Maxillary Swing Approach to the Nasopharynx

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INTRODUCTION

The nasopharynx may contain pathology that requires surgical intervention. This may be done endoscopically as a minimally invasive procedure or as an open procedure. The advantage of an open procedure is the better surgical access it offers. There are a variety of open routes to the nasopharynx including transnasal, transmaxillary, infratemporal fossa and transpalatal approaches. The maxillary swing is a variation of a transmaxillary approach and offers wide access to the nasopharynx as well as to the pterygopalatine fossa and pterygomaxillary fissure. At the same time the approach preserves soft palate function which is so vital for speaking and swallowing. Indications for performing a maxillary swing approach to the nasopharynx include the surgical excision of a locally residual or recurrent nasopharyngeal malignancy which is usually a carcinoma or resection of a recurrent juvenile nasopharyngeal angiofibroma. This approach is also used for covering an exposed internal carotid artery with a pedicled or free flap following radionecrosis of the nasopharynx after radiotherapy for a nasopharyngeal malignancy.

SURGICAL STEPS

Pre-operative consent includes but is not limited to the facial incisions, loss of sensation in the infraorbital nerve distribution, possible loss of the maxilla bone, wound dehiscence and breakdown, oronasal and oronasopharyngeal fistulae and ectropion.

The operation may be considered in three stages: First the soft tissue preparation - the incisions and limited soft tissue dissection to expose bone for the osteotomies, second the bone work involving - miniplate preparation, the osteotomies and the maxillary swing, and thirdly the closure.

It is important to complete the soft tissue dissection and bone exposure before doing any bone work to avoid excessive blood loss.

GENERAL PREPARATION

A routine tracheostomy is performed either under local anaesthesia or following the administration of a general anaesthetic. Peri-operative antibiotics are given on induction of general anaesthesia.

The patient is positioned supine and the head supported with a head ring. An ocular lubricant or ointment is placed into both eyes, such as chloramphenicol eye ointment if the patient is not allergic to it. The eyes are protected according to the institution’s protocol. The contralateral eye may be covered with a transparent protective adhesive dressing. A tarsorrhaphy is performed on the ipsilateral eye taking care not to invert the eyelashes which avoids corneal abrasions.

The patient’s face and neck are prepared with the institution’s usual topical solution. An alcohol based solution, or other solution that may be irritant to the eyes or to which the patient is allergic should be avoided. The oral cavity is also prepared. The nasal cavity is packed with topical vasoconstrictor soaked ribbon gauze.
The scalp, lower neck and chest are draped, leaving the forehead, face, upper neck and both ears exposed.

Using a sterile skin marking pen, draw an incision 5 mm below and parallel to the lower eyelid lash line. This incision is placed close to the palpebral margin so that oedema of the lower lid above the scar is avoided after surgery.

At the vertical or parasagittal plane of the lateral orbital rim, the incision turns postero-inferiorly towards the 135 degree angle that the inferior border of the maxillary process of the zygoma makes with the zygomatic process of the maxilla. This inferior border can be palpated through the soft tissues of the lateral cheek. The incision is marked to the midpoint of this angled line between the lateral orbital rim and the inferior border of the zygoma. This incision is roughly parallel but posterior to the zygomaticomaxillary suture line.

The medial end of the lower eyelid incision is not carried onto the nasal bone as would be the case for a Weber Ferguson incision that is made to follow the concept of facial subunits. Instead this incision avoids the epicanthal fold and so turns inferior just before the vertical or parasagittal plane at the medial canthus to follow the junction of the cheek and the lateral nose to the ala. It then follows the alar groove into the nostril. After a 90 degree notch is made on the nasal sill of the vestibule floor, the incision then continues to the midline junction of the columella and the lip, at which point it turns inferiorly through 90 degrees and continues in the midline of the philtrum to the midline of the upper vermilion border of the lip. Figure 1 A notch is made at the vermilion border and the incision continues in the midline of the lip and through the superior labial frenulum to the midline gingiva between the upper central incisors.
Use a tonsil or Ferguson Auckland mouth gag to open the mouth and retract the tongue to visualize the hard and soft palates.

On the hard palate mucosa a paramedian or parasagittal incision is marked 7 mm from the midline on the side of the swing. Make a mark from the junction of the hard and soft palate posteriorly to the premaxilla mucosa anteriorly where the incision turns towards the midline and to the gingiva between the two upper central incisors.

Identify the maxillary tuberosity and the bony spines of the pterygoid plates and pterygoid hamulus immediately posterior to the tuberosity.

The posterior end of the hard palate incision is continued laterally through the soft palate mucosa to the posterior surface of the ipsilateral maxillary tubercle.  

Figure 1
The skin incisions for the maxillary swing approach. The medial canthal structures are avoided. A notch is marked in the nasal vestibule and at the vermillion border.

Figure 2
The hard palate paramedian and soft palate incision.
All incisions are infiltrated with a vasoconstrictor such as 1:80,000 adrenaline. All facial skin and palatal incisions are made with a scalpel and are carried through from the skin or mucosa to the periosteum and onto bone. The lower eyelid and soft palate incisions are exceptions.

With very gentle pressure on the eye, and with retraction of the cheek skin, the lower eyelid is put under tension and the skin incised with a number 15 scalpel blade. Figure 3

The skin is divided until the stretched orbicularis oculi muscle is visible. This muscle is gently stroked with the scalpel blade until all the fibres are divided taking care not to incise into the inferior orbital septum or anterior capsule of the inferior orbital fat pad. Using single skin hooks to retract the lower eyelid skin, the skin and orbicularis muscle are elevated with sharp dissection as a unit from the orbital fat pad in a preseptal plane. Using sharp dissection on the inferior orbital fat pad septum will preserve facial nerve branches which innervate the orbicularis muscle on its deep surface. Figure 4

As the medial end of the lower eyelid incision turns inferior, the angular vein and artery will be encountered. They should be ligated and divided otherwise they tend to retract and bleed. Figures 5, 6
**Figure 3**
The lower eyelid is put under gentle tension and the incision made.

**Figure 4**
The lower eyelid musculocutaneous flap is elevated off the inferior orbital fat pad (yellow arrow) in the preseptal plane. OC – orbicularis oculi.

**Figure 5**
The angular vessel encountered in the facial incision (indicated above).

**Figure 6**
The angular vessels are ligated and divided.
The inferior orbital septum fuses with the periosteum at the superior surface of the inferior orbital rim. The periosteum of the inferior orbital rim is incised anterior to this fusion on the anterior surface of the rim, so as to preserve the integrity of the inferior orbital fat pad. *Figure 7*

Using a periosteal elevator such as a Howarth's, the soft tissues of the cheek are elevated off the upper maxilla in a subperiosteal plane to the level of the infra-orbital foramen. *Figure 8* The infraorbital nerve and vessels are identified, ligated and divided. *Figure 9*

Do not elevate the soft tissue off the anterior maxilla further inferior than the infraorbital foramen as the maxilla depends on the soft tissue of the cheek for its blood supply.

At the lateral end of the lower eyelid incision, stay in the subperiosteal plane and elevate tissue laterally off the zygoma until the inferior margin of the zygoma can be palpated with the angled end of the elevator. It is not necessary to incise the skin over the entire zygoma, but just enough to allow the osteotomy to be made. Usually the skin incision is made to the midpoint of the zygoma.

Muscles incised with the facial incision include the orbicularis oculi, nasalis and orbicularis oris. *Figure 10*

Once the rim of the ipsilateral pyriform aperture has been defined, free the nasal cavity soft tissues from the margin of the nasal aperture with diathermy.

Retract the nasal ala medially and incise the lateral wall of the nasal vestibule to expose the ipsilateral nasal cavity and inferior turbinate, taking care not to injure the inferior turbinate or septum so as to avoid troublesome bleeding.
Figure 7
The lower eyelid incision is carried through the skin and orbicularis muscle. The lower eyelid musculocutaneous flap is elevated off the inferior orbital fat pad in the preseptal plane and the orbital periosteum incised on the anterior aspect of the inferior orbital rim.

Figure 8
The soft tissues of the cheek are elevated off the upper maxilla in a subperiosteal plane to the level of the infra-orbital foramen.

Figure 9
The infra-orbital nerve and vessels (yellow arrow) are ligated and divided.

Figure 10
Facial muscles divided with the facial incision.

Orbicularis oculi
Orbicularis oris
In this way the nasal cavity is entered through the facial wound. At the inferior margin of the aperture, use an elevator to elevate the mucoperiosteum of the floor of the nasal cavity. Elevate the entire nasal cavity floor mucoperiosteum from the septum medially to the lateral aspect of the inferior meatus laterally and from the pyriform aperture anteriorly to the posterior margin of the hard palate posteriorly, which is the horizontal plate of the palatine bone. Then incise the elevated mucosa from anterior to posterior as lateral as possible to create a medially based mucoperiosteal flap that will be used to cover the maxillary osteotomy at the end of the procedure. Figures 11, 12

A scalpel is used to incise the mucosa of the hard palate along the planned paramedian incision onto bone. The incision is extended laterally on the soft palate from the posterior edge of the hard palate incision to the groove between the maxillary tuberosity and the pterygoid plates. Figure 2

Use a periosteal elevator in the subperiosteal plane to elevate the hard palate mucoperiosteum off the hard palate bone on the non-swing side of the palatal incision to just beyond the midline. Figure 12

**Soft Tissue Dissection to Expose Bone for the Osteotomies**
Figure 11
Coronal view of the hard palate and nasal floor showing mucosa in pink.

Figure 12
Coronal view of the hard palate and nasal floor showing the positions of the respective mucosal incisions and elevated mucoperiosteal flaps. The position of the osteotomy is indicated by the dotted line.
Bone Work, Miniplate Preparation, Osteotomies and the Maxillary Swing

Refer to the patient’s sagittal imaging to confirm that the orbital floor does not dip below the level of the infra-orbital foramen in the plane of the foramen nor at the midpoint of the orbit. Figures 13, 14

If this is the case, the osteotomy must be placed below the level of the orbital floor. If the orbital floor does not bulge or hang into the antrum, then a straight horizontal osteotomy is marked at the level of the inferior margin of the infra-orbital foramen, from the rim of the pyriform aperture medially to the malar surface of the zygoma laterally. Figures 15-18

This osteotomy will separate the boney orbit superiorly from the remaining maxilla/zygoma inferiorly. At the lateral end of this osteotomy, a second osteotomy is marked at 90 degrees to the postero-inferior border of the zygoma. This osteotomy completes the division of the zygoma. Figure 18

A third vertical osteotomy is marked in the midline of the anterior surface of the maxilla and extends to between the upper medial incisors. Figure 15 On the exposed hard palate bone (the palatine process of the maxilla and horizontal plates of the palatine bones), the plane of the vertical osteotomy is marked just off the midline on the ipsilateral side so that it divides the nasal cavity floor from the septum. This osteotomy divides the maxilla just off the midline away from the septum, so that the septum remains intact articulating with the contralateral maxilla. Figures 12, 15, 24

A 1 cm x 1 cm sagittal saw blade is used to mark the osteotomies where two 4-hole miniplates will be placed and their holes drilled.

Two 4-hole miniplates are contoured to the bone. One plate is placed in the midline of the anterior surface of the maxilla where
Figure 13
The sagittal plane of the orbital floor at the infra-orbital foramen (indicated above).

Figure 15
Anterior view of a dry skull showing the positions of the osteotomies.

Figure 14
The sagittal plane of the orbital floor at the mid-orbit.

Figure 16
Oblique view of a dry skull showing the positions of the osteotomies.
a very prominent crest may need to be burred down to facilitate plating. It is important that the holes avoid the roots of the teeth by positioning the miniplates above or between the teeth roots if the height of the maxilla is inadequate. Figure 19

The second miniplate is positioned over the osteotomy that divides the lower lateral free border of the zygoma. The miniplates should be positioned at 90 degrees to the osteotomy Figure 20. As each hole is drilled a screw is inserted but not tightened fully. This is done before drilling the next hole. Drilling all the holes before inserting screws may lead to misalignment of the holes. Remove all screws and record or mark the orientation of the plates. A drawing using sterile adhesive strips to attach the orientated plates to the diagram is suggested.

A heavy curved osteotome is inserted into the oral cavity and its blade positioned into the mucosal incision behind the maxillary tubercle to divide the maxillary tuberosity from the pterygoid plates. Figures 21, 22

Using a finger to guide the osteotome and then it is tapped by an assistant and the osteotomy completed. This intentional separation ends superiorly in the pterygomaxillary fissure and the pterygopalatine fossa. There will be no movement of the maxilla at this stage as none of the other osteotomies have yet been completed. This is done first while the maxilla is still stable, otherwise unpredictable fracturing of the pterygoid process can occur.

The maxilla and zygoma osteotomies are deepened to the hilt of the more controllable 1 cm oscillating saw blade, keeping the blade perpendicular to the
Figure 17
Zygomatic process (blue arrow), Frontal process (red arrow) and Alveolar process (yellow arrow)

Figure 18
The infra-orbital (yellow arrow) and zygomatic (blue arrow) osteotomies. The ligated infra-orbital neurovascular bundle is visible.

Figure 19
Plating the alveolar osteotomy.

Figure 20
Plating the zygomatic osteotomy.
Bone Work, Miniplate Preparation, Osteotomies and the Maxillary Swing

bone. The blade is then changed for a longer 4 cm blade. At some time prior to this, the axial image should be reviewed and the anterior-posterior dimension of the maxillary sinus measured to determine the distance from the anterior surface of the maxilla to the posterior wall of the maxillary sinus. Figure 23

The posterior wall of the maxillary sinus is thin and will easily fracture when the maxilla is mobilized. It does not need to be sawed, which should actually be avoided. Sawing the posterior wall of the antrum will lacerate the internal maxillary artery and lead to torrential bleeding before the osteotomies can be completed and the maxilla swung away to gain access to the bleeding artery.

When making the inferior orbital osteotomy it is important to keep the sagittal saw blade horizontal. It is especially important to know about the level of the orbital floor and whether it dips below level of the infra-orbital foramen, which can be determined from the preoperative imaging. This is to avoid injuring the contents of the orbit while making the osteotomy, the lateral nasal wall will offer increased resistance medially, and the lateral wall of the antrum will offer increased resistance laterally. The resistance decreases significantly once these walls have been divided.

When making the midline vertical paramedian or parasagittal maxillary osteotomy under direct vision, an assistant ensures that the hard palate mucoperiosteal flap and the nasal floor mucoperiosteal flap are both retracted away from the blade so as not to damage or lacerate them. Figure 12 The palatal osteotomy is extended posteriorly to the posterior margin of the hard palate. Figure 24

A sharp straight osteotome is then inserted into the anterior osteotomy and gently twisted to finalize fracturing the bone.
**Figure 21**
The (red arrow) indicates the position that the blade of the curved osteotome is placed by palpation to divide the maxilla from the pterygoid process.

**Figure 22**
The blade of the curved osteotome is placed by palpation into the groove posterior to the maxillary tubercle in order to divide the maxilla from the pterygoid process.

**Figure 23**
The horizontal distance between the infraorbital foramen and the posterior wall of the antrum should be estimated prior to the horizontal infra-orbital osteotomy. This facilitates the appropriate selection of the saw blade length to avoid lacerating the maxillary artery.

**Figure 24**
The position of the vertical maxillary osteotomy is just to the ipsilateral side of the midline to avoid the nasal septum.
This is usually the thin posterior wall of the maxillary antrum where it is best that the oscillating saw blade does not reach to avoid lacerating the internal maxillary artery. Figures 25, 26 If the maxilla remains stable, twisting and tapping a sharp straight osteotome can be performed at multiple sites. Take care not to damage the screw holes.

When the maxilla is loose it is gently retracted or swung laterally and any soft tissue that is tethering the maxilla is divided with a pair of curved mayo scissors. Figure 27 The maxilla is wrapped in a long saline soaked swab which is used to retract and keep the maxilla out of the surgical field with a Rochester pean forceps or equivalent.

If there is significant bleeding, it is usually due to laceration of the internal maxillary artery and this must be quickly stopped. Using suction and a long curved haemostat, the artery is clamped, divided and tied with a strong silk ligature.

The inferior turbinate is excised and the posterior nasal septum can be resected for better exposure of the nasopharynx.
Figure 25
A thin sharp osteotome is placed into the osteotomy and gently twisted to complete the fracture of the posterior wall of the antrum.

Figure 26
The twisting of the osteotome finalizes the bone work. Soft tissue remains to be divided before the maxilla is fully swung laterally.

Figure 27.
The position of the maxilla once it has been fully swung laterally. It remains based on the soft tissues of the cheek.
Closure

Bleeding that occurs from the pterygoid venous plexus may initially be controlled with packing. Meticulous haemostasis is achieved with bipolar cautery, suture ligatures, clips, bone wax, oxidized cellulose polymer and topical haemostatics.

A fine bore nasogastric tube is placed via the contralateral nasal cavity for postoperative enteral feeding.

Depending on the operation, the nasopharyngeal wound may be left to mucosalize, dressed with a mucosal graft taken from the inferior turbinate or with a vascularized septal mucosal flap based on the posterior septal branches from the sphenopalatine artery.

The nasopharynx is packed with a dressing via the ipsilateral nasal cavity, such as a single length of paraffin gauze, to hold any graft in place and to aid mucosalization. A foley catheter is inserted into the nasopharynx via the contralateral nasal cavity and the balloon inflated with sufficient sterile water to prevent the pack from slipping into the oropharynx.

On the swung maxilla, an inferior meatal antrostomy is fashioned by carefully elevating the mucosa off the medial wall of the antrum and using a bone nibbler to remove the bone. The mucosa is laid over the raw bone. In this way the crest between the nasal cavity floor and antral floor is removed which allows free drainage of antral mucus in the future.

The soft and hard palate mucosal incision is preloaded with 3.0 synthetic absorbable polyglycolic acid sutures. This will allow for the accurate placement of the sutures while maximum access is available. Posteriorly it is best to insert the suture through the mucosa of the soft palate and then through the posterior mucosa of the swung maxilla. Medially it is best to insert the suture through the mucoperiosteum of the swung maxilla and then through the
mucoperiosteum of the contralateral hard palate flap. The sutures are kept in order by clamping each with a haemostat and sliding its finger grip onto a closed larger forceps.

The maxilla is then reduced and held firmly in position. Figure 28 At this point make sure the mucosal flap of the nasal floor or any packing material is not trapped between the maxilla bones. While maintaining accurate reduction, the two 4-hole miniplates are securely screwed into place and each screw tightened but not to the point of stripping either the bone or screw thread. Figures 19, 20

The sutures of the palate mucosa are tied starting posteriorly. Care should be taken as it will not be possible to reinsert a suture should it tear out or break.

The facial and lip wounds are closed in two layers, a deeper subcutaneous layer and a skin layer. The subcutaneous layer and lip mucosa are closed using a 3-0 braided absorbable suture. The skin is closed using a 4-0 non-absorbable monofilament suture except for the lower eyelid where a 5-0 is used.

It is important to securely anchor the superomedial corner of the cheek flap to its counterpart. This is to ensure that the main stress of the cheek flap is taken at this point and is not transmitted to the lower eyelid wound. This is accomplished by preloading four braided absorbable sutures with sufficient tissue on both sides of the wound before tying the sutures and closing the rest of the cheek and eyelid wounds.

A prefabricated palatal dental splint is securely placed to maintain apposition of the hard palate mucoperiosteal flap against the underlying bone during the healing phase.
Day 0 - The following are ordered on the day of the operation or the following day. Peri-operative antibiotics are continued for 5 days. A chest X-ray is performed to confirm the position of the nasogastric tube prior to feeding. Chest physiotherapy, tracheostomy care and suctioning. Institution-based mouth care.

Day 1 - The nasopharyngeal foley is deflated after 24 hours.

Day 5 - The lower eyelid sutures are removed.

Day 6 - The nasopharyngeal pack is shortened and loosened on day 6.

Day 7 - The nasopharyngeal pack is removed on day 7. Start rinsing the nasal cavities and nasopharynx three times a day with normal saline. The rest of the facial sutures are removed.

Day 8 - The tracheostomy tube is removed if there has been no significant bleeding.

Day 14 - The nasogastric tube is removed and an oral liquid diet begins on day 14.

Day 21 - A soft diet begins if the palatal wounds are well healed.

**Figure 29**
The facial scar of a patient who underwent a maxillary swing procedure.
KEY POINTS

1. Complete the soft tissue dissection and bone exposure to avoid excessive blood loss before doing any bone work.
2. Make the lower eyelid incision close to the palpebral margin, 5 mm below and parallel to the eyelid lash line, to avoid oedema of the lower lid above the scar.
3. The hard palate mucosal incision is made in a paramedian or parasagittal plane and 7 mm from the midline on the side of the swing.
4. The lower eyelid flap (skin and orbicularis muscle) is elevated off the orbital fat pad in a preseptal plane taking care not to incise into the capsule of the fat pad.
5. Via the pyriform aperture, elevate the mucoperiosteum of the entire nasal cavity floor and then incise the elevated mucosa from anterior to posterior as lateral as possible to create a medially based mucoperiosteal flap.
6. A heavy curved osteotome is placed behind the maxillary tubercle to divide the maxillary tuberosity from the pterygoid plates.
7. A straight horizontal osteotomy is made at the level of the inferior margin of the infraorbital foramen, from the pyriform aperture to the malar surface of the zygoma.
8. A straight vertical osteotomy is made just off the midline on the ipsilateral side to divide the nasal cavity floor keeping clear of the septum.
9. A thin sharp osteotome is placed into the osteotomies and gently twisted to complete the fracture of the posterior wall of the antrum which frees the maxilla.
10. The loosened maxilla is gently retracted laterally and any soft tissue that is tethering it is divided with a pair of curved mayo scissors.