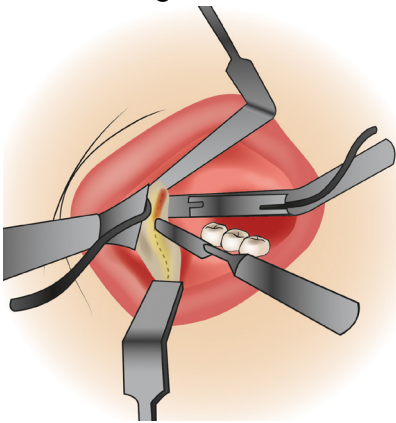


Figure 17-27. Osteotomy continued through inner cortical table of ascending ramus. © 2017 A Campbell, C Restrepo.

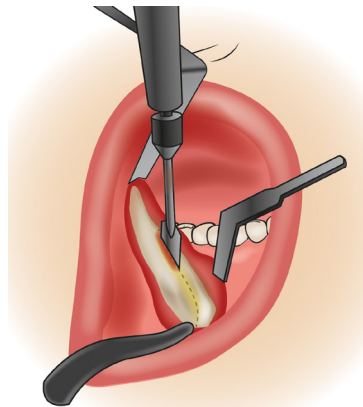


Figure 17-28. Osteotomy along anterior border. © 2017 A Campbell, C Restrepo.

- The anterior corticotomy is also deepened by a thin osteotome. The medial and the anterior osteotomies are connected by this thin osteotome.
- Now with a wedge osteotome, the mandible is split at the osteotomy. Care should be taken to avoid excessive force. If the mandible is not splitting easily, the osteotomies are inspected using

light suction to delineate the area of incomplete osteotomy.

- After all the cuts are made thoroughly, the split should occur with minimum force.
- After the mandible is split, the nerve should be noted and all the cuts inspected for bad split.
- Before starting the other side, it is prudent to place a small gauze piece soaked with a vasoconstrictor solution into the cut.
- The same procedure is repeated on the contralateral side.
- After the split, the mandible is maneuvered using gentle force to note any interferences.
- The mandible is then fixed to the splint and gently guided into the pre-determined position. The jaws are immobilized using intermaxillary fixation.
- Fixation can be done by a variety of methods. The author prefers using three bi-cortical screws. The author prefers using three bi-cortical screws, above and below the nerve to get a stable fixation. This can be achieved by transbuccal fixation to ensure that the screws are perpendicular.
- Some authors have reported good stability even when the screws are oblique.
- Once the fixation is completed the intermaxillary fixation is removed to note any immediate relapse.

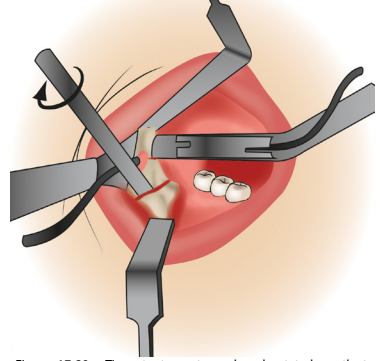


Figure 17-29. Tin osteotome tapped and rotated gently to create split. © 2017 A Campbell, C Restrepo.

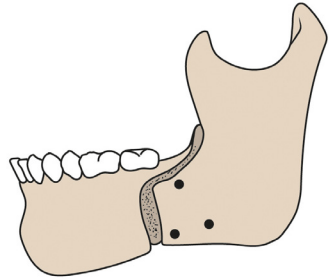


Figure 17-30 BSSO fixation using three bicortical screws. © 2017 A Campbell, C Restrepo.

Complications:

- Haemorrhage:
- Loss of vascularity
- Bad split
- Condylar fracture

- Injury to inferior alveolar and or lingual nerve
- Injury to teeth
- Non-union or delayed union
- Relapse due to improper fixation.

KEY READING

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