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TRANSORBITAL NEUROENDOSCOPIC SURGERY (TONES) TECHNIQUES FOR PARANASAL SINUS AND SKULL BASE PATHOLOGY

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Minimally invasive transorbital neuroendoscopic surgery (TONES) is performed through surgical portals created between the bony walls of the orbit and the periorbital fascia and by gently pushing the orbital contents aside. Endoscopes and instruments can then be passed through these surgically created pathways to access pathology located ***within the orbit's four bony walls***, or addressing ***pathology located in the paranasal sinuses or difficult-to-reach skull base space*** by breaching the orbital walls. Neurosurgeons can also address ***intracranial pathology, especially in the anterior and middle cranial fossae***.

Endonasal approaches permit access to all the paranasal sinuses, medial orbit, pterygopalatine and infratemporal fossae, and midline skull base from the cribriform area to the pituitary fossa and beyond. Its limitation however is to address pathology in well-pneumatised sinuses, especially the frontal and sphenoid sinuses. This is where ***transorbital surgery allows access to some areas of the paranasal sinuses that may be difficult to reach or require exceptional skill with standard endonasal techniques***.

TONES is also a useful adjunct to address ***lesions that cross surgical boundaries***. Some areas are better accessed with TONES approaches e.g., the precaruncular approach provides quick and direct access to the ***ethmoidal arteries*** and avoids a scar of a Lynch-Howarth incision and avoids trauma to the orbicularis muscle and surrounding neurovascular structures.

Surgical portals

Each orbit provides 4 surgical portals: superior, lateral, medial, and inferior. When combined with the 2 endonasal corridors, multiportal surgery can be performed using any combination of these 10 portals. This flexibility allows a variety of trajectories to be used to target the surgical area with a zero-degree endoscope and allows instruments to be manipulated at different angles. For instance, a maxillary sinus tumour invading the orbital floor and inferior orbital tissues and extending along the infraorbital nerve can be resected via an inferior orbital portal together with an endonasal approach.

Preoperative planning

A ***multidisciplinary approach is essential*** to ensure that the best surgical approach is selected. The ***multidisciplinary team*** should include an otolaryngologist, ophthalmologist, and a neurosurgeon. They must be involved with planning the surgical approach(es) and should decide who should be involved at each stage of the surgery. If the periorbital fascia is crossed to resect an orbital lesion, an ophthalmologist should ideally be involved. Similarly, when dura is breached, a neurosurgeon should be involved.

The ***approach*** must provide access to the pathology and ensure complete resection and should be the most direct approach to the target area without causing collateral tissue damage to normal, uninvolved anatomical structures.

Ophthalmology assessment should be done of visual acuity, fundoscopy, intraorbital pressure and proptosis.

Imaging may include CT and MRI of the orbits, paranasal sinuses, and brain.

Contraindications to surgery should be determined. Patients should stop aspirin and

other anticoagulants prior to surgery. The risk of causing ocular trauma needs to be weighed against the benefits of transorbital surgery. Consulting an ophthalmologist is essential if ocular pathology exists prior to transorbital surgery.

- ***Relative contraindications***
  - Prior intraocular surgery within 6 months as it increases risk of ocular rupture when retracting the globe
  - Corneal ectasia
  - Glaucoma
  - Shallow orbit
  - Only seeing eye
  - Prior retinal or optic nerve ischaemic event

- ***Absolute contraindications***
  - Intraocular surgery within 6 weeks has a high risk of wound dehiscence
  - Advanced glaucoma
  - Severe corneal ectasia
  - Scleromalacia
  - Ocular ischaemic syndrome
  - Acute infections such as acute dacryocystitis or conjunctivitis need to be treated prior to surgery

Image guidance may be useful to plan for but is not essential. Electromagnetic navigation is preferred to avoid line-of-sight issues.

Intraoperative preparation

- ***TIVA (Total Intravenous Anesthesia)*** is generally used as multiportal surgery often involves using the endonasal route as well
- ***Patient positioning*** is the same for all four approaches and is similar to standard endoscopic sinus surgery with the head slightly flexed and turned towards the surgeon. An exception is with frontal sinus pathology in which case the head needs to be extended as for a Lothrop operation to achieve the correct angle to access the frontal sinus
- ***The surgeon stands*** to the right of the patient (as with FESS) for the superior-lateral and medial approaches and at the head of the patient (as for tonsillectomy) for the inferior approach. It may be easier to stand on the same side as the eye being operated on during the initial incision
- ***Draw*** the superior eyelid crease incision prior to infiltration with a marking pen
- After the patient is draped, ***local anaesthesia*** (Lidocaine hydrochloride 2% and adrenaline 1:80 000) is injected into the incision site
- ***Lubricate the eyes*** throughout surgery
- Keep the ***pupils exposed***
- ***Monitor pupil shape and size***, especially during retraction of the orbit. A change in pupil shape and size may occur with increased intraorbital pressure or with traction on neurovascular structures and is an indication to relax the malleable retractor for a few seconds until the pupil returns to normal

Surgical instruments

Essential instruments include the following, in the order in which they will be required:

- Dental syringe for local anaesthesia
- Sharp-tipped curved iris scissors
- Fine-tipped forceps
- Malleable retractors - sizes 8, 10, 12, 15 mm diameter *(Figure 1)*. Malleable retractors are absolutely essential to access any of the four portals and can usually be found on oculoplastic or neurosurgery surgical trays
- Suction elevator
- Freer elevator
- Cottle elevator
- Standard FESS set

- High speed endonasal drill with short-shafted burrs to prevent shaft catching orbital fat and muscle

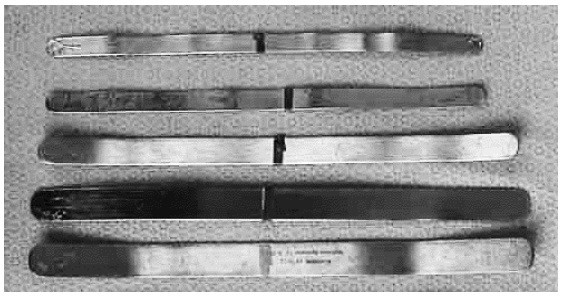

Figure 1: Malleable retractors

Four transorbital surgical portals

Each orbit provides 4 potential surgical portals for TONES: ***superior, lateral, medial, and inferior***.

1. Superior Portal

The superior portal provides wide access to:

- Superior orbit
- Orbital roof
- Frontal sinus (including laterally)
- Anterior cranial fossa lateral to cribriform plate

The superior portal overcomes limitations of a purely endonasal approach to access the ***lateral part of a well-pneumatized frontal sinus***. While a modified endoscopic Lothrop procedure may allow good visualisation of the lateral part of a well-pneumatized frontal sinus, angled endoscopes are often required, and even a 70-degree Lothrop drill-burr may not reach the lateral wall of the frontal sinus to remove bone infiltrated by an inverting papilloma. Hence an external surgical approach is often needed to ensure complete clearance to complement a transnasal endoscopic approach.

The superior portal can also be used to safely drain extradural ***abscesses*** secondary to frontal sinusitis, avoiding a craniotomy.

The authors generally use a ***superior eyelid crease incision*** for the superior orbital approach *(Figure 2)*. The ***superior eyelid crease incision*** causes minimal morbidity and discomfort and is cosmetically favourable. When pathology is limited to the superior orbit, anterior cranial fossa or medial aspect of the frontal sinus, the incision does not have to be extended beyond the lateral canthus. It permits both inferior and medial retraction of the orbital contents.

Figure 2: Superior eyelid crease incision (left eye)

Superior and extended superior eyelid crease approaches: Surgical steps

- Hide the skin incision in the eyelid crease for a cosmetically acceptable scar *(Figures 2, 3)*
- Using loupes, identify and mark the natural superior eyelid crease approximately 6mm above free margin of the upper eyelid *(Figures 2, 3)*
- The *levator palpebrae superioris* muscle attaches to the tarsal plate to form the upper eyelid crease *(Figure 4)*
- Inject the incision line with local anaesthetic with vasoconstrictor to provide haemostasis
- Use an ***extended superior eyelid crease approach*** to gain additional access to the superior and lateral orbital portals *(Figure 3)*

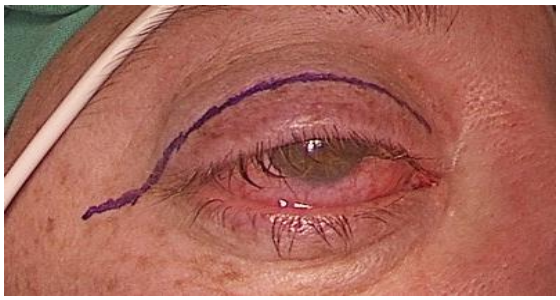

Figure 3: Extended superior eyelid crease incision (right eye)

- Extend the incision laterally from the eyelid crease incision in a natural crease to spare the lateral canthus of the eye
- A Colorado microdissection needle can be used to cut through the orbicularis muscle onto the bone just lateral to the orbital rim
- Use a no.15 scalpel to cut through skin and the thin *orbicularis oculi* muscle
- Dissect superiorly, staying just deep to the *orbicularis* muscle and superficial to the orbital septum and the aponeurosis of the *levator palpebrae superioris* muscle as it attaches to the upper tarsal plate *(Figure 4, 5)*
- Do not breach the orbital septum as doing so will put the *levator palpebrae superioris* muscle at risk of injury and cause orbital fat to herniate into the surgical field

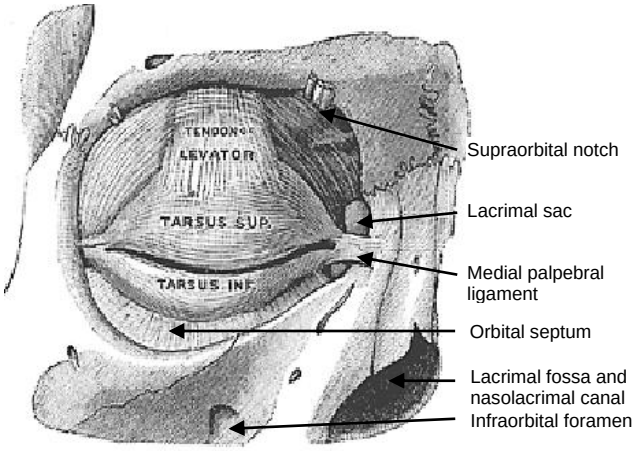

Figure 4: Right orbit: medial palpebral ligament, orbital septum, lacrimal sac and lacrimal fossa

Figure 5: Dissection in the sub-orbicularis plane and exposure of periosteum (right)

- Expose the periosteum of the superior orbital rim *(Figure 6)*
- Continue to dissect in a subperiosteal plane
- Take care not to apply excessive traction superiorly as it may injure the levator aponeurosis and cause an aponeurotic ptosis

Figure 6: Right superior eyelid approach with orbital rim exposed

Superior Portal: Surgical steps

- Having exposed the superior orbital rim, incise the periosteum just inferior and posterior to the orbital rim *(Figure 6)*
- Continue to dissect in a subperiosteal dissection plane using a Freer elevator
- Identify and preserve the supratrochlear and supraorbital nerves in the superior

medial orbital rim, by mobilising the nerves out of their bony canal / foramen if required *(Figure 7)*

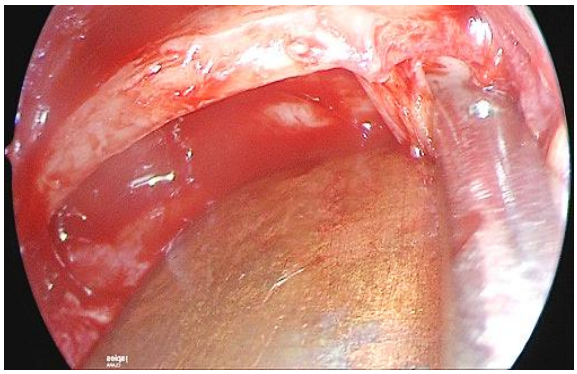

Figure 7: Right supratrochlear nerve exposed during superior transorbital approach

- Enlarge the surgical portal to provide access to the target area
- Expose the whole orbital roof
- Remove the orbital roof for access to the anterior cranial fossa
- The ***optic nerve*** can be found at the orbital apex *(Figure 8)*
- ***At the end of the surgery, suture the periosteum of the superior orbital rim*** to prevent ptosis
- Close the incision in two layers, submucosal and cutaneous

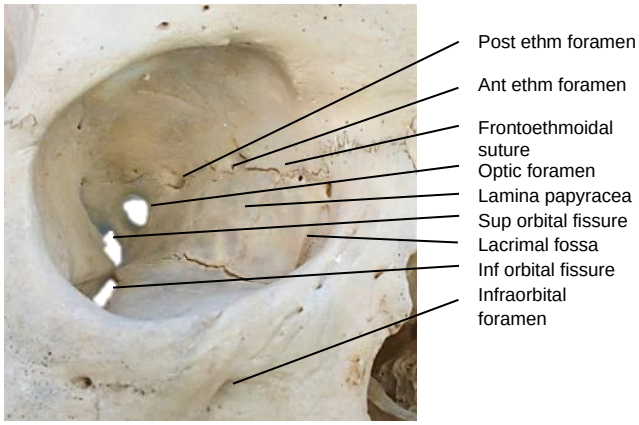

Figure 8: Right medial orbital wall

2. Lateral Portal

The lateral portal provides access to

- Lateral aspect of the eye (cavernous haemangiomas, pseudotumours)
- Lateral orbital wall (lateral orbital decompression for thyroid eye disease)
- Temporal fossa (angiofibromas)
- Middle cranial fossa (sphenoid wing meningiomas) *(Figures 9, 10)*

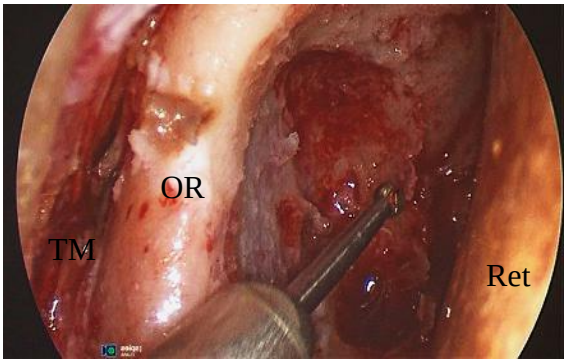

Figure 9: Combined superior and lateral portals with temporalis muscle (TM) and lateral orbital rim (OR) exposed laterally, retractor on orbit (Ret), and meningioma of greater wing of sphenoid being drilled (right side)

Figure 10: Sphenoid wing meningioma involving middle cranial fossa, lateral orbital wall and orbit

- The superior and inferior orbital fissures *(Figure 10)* are generally the limits of surgical exposure in patients with normal neurological function (CNs III, IV, V_1, VI) where no intracranial pathology needs to be addressed, as with thyroid eye decompressions

Lateral Portal: Surgical steps

- The lateral portal is bound by the orbit medially and lateral orbital wall *(Figure 8)*
- The authors generally use an ***extended superior eyelid crease incision*** for the lateral orbital portal approach *(Figure 3)*
- Incise the periosteum and elevate it in a lateral-to-medial direction over the rim of the orbit
- This ensures a subperiosteal dissection is maintained and that the ligaments that attach to Whitnall's tubercle are elevated off the bone
- The upper and lower eyelids converge at the ***lateral canthus*** *(Figure 4)*
    - The ***lateral canthal tendon*** is composed of fibrous tissue from the upper and lower tarsi *(Figure 4)*
    - The lateral canthal tendon inserts onto a bony protuberance on the lateral orbital wall called ***Whitnall's tubercle***
    - The lateral canthus directs tears towards the medial canthus and lacrimal canaliculi
    - If the lateral canthal tendon is damaged it may cause lateral ectropion and pooling of tears and epiphora
- Avoid damage to the lateral canthal tendon by dissecting it off the bone in a ***subperiosteal plane***
- The first neurovascular structure encountered laterally is the ***recurrent branch of the middle meningeal artery*** *(Figure 11);* it is a constant landmark identified in the lateral approach and is useful to identify the ***superior orbital fissure*** which is located approximately 1cm posteriorly at the same level *(Figure 8)* and it can be cauterised using bipolar forceps

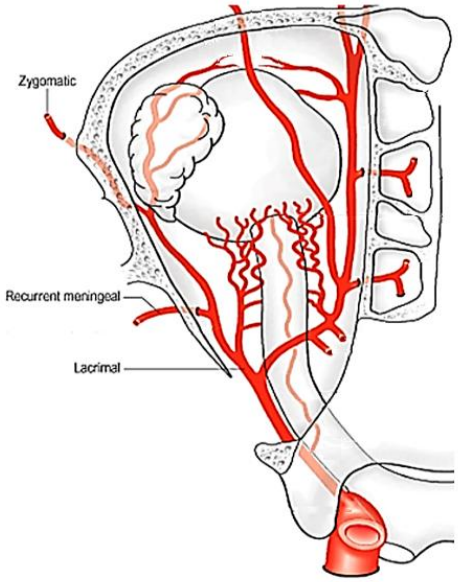

Figure 11: Recurrent meningeal artery

- ***Excessive medial traction*** on the orbit may cause ***superior orbital fissure syndrome*** with fallout of cranial nerves III, IV, V_1 and VI
- ***Suture the periosteum back laterally*** at the conclusion of surgery to secure the ligaments attached to Whitnall's tubercle and to preserve the angle and height of the lateral canthus
- ***Suture the periosteum of the superior orbital rim*** to prevent ptosis
- Close the incision in two layers, submucosal and cutaneous

Resecting the superior/lateral orbital walls

- The lateral wall of the orbit may need to be resected
- Preserve at least 5mm of the lateral orbital rim
- The temporalis muscle can be exposed anterolaterally and the middle cranial fossa dura more posteriorly as bone is drilled away up to the superior orbital fissure *(Figure 9)*

- Take care not to cause a CSF leak posteriorly (middle cranial fossa) or superiorly (anterior cranial fossa dura)
- A CSF leak can be closed using fat harvested from the abdomen or upper thigh with or without fascia lata as an underlay graft

3. Medial Portal

The medial portal is performed via a ***pre- or transcaruncular approach,*** and provides access to

- Anterior (AEA) and posterior ethmoidal arteries (PEA)
- Medial orbital tumors (intra- and extraconal)
- Ipsilateral and contralateral sphenoid sinuses
- Contralateral Sternberg canal defect
- Optic nerve decompression using a multiportal approach (endonasal and precaruncular)
- Anterior cranial fossa

The medial portal is ideally suited to ***accessing and ligating the anterior (AEA) and posterior ethmoidal arteries (PEA)*** e.g., for epistaxis secondary to a nasoethmoidal fracture, or to achieve haemostasis with tumour surgery. As the incision leaves no scar, it is also cosmetically favourable.

The AEA can traditionally be found 24mm from the anterior lacrimal crest; the posterior ethmoidal foramen is 12mm posterior to this; and the optic canal 6mm posterior to the PEA *(Figures 8, 11)*. During transorbital surgery and the transcaruncular approach, the frontoethmoidal suture line and the lacrimal crest are often not visualized. Great care must be taken not to injure the nerve with bipolar cautery applied to the PEA. Note that the PEA can be absent and there may be accessory ethmoidal vessels. Should the optic nerve be injured, the medial portal provides good access to the medial optic canal e.g., to remove a bony spicule or to decompress the optic nerve.

Medial orbital tumours (intra- and extraconal) are easily accessed through the medial portal via a precaruncular approach. Such surgery should be done with an ophthalmologist. Medially located orbital cavernous haemangiomas are historically often resected using a transnasal endoscopic approach. Transnasal approaches require extensive resection of normal sinuses, and the lamina papyracea, and breaching of the periorbita and mobilisation of the medial rectus muscle to access the lesion. The medial portal precaruncular approach avoids this extensive dissection of normal tissues and obviates the need to reconstruct the orbital wall as the lamina papyracea remains undisturbed.

The ***ipsilateral sphenoid sinus*** is quickly and easily accessed using the medial precaruncular corridor. This is useful when optic nerve decompression is done via a multiportal approach (endonasal and precaruncular).

The ***contralateral sphenoid sinus*** can also be accessed. This is achieved by breaching the lamina papyracea and performing an ethmoidectomy and posterior septectomy. The medial portal approach provides a direct view of the lateral wall of a well-pneumatised contralateral sphenoid sinus and is especially useful in patients with spontaneous cerebrospinal fluid (CSF) leaks secondary to a '***Sternberg canal defect'***. Advantages of using a medial portal approach include a direct view with a zero-degree endoscope and use of standard straight FESS instruments to repair the defect.

The ***anterior cranial fossa*** is entered by breaching the medial orbital wall above the frontoethmoidal suture line *(Figures 8, 12)*. The AEA and PEA run within this suture line and are reliable landmarks for the floor of the anterior cranial fossa *(Figure 13)*.

CSF leaks in this area can be accessed and repaired using standard techniques of fat plugging with an underlay fascia and/or cartilage graft. Utility of this approach to anterior cranial fossa pathology requires further study.

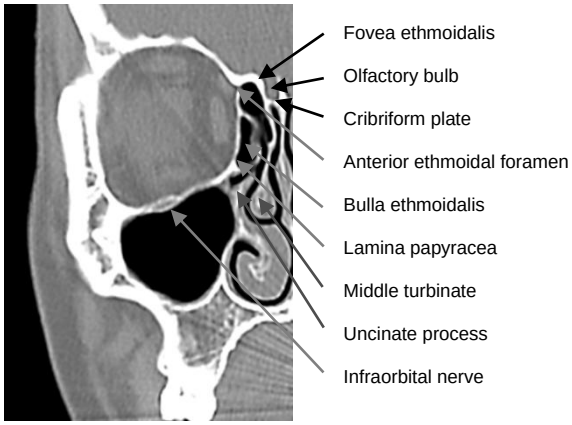

Figure 12: Note the position of the anterior ethmoidal artery where it passes through its foramen which is located in the frontoethmoidal suture line at the level of the floor of the anterior cranial fossa

The medial portal approach is very useful for ***optic nerve decompression***, especially when patients have had a previous medial orbital decompression or with marked proptosis. Combining a medial portal precaruncular and endonasal approaches has ***some advantages over using only a one or two nostril endonasal approach***. Firstly, it can be difficult to perform optic nerve decompression if there is extensive herniation of orbital fat e.g., in patients who have had previous orbital decompression, even when using the contralateral nostril. With the medical portal approach, a malleable retractor can retract the orbital contents, especially if fat is herniating into the ethmoidal cells. This ensures good visualisation of the optic canal using either an ipsilateral or contralateral endonasal approach. The second advantage of the medial portal is that it obviates the need for a posterior septectomy with the bi-nostril approach to get instruments to the target site. The medial portal approach can be combined with an ipsilateral endonasal approach, preserving the nasal septum.

Precaruncular and transcaruncular approaches: Surgical steps

The medial portal is accessed via a ***precaruncular or transcaruncular approach***.

- The ***medial canthus*** is made up of tendon attachments to the *orbicularis oculi* muscle and tarsus. It attaches to the anterior lacrimal crest on the frontal process of the maxilla *(Figure 4)*
- The ***lacrimal caruncle*** is a mucosal structure located at the medial palpebral commissure and occupies the *lacus lacrimalis* (triangular space of conjunctiva at the medial aspect of the eye) *(Figure 13)*

Figure 13: Forceps retracting caruncle laterally in preparation for transcaruncular or precaruncular incision (Right eye)

- ***Horner's muscle*** forms part of a minor attachment to the posterior medial canthus
- It is important to identify the ***superior and inferior canaliculi*** of the lacrimal system as they lie superficial to the plane of dissection when accessing the medial orbital portal *(Figure 14)*
- An inexperienced surgeon should ***probe the lacrimal system*** prior to proceeding with a pre- or transcaruncular approach
- Identify the lacrimal caruncle and medial canthus *(Figure 13)*

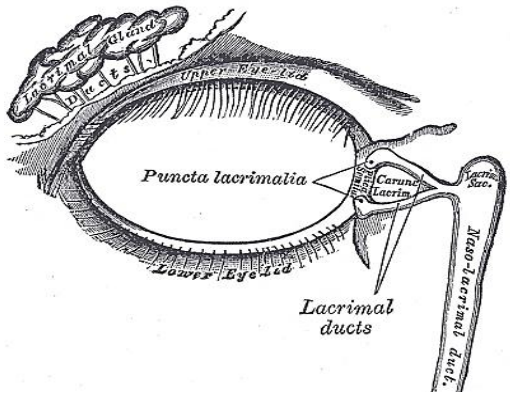

Figure 14: Right lacrimal system

Figure 15: Medial wall of orbit and lacrimal fossa and anterior lacrimal crest. Nasion corresponds with level of frontoethmoidal suture line

- Retract the caruncle laterally *(Figure 13)*
- Use iris scissors to cut between the caruncle and skin or through the caruncle *(Figure 16)*
- As the lacrimal system lies superficial to the dissection, a ***transcaruncular incision*** may be safer for those not familiar with dacryocystorhinostomy
- Insert a malleable retractor *(Figure 17)*
- Locate the nasion as a landmark to determine the vertical level of the AEA *(Figure 15)*
- Aim the tip of the iris scissors at the medial bony orbital wall at or just below the level of the nasion

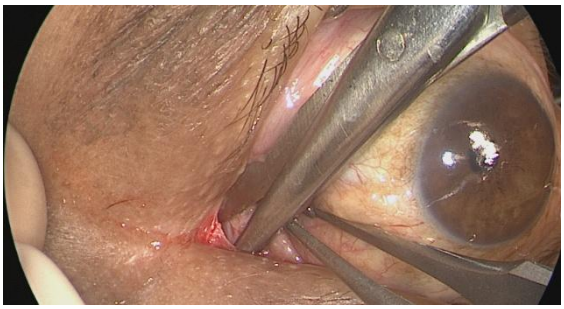

Figure 16: Use iris scissors to cut through the caruncle or between the caruncle and skin

Figure 17: Malleable retractor retracting orbit to open precaruncular corridor (Right eye)

- Take care not to breach the lamina papyracea below this level to avoid entering the ethmoid sinuses
- If the bone is breached superior to the AEA, the anterior cranial fossa will be entered, and cause a CSF leak *(Figure 12)*
- Once bone is identified, use a suction Freer dissector in a subperiosteal plane at the level of the nasion to create the medial portal
- Retract the orbit laterally with a malleable retractor and insert a zero-degree endoscope *(Figure 17)*
- The pre- and transcaruncular incisions do not require suturing at conclusion of surgery
- Apply chloromycetin ointment to the medial canthus postoperatively

Medial Portal: Surgical steps

- The medial portal has been accessed, and the periosteum of the medial orbital wall has been elevated
- The medial orbital portal is a potential space located between the medial periorbital fascia and medial orbital wall
- The medial orbital wall is comprised of the ethmoid bone (lamina papyracea), lesser wing of the sphenoid, lacrimal bone, and frontal process of the maxilla *(Figures 8, 15)*
- Posteriorly the medial orbital portal ends at the optic nerve foramen *(Figures 8, 15)*
- The 24:12:6 rule (AEA 24mm posterior to anterior lacrimal crest; PEA 12mm posterior to AEA; optic nerve 6mm posterior to PEA) to locate the AEA, PEA and optic nerve has little value with the endoscopic approach until the AEA is reached, as the anterior lacrimal crest is not exposed to protect the lacrimal sac
- The frontoethmoidal suture line is also an unreliable landmark to identify these structures as it is clearly visible in <50% of orbits
- Instead, the level of the nasion is used as it corresponds with the level of the base of skull and serves as a guide to identify the expected level of the AEA and PEA *(Figure 15)*
- Identify and cauterize the AEA using bipolar forceps or apply a Liga clip *(Figure 18)*
- The PEA is located 12mm posterior to the AEA and the optic nerve 6mm posterior to the PEA
- Good access is achieved to the medial orbit for intra- and extraconal lesions such as cavernous haemangiomas
- The lamina papyracea can now be removed (if needed) and the ethmoids and/or sphenoid entered, remaining below the level of the PEA and optic nerve
- The pre- and transcaruncular incision do not require suturing
- Apply chloromycetin ointment to the medial canthus postoperatively

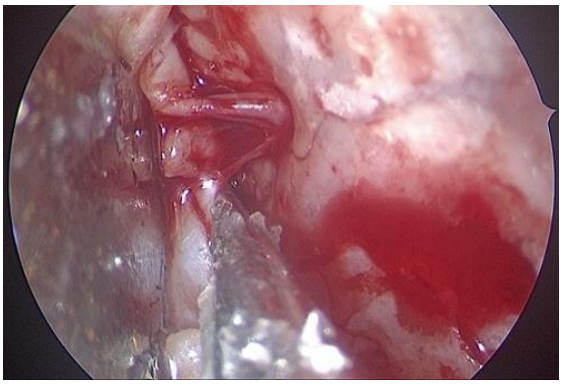

Figure 18: AEA exiting foramen in frontoethmoidal suture line which is in line with the nasion (right eye)

4. Inferior Portal

The inferior orbital portal provides access to the area between the orbit and the orbital floor or roof of the maxillary sinus. It is accessed via a ***lower eyelid transconjunctival approach***.

The inferior orbital portal allows access to

- Orbital floor
- Inferior orbital fissure
- Infraorbital nerve
- Lesions of the orbit

The inferior portal provides good access to resect the orbital floor, or inferior orbital tumours, or to follow the infraorbital nerve posteriorly for perineural tumour extension.

Orbital blow-out fractures can be endoscopically directly visualised and repaired. Small defects of the orbital floor can be reconstructed with cartilage or polydioxanone sheeting, and larger defects with preformed titanium covered with 0.25mm polydioxanone sheeting. Entrapped extra-ocular muscles can be released under direct vision.

The inferior portal permits reconstruction / elevation of the orbital floor through a combined middle meatal antrostomy approach for imploded maxillary sinuses (silent sinus syndrome).

Lower eyelid transconjunctival approach: Surgical steps

- The approach may be pre- or postseptal
- The ***orbital septum*** merges with the capsulopalpebral fascia, which is formed by fibers of the inferior rectus muscle
- The orbital septum attaches to the lower edge of the ***tarsal plate*** *(Figures 4, 19)*

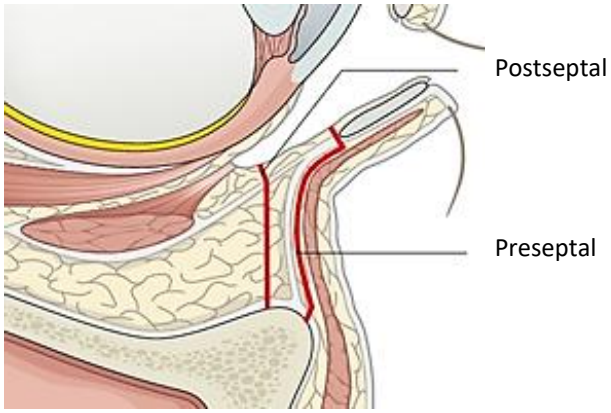

Figure 19: Pre- and postseptal transconjunctival approaches (AO)

- ***Preseptal approach***
  - The ***preseptal approach is preferred*** as it avoids herniation of fat into the surgical field
  - Stand at the head of the patient
  - Make a transconjunctival incision 2mm inferior to the tarsus using either a scalpel or a Colorado needle-point monopolar cautery *(Figures 19, 20)*
  - The incision can be extended medially or laterally depending on the exposure required
  - Blunt dissection is to be continued in the preseptal plane towards the inferior orbital rim *(Figure 19)*

Figure 20: A transconjunctival incision is made at least 2mm inferior to tarsus

- ***Postseptal approach***
  - Make a transconjunctival incision at least 2mm inferior to the tarsus with either a scalpel or a Colorado needle-point monopolar cautery
  - Next, the orbital septum can be opened using monopolar cautery
  - Care should be taken to identify the inferior oblique muscle, whose origin is posterior to the inferomedial orbital rim

Inferior portal approach: Surgical steps

- Strip the tissues of the inferior orbital rim and floor of the orbit with a Freer dissector *(Figure 21)*

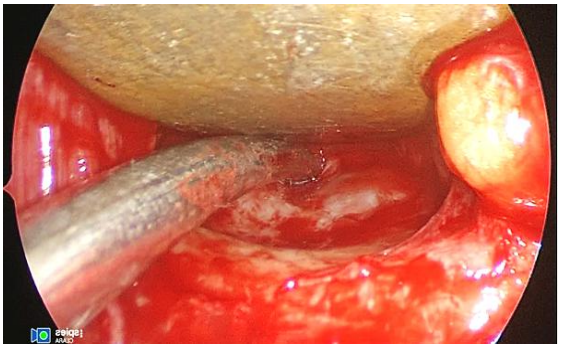

Figure 21: Right orbital floor exposed

- Remain in a subperiosteal plane to avoid injuring the ***inferior oblique muscle*** which arises just lateral to the lacri-

mal groove in the anterior part of the orbital floor at the medial end of the orbital rim *(Figure 22)*

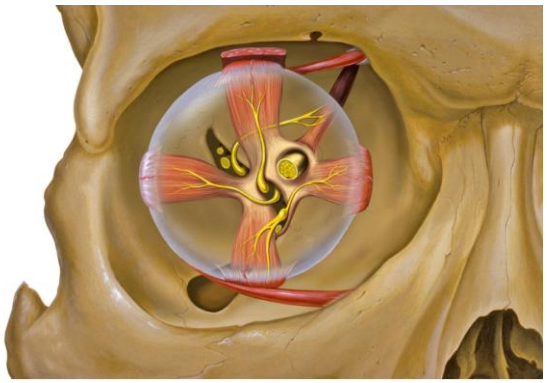

Figure 22: Note origin of inferior rectus muscle just lateral to the lacrimal groove in the anterior part of the orbital floor (Wikipedia)

- The inferior orbital fissure is the ***lateral*** limit of the exposure *(Figure 15)*
- ***Medially*** the dissection can be extended to the medial orbital wall and combined with a medial portal
- The ***infraorbital nerve*** is often visible in the floor of the orbit and is usually covered by a layer of bone
- It is usually ***not necessary to close the skin incision***
- A ***temporary tarsorrhaphy*** suture can be placed in patients with chemosis

Postoperative care

Meticulous postoperative care is essential to optimise recovery and to ensure good outcomes.

- Perioperative antibiotic prophylaxis is given for 24hrs if both the orbit and nasal cavity are entered
- When using the superior-lateral approach, use a small suction drain to prevent a lateral orbital hematoma, except when a CSF leak has been repaired
- Apply ice packs to the eye for a few minutes every hour for 24hrs to reduce swelling and bruising
- Prescribe lubricant eye ointment to prevent a dry eye
- Excessive chemosis (usually present preoperatively with proptosis) is treated with a suspension (Frost) suture
- Postoperative ophthalmology review is required to assess vision

Complications

In the authors' experience, complications are uncommon.

- ***Excessive orbital retraction***
  - Important to check the pupil regularly during surgery for changes in shape and size and to relax the retraction every few minutes
  - Excessive retraction during the superior-lateral approach can cause superior orbital fissure syndrome with CN III, IV, VI palsies and blindness if the optic nerve is damaged by a retractor
- ***Ptosis*** caused by upper eyelid retraction and temporary damage to the levator palpebrae superioris muscle
- ***Dissection through the orbital septum*** can cause permanent damage to the muscle which will require a blepharonplasty
- ***CSF leaks*** if anterior cranial fossa is entered with a medial or superior approach, or if the middle cranial fossa is entered with a lateral approach
- ***Enophthalmos*** with resection of the inferior or medial orbital walls in patients without exophthalmia. A decision needs to be made pre- and intraoperatively whether reconstruction is required
- ***Lacrimal system*** injured during the precaruncular approach if the dissection is too superficial. Inserting probes into the canaliculi can prevent injury

Key points

- A multidisciplinary approach is essential
- Training and special instruments and retractors are required before embarking on transorbital surgery
- Multiportal surgery allows resection of lesions crossing surgical boundaries
- Subperiosteal tissue planes preserve neurovascular structures and ocular muscles
- Resuturing the periosteum is important to avoid ptosis and lateral canthal dystopia

Suggested reading

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