



Transorbital Endoscopic Surgery of the Paranasal Sinuses and Skull Base

37

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Introduction

Gentle displacement of the orbit allows for the creation of surgical portals between the bony walls of the orbit and periorbital fascia. An endoscope and instruments can be passed through these greater than 1-cm-wide portals to access pathology within the orbit or its four walls. By breaching the orbit's bony boundaries, the sinuses and difficult-to-reach skull base spaces can be accessed through a minimally invasive transorbital approach (Fig. 37.1).

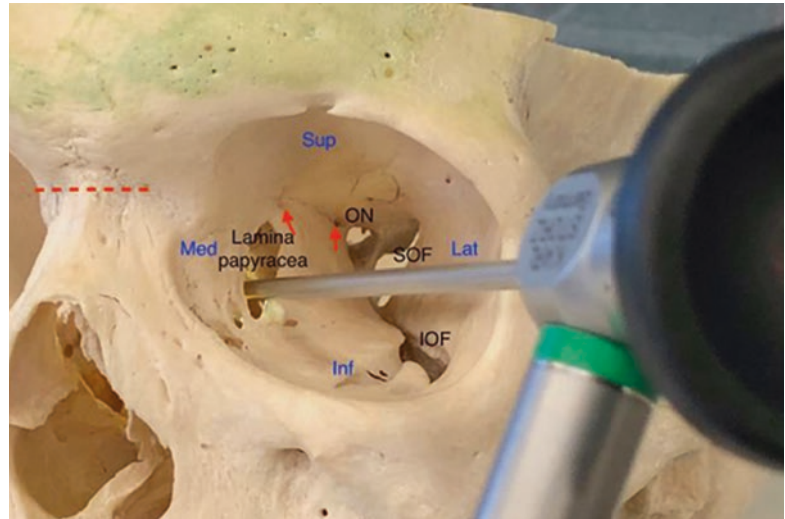
Since Kris Moe popularized this technique in 2010, numerous advances in instrumentation and

closer interdisciplinary cooperation have led to transorbital surgery being performed regularly and safely in many skull base units across the world. A multidisciplinary approach is required, starting with a discussion between the otolaryngologist, ophthalmologist and neurosurgeon. A decision is made on the best surgical approach and which team members should be involved at which stage of the surgery. If the periorbital fascia is breached to address a lesion within the orbit itself, an ophthalmologist should always be involved. Similarly, when the dura is breached to address an intracranial lesion, a neurosurgeon should form part of the surgical team.

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Fig. 37.1 Orbital osteology; the four walls of the bony orbit can be breached to reach skull base spaces. The endoscope is passed through the lamina papyracea (medial wall) to the ipsilateral ethmoids and contralateral sphenoid sinus. Nasion (red interrupted line) lies at the same level as the anterior ethmoidal artery (AEA) and the posterior ethmoidal artery (PEA) (red arrows). Key: ON Optic nerve, SOF Superior orbital fissure, IOF Inferior orbital fissure



Rationale for Transorbital Surgery

Whilst endoscopic endonasal surgery allows access to all the paranasal sinuses, medial orbit, pterygopalatine and infratemporal fossa, midline anterior skull base structures from cribriform area to pituitary fossa and beyond, certain areas are best accessed with a minimally invasive transorbital approach [1–3].

Certain open procedures can be replaced with a transorbital approach, e.g. the Lynch-Howarth incision for accessing the ethmoidal arteries. The precaruncular approach has the advantage of leaving no external scar and provides quick direct access to the vessels without traumatizing the orbicularis muscle or surrounding neurovascular structures.

Transorbital surgery allows access to all paranasal sinuses and is a useful adjunct to addressing lesions that cross surgical boundaries. Each orbit has four surgical portals and together with the two nasal corridors, multiportal surgery is possible using any of the ten portals in various combinations (Fig. 37.2). This allows different trajectories to the target area—not only for visualization with a zero-degree endoscope but also for manipulating instruments at different angles. Thus, a tumour of the maxillary sinus invading the orbital floor, inferior orbital structures and extending along the infraorbital nerve would be eminently accessible with these approaches. Multiportal surgery utilizing an inferior orbital portal together with an endonasal approach allows for resection of such

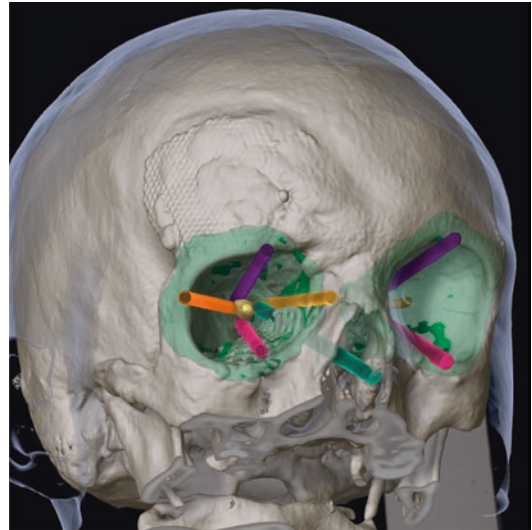


Fig. 37.2 Each orbit has four transorbital portals, and together with the two nasal portals, the ten portals can be used in various combinations

lesions. It is important to remember that oncologic principles should always be followed, regardless of the surgical approach.

Indications for the Otolaryngologist

The key approaches are as follows:

1. Superior-lateral portal
2. Medial portal
3. Inferior portal

Superior-Lateral Portal

It can be difficult to access the lateral aspect of a well-pneumatized frontal sinus using a purely endonasal approach. A modified endoscopic Lothrop/Draf procedure may allow for good visualization of the lateral aspect of a well-pneumatized frontal sinus, but often an angled endoscope is required. In these cases, even a 70° Lothrop drill burr may not reach the lateral wall of the frontal sinus to remove bone infiltrated by an inverting papilloma for instance. Another external surgical approach is often needed to ensure complete clearance. The superior orbital approach is useful in these cases. The only advantage over the eyebrow approach is cosmesis, and either approach could be used as part of multiportal surgery.

The superior-lateral incision is favoured where wide access is required to the orbital roof, superior orbit, frontal sinuses and anterior cranial fossa (lateral to cribriform plate). An extradural empyema secondary to a frontal sinusitis can be safely drained through a transorbital approach, avoiding a craniotomy.

The author prefers the extended eye crease incision in most instances since it allows for better inferior and medial retraction of the orbital contents. Where pathology is limited to the superior orbit, anterior cranial fossa or medial aspect of the frontal sinus, the incision does not have to extend beyond the lateral canthus of the eye.

The extended superior eyelid crease incision (Fig. 37.3) spares the lateral canthus and allows for minimal morbidity and increased patient comfort. This extended incision is required to access the lateral portal to address lesions of the lateral aspect of the eye itself (e.g. cavernous haemangioma, pseudotumours), lateral orbital wall (e.g. in thyroid eye



Fig. 37.3 Extended superior eyelid crease incision of the left eye

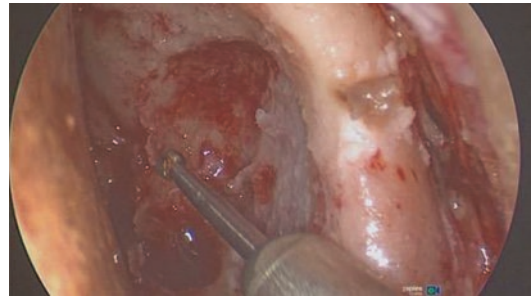


Fig. 37.4 Left orbital portal with temporalis muscle exposed laterally and greater wing of sphenoid drilled away

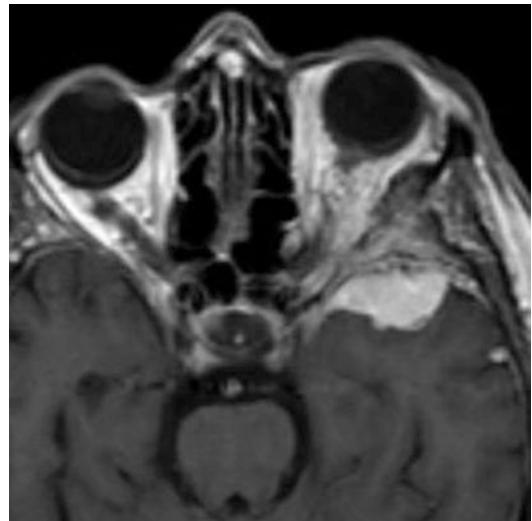


Fig. 37.5 Sphenoid wing meningioma infiltrating the middle cranial fossa, lateral orbital wall and orbit itself

disease for lateral decompression) and infratemporal fossa (angiofibroma) and during sphenoid wing meningioma surgery where the middle cranial fossa is exposed (Fig. 37.4 and 37.5). The superior and inferior orbital fissure can be accessed through this portal and typically forms the limit of the dissection in patients with normal neurological function (CNs III, IV, V₁, VI).

Medial Portal

The medial portal is ideal for accessing the anterior ethmoidal artery (AEA) and posterior ethmoidal artery (PEA). These arteries often need ligation in patients with epistaxis secondary to a nasoethmoid fracture or to assist with haemosta-

sis during tumour surgery. The optic nerve can be found 6 mm posterior to the posterior ethmoidal artery and great care must be taken to ensure that the optic nerve is not damaged during bipolar cautery to the vessels. It is important to note that the posterior ethmoidal artery can be absent or that there may be accessory ethmoidal vessels. In the event of a traumatic optic nerve injury, the medial portal gives good access to the medial optic canal if a bony spicule requires removal or if an optic nerve decompression is required.

Together with an ophthalmologist, medial orbital tumours can easily be accessed through this route. Both intra- and extraconal lesions can be resected through a precaruncular approach. A standard transnasal approach is often used to resect medially located orbital cavernous haemangiomas, but this approach requires extensive resection of normal sinuses, removal of the lamina papyracea, breach of periorbita and mobilization of the medial rectus muscle. The precaruncular approach avoids this extensive dissection of normal tissues and obviates the need for reconstruction since the lamina papyracea is left intact.

The ipsilateral sphenoid sinus can quickly be entered using the medial corridor. This is useful in cases where an optic nerve decompression is performed using a multiportal approach (endonasal and precaruncular).

The contralateral sphenoid can also be entered by breaching the lamina papyracea, performing an ethmoidectomy and posterior septectomy, thus facilitating a direct view of the lateral wall of a well-pneumatized contralateral sphenoid sinus. This approach is especially useful in patients with spontaneous cerebrospinal fluid leaks secondary to a Sternberg canal defect. The huge advantage of this approach is that it offers a direct view of the lesion, the ability to use a zero-degree endoscope and standard straight FESS instruments to repair the defect.

The anterior cranial fossa can be entered via the medial orbital wall superior to the frontoethmoidal suture line. The AEA and PEA are excellent landmarks as they run within this suture line. The approach facilitates repair of cerebrospinal fluid leaks, utilizing standard techniques of fat plugging with an underlay fascia or cartilage graft. This transorbital approach to the anterior cranial fossa requires further clinical investigation and studies.

The precaruncular approach is very useful during optic nerve decompression, especially where patients have had a previous medial orbital decompression or where significant proptosis is present. Combining the precaruncular approach with an endonasal approach has some advantages over using a one- or two-nostril endonasal approach. Firstly, a malleable retractor can be placed through the medial portal to retract the orbital contents, especially if fat is herniating into the ethmoidal cells. Extensive herniation of orbital fat makes it difficult to perform optic nerve decompression, especially in patients who have had previous orbital decompressions, even when using the contralateral nostril. Retraction of the fat via the precaruncular portal facilitates good visualization of the optic canal, using either ipsilateral or contralateral endonasal approaches.

The second advantage of using the medial portal is it obviates the need for doing a posterior septectomy in order to get more instruments at the target site using the binostril approach. The precaruncular approach can be combined with an ipsilateral endonasal approach, thereby preserving the nasal septum.

Inferior Portal

The inferior conjunctival incision allows for access to the floor of the orbit, the inferior orbital fissure and the infraorbital nerve and for lesions of the orbit itself. Using the endoscope through this portal allows for direct visualization and repair of blowout fractures. For smaller fractures, plating can be avoided by inserting septal cartilage over the defect. Entrapped muscles can be released under direct vision.

This route allows for reconstruction/elevation of the orbital floor patients with imploded maxillary sinuses/silent sinus syndrome, once a middle meatal antrostomy has been performed.

Transorbital Surgery: Surface Anatomy

Superior and Lateral Orbital Portals

An extended superior eyelid crease approach is used to gain access to the superior and lateral

orbital portals. The levator palpebrae superioris muscle attaches to the tarsal plate to form the upper eyelid crease. The surgical incision is made in the crease, allowing for a cosmetically acceptable hidden scar (Fig. 37.3). The incision transects the skin and orbicularis muscle so that the dissection is carried out in a sub-orbicularis plane, staying superficial to the orbital septum and the aponeurosis of the levator muscle as it attaches to the upper tarsal plate (Figs. 37.6 and 37.7).

Dissection is aimed superiorly until the periosteum of the superior orbital rim is reached. Dissection then continues in a subperiosteal plane. Care must be taken not to apply excessive traction superiorly as it may injure the levator aponeurosis and result in an aponeurotic ptosis.

The lateral portal is bound by the orbit contents medially and lateral orbital wall laterally. The lateral canthus is where the upper and lower

eyelids converge laterally. The lateral canthal tendon is composed of fibrous tissue from the upper and lower tarsi and the common tendon known as Whitnall's ligament, which inserts onto a bony protuberance on the lateral orbital wall. During the lateral approach, it is important to dissect in the subperiosteal plane as not to damage the lateral canthal tendon. In addition, the periosteum must be sutured back into place to preserve the angle and height of the lateral canthus. The function of the lateral canthus is to direct tears towards the medial canthus and lacrimal canaliculi. If the lateral canthal tendon is damaged, it may result in lateral ectropion, which may cause pooling of tears and epiphora.

The recurrent branch of the middle meningeal artery (MMA) (also referred to in the literature as the meningolacrimal artery/orbital branch of the middle meningeal artery/sphenoidal artery) enters the lateral orbit through the meningo-orbital foramen (sometimes referred to as Hyrtl canal) [4] (Figs. 37.8, 37.9 and 37.10). This artery is a constant landmark when using the lateral portal and helps to identify the superior orbital fissure (SOF) that lies approximately 1 cm posterior to the artery as it exits the canal in the superior-lateral orbit (Fig. 37.8) [3].

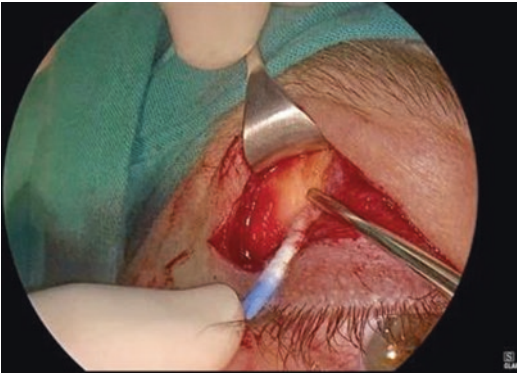


Fig. 37.6 Dissection in the sub-orbicularis plane and exposure of periosteum in a right eye



Fig. 37.7 Left superior eyelid approach with rim exposed



Fig. 37.8 Left orbit with arrow pointing to the meningo-orbital foramen on the lateral orbital wall where the recurrent branch of the middle meningeal artery (MMA) exits

Fig. 37.9 Blue arrow showing the recurrent branch of the middle meningeal artery (MMA) exiting through the meningo-orbital foramen (Hyrtl canal) in the lateral orbital wall, 1 cm anterior to the superior orbital fissure (SOF). Key: *ECA* External carotid artery, *MMA* Middle meningeal artery, *LA* Lacrimal artery, *ANA* anastomotic branch, *ICA* Internal carotid artery, *OA* Ophthalmic artery, *PCA* posterior ciliary arteries, *PEA* Posterior ethmoidal artery, *AEA* anterior ethmoidal artery, *AFA* anterior falx artery

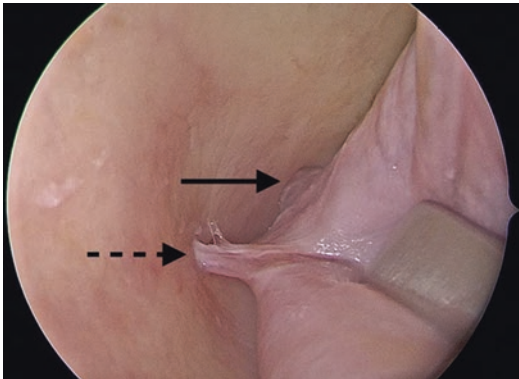
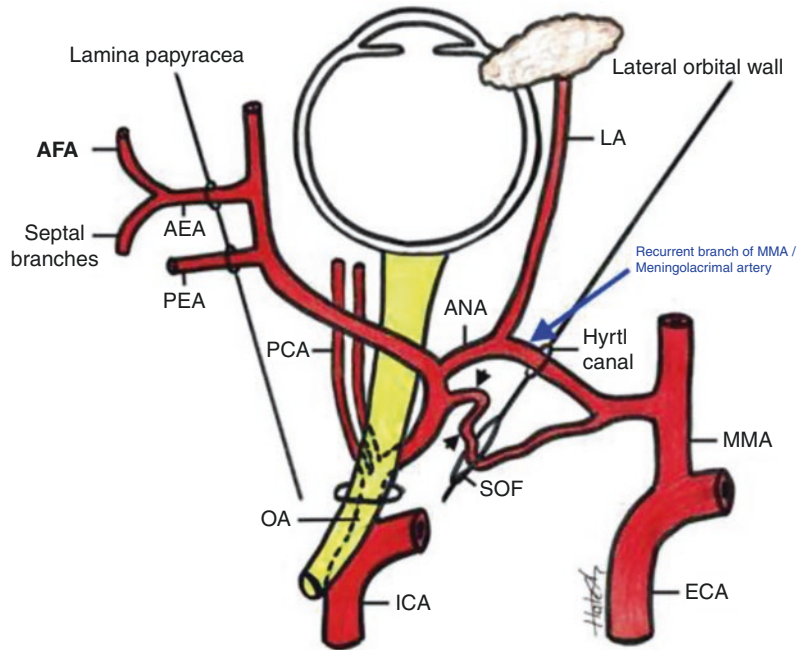


Fig. 37.10 Recurrent branch of right middle meningeal artery (MMA)/meningolacrimal artery (broken arrow). Note this artery lies 1 cm anterior to the lateral superior orbital fissure (SOF) (solid arrow)

Excessive traction on the orbit medially may potentially result in a superior orbital fissure syndrome with functional impairment of cranial nerves III, IV, V₁ and VI.

Medial Orbital Portal

The medial orbital portal is a potential space between the medial periorbital fascia and medial

orbital wall. The medial wall is comprised of ethmoid bone (lamina papyracea), lesser wing of the sphenoid, lacrimal bone and frontal process of the maxilla. Posteriorly the medial orbital portal ends at the optic nerve foramen (Fig. 37.1). In order to gain surgical access to the medial portal, the lacrimal caruncle and medial canthus must be identified. The lacrimal caruncle is a mucosal structure located at the medial palpebral commissure occupying the lacus lacrimalis (triangular space of conjunctiva at the medial aspect of the eye).

Approaches to the medial orbital portal include the 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.

Horner's muscle (more recently termed Horner-Duverney muscle) is a historical term that refers to deeper fibres of the lacrimal portion of orbicularis oculi that attach the tarsus to the posterior lacrimal crest.

It is important to identify the superior and inferior canaliculus of the lacrimal system as it lies superficial to the plane of dissection when accessing the medial orbital portal. It is recom-

mended for the novice to probe the lacrimal system prior to dissection of the pre- or transcaruncular approach to the medial orbital portal. Once the medial portal has been accessed and periosteum of the medial orbital wall elevated, the first structure identified is the anterior ethmoidal artery (AEA) and anterior ethmoidal nerve. The traditional 24:12:6 rule for identifying the AEA, PEA and optic nerve, i.e. the AEA lies 24 mm posterior to the anterior lacrimal crest, the PEA lies 12 mm posterior to the AEA and the optic nerve lies 6 mm posterior to the PEA, has little clinical relevance intraoperatively during the medial approach until the AEA is reached. This is because intraoperatively the anterior lacrimal crest is not dissected or identified in order to preserve the lacrimal sac. In addition, the frontoethmoidal suture line is not a reliable landmark to identify these structures as it has been found to only be clearly visible in up to 50% of cases [5]. Instead, the level of the nasion that corresponds with the level of the base of skull can be used as a guide to identify the level of the AEA and PEA during the precaruncular approach (Fig. 37.1).

Inferior Portal

The inferior orbital portal accesses the area between the eye and the orbital floor or roof of the maxillary sinus. The orbital septum merges with the capsulopalpebral fascia, which is formed from the fibres of the inferior rectus muscle, to attach to the lower end of the tarsal plate. The tarsal plate of the lower eyelid is shorter than its superior counterpart by an average of 4 mm. A lower eyelid transconjunctival approach is used to gain access. The approach may be preseptal or postseptal, with the preseptal being more favourable as it avoids herniation of fat into the surgical field. Care is taken to remain in the subperiosteal plane to avoid injuring the inferior oblique muscle that arises just lateral to the lacrimal groove in the anterior margin of the floor of the orbit.

Preoperative Planning

A multidisciplinary approach is essential with all cases being discussed between specialties to ensure the best approach is chosen. The best approach will be the one giving best access to the lesion for complete resection and the most direct approach to the target area without causing collateral tissue damage to normal uninvolved structures. It is important to have a full visual assessment - visual acuity, fundoscopy, intraorbital pressure and proptosis measurement prior to transorbital surgery.

Imaging will often include CT and MRI of the orbits depending on the pathology.

Contraindications to surgery need to be excluded and patients need to be warned against using aspirin or other anticoagulants prior to surgery. Image guidance is often useful although not essential. Electromagnetic navigation is preferred to avoid line of sight issues.

Contraindications

In general, intraocular surgery within a 6-month period is a relative contraindication as it may increase the risk of wound rupture during retraction of the globe. Other relative contraindications include corneal ectasia, glaucoma, shallow orbit, single-eye patients and a previous retinal or optic nerve vascular event.

Absolute contraindications include intraocular surgery within 6 weeks (high risk of wound dehiscence), advanced glaucoma, severe corneal ectasia, scleromalacia and ocular ischemic syndrome.

Acute infective conditions such as acute dacryocystitis or conjunctivitis need to be treated prior to transorbital surgery. The risks with ocular pathology need to be weighed against the benefits of transorbital surgery in each individual patient. Consultation with an ophthalmologist is essential if concurrent ocular pathology exists prior to transorbital surgery.

Surgical Technique and Tips

Intraoperative Preparation

The positioning of the patient is the same for all four approaches, and similar to standard endoscopic sinus surgery, with the head slightly flexed and turned towards the surgeon. The only exception is frontal sinus pathology when the head needs to be extended as for a modified Lothrop operation to get the correct angle to access the frontal sinus.

TIVA is recommended since multiportal surgery is often combined with the endonasal route.

After the patient is draped, local anaesthesia is administered (lidocaine hydrochloride 2% and adrenaline 1:80000) into the incision site. It is useful to use a marking pen to delineate the superior eyelid crease prior to infiltration.

The eyes should be lubricated throughout the procedure and the pupils need to be observed, especially during retraction of the orbit. The pupil can change shape and size from increased intraorbital pressure or traction on neurovascular structures, and retraction by the malleable retractor should then be relaxed for a few seconds until the pupil returns to normal.

The surgeon normally stands to the right of the patient (as with FESS) for the superior-lateral and medial approach and at the head of the patient (as for tonsillectomy) for the inferior approach. However, during the initial incision, it can be easier to stand on the same side as the eye being operated on, but once the endoscope is used within the corridor, it is easier to operate on the right side of the patient.

Surgical Instruments

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

- Dental syringe for injecting local anaesthetic
- Sharp-tipped curved iris scissors
- Fine-tipped forceps
- Malleable retractors—sizes 8, 10, 12 and 15 mm diameter

- Suction elevator, Freer elevator and Cottle elevator
- Standard FESS set
- High-speed endonasal drill with short-shafted burrs (to prevent shaft catching orbital fat and muscle)

Surgical Steps and Tips

Superior Lateral Portal

Using loupes, the natural superior eyelid crease is identified approximately 6 mm above the superior eyelid margin, marked and infiltration applied to assist with haemostasis. A no. 15 surgical scalpel blade is used to cut through the skin and the thin orbicularis oculi muscle. Dissection is continued superiorly, staying just deep to the orbicularis muscle and superficial to the orbital septum. The septum must not be breached for this will put the levator palpebrae muscle at risk and cause orbital fat to herniate into the surgical field. Once the superior orbital rim is reached, the periosteum is incised just inferior and posterior to the orbital rim. Subperiosteal dissection continues using a Freer elevator, and depending on the target area, the surgical portal is enlarged to expose the necessary area. In the superior medial orbital rim, the supratrochlear and supraorbital nerves will be identified and must be preserved by mobilizing the nerves out of their bony canal or foramen if indicated (Fig. 37.11). The whole orbital roof will be visible and can be removed for access to the anterior cranial fossa. The optic nerve can be found at the orbital apex.

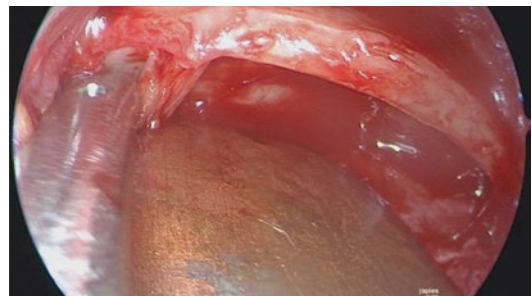


Fig. 37.11 Supratrochlear nerve exposed during superior transorbital approach in the left eye

If lateral access is required for a lateral orbital decompression or to gain access to the temporal fossa, superior orbital fissure or middle cranial fossa, the extended superior eyelid incision is made. This incision continues laterally from the eyelid crease incision within 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. The periosteum is incised and elevated in a lateral to medial direction over the rim of the orbit. This ensures a subperiosteal dissection and elevation of the ligaments that attach to Whitnall's tubercle (described in 4.1). The first neurovascular structure encountered laterally is the recurrent branch of the middle meningeal artery. This structure can be cauterized using bipolar forceps. The superior orbital fissure can be found just 1 cm posterior to this vessel.

A decision to resect the lateral wall of the orbit is dependent on the pathology to be addressed. A bony margin of at least 5 mm of lateral orbital rim should be preserved.

The temporalis muscle can be exposed anterior laterally and the middle cranial fossa dura more posteriorly as bone is drilled away up to the lateral superior orbital fissure.

Care must be taken not to cause a cerebrospinal (CSF) leak posteriorly (middle cranial fossa) or superiorly (anterior cranial fossa dura). Any CSF leak can be closed using fat harvested from the abdomen or upper thigh with or without fascia lata as an underlay graft.

It is important to suture the periosteum of the superior orbital rim to prevent ptosis and the lateral orbital periosteum to replace the ligaments attaching to Whitnall's tubercle.

Medial Portal

The caruncle is retracted laterally, and the iris scissors used to cut through the caruncle or between the caruncle and skin (Figs. 37.12 and 37.13). The lacrimal system lies superficial to the dissection so a transcaruncular incision may be safer for those not familiar with dacryocystorhinostomy. Lacrimal probes can be inserted into the canaliculi to prevent damage to the lacrimal system. The tip of the iris scissors is aimed at the

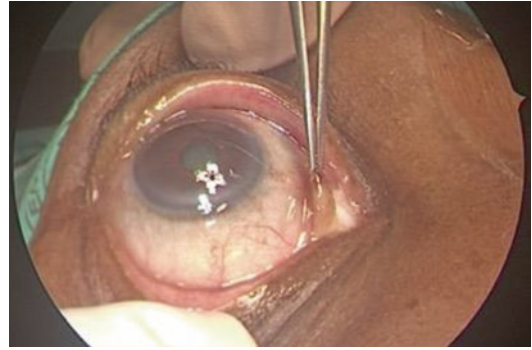


Fig. 37.12 Right eye, forceps retracting caruncle laterally in preparation for transcaruncular or precaruncular incision



Fig. 37.13 Right eye, malleable retractor in precaruncular corridor for anterior ethmoidal artery (AEA) ligation

medial orbital wall bone at the level of the nasion or just below (Fig. 37.1). The nasion is the landmark for finding the height of the AEA, and care must be taken not to breach the surrounding bone: A breach below this level, through the lamina papyracea, will lead directly to the ethmoids; a breach above the AEA will open the anterior cranial fossa and cause a CSF leak (Figs. 37.1 and 37.14).

Once the bone is reached, a suction Freer is used to dissect in a subperiosteal plane, staying at the level of the nasion. The AEA can be cauterized using bipolar forceps or a ligaclip can be applied. The PEA can be found 12 mm posterior to the AEA and the optic nerve 6 mm posterior to the PEA. Depending on the pathology to be addressed, the lamina can be removed to enter the ethmoids or the sphenoid can be entered below the level of the PEA and optic nerve. Good access

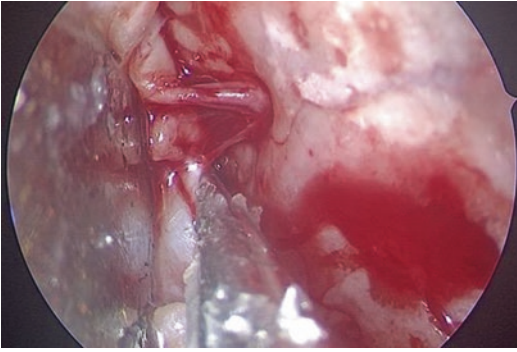


Fig. 37.14 Anterior ethmoidal artery (AEA) in the right eye in frontoethmoidal suture line, which is in line with the nasion

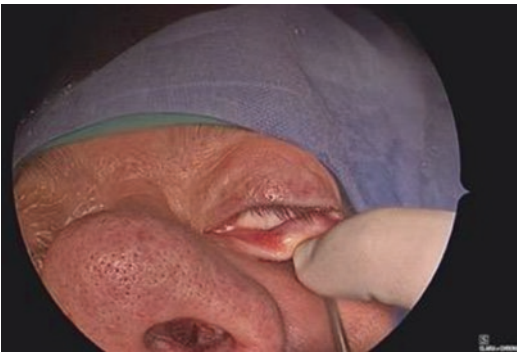


Fig. 37.15 A transconjunctival incision is made at least 2 mm inferior to the tarsus

is provided to the medial orbit for intraconal and extraconal lesions such as cavernous haemangiomas. The precaruncular incision does not require closure. Chloromycetin ointment is placed in the medial canthus postoperatively.

Inferior Portal

Standing at the head of the patient, a transconjunctival incision is made at least 2 mm inferior to the tarsus (Fig. 37.15). The incision is directed to the inferior orbital rim and can then be extended medially or laterally depending on the indication for the surgery. A subperiosteal dissection must be carried out to avoid damaging the inferior oblique muscle that originates at the medial aspect of the orbital rim (Fig. 37.16). The inferior orbital fissure forms the lateral limit, and medially the dissection can extend to the medial orbital wall/lamina papyracea.

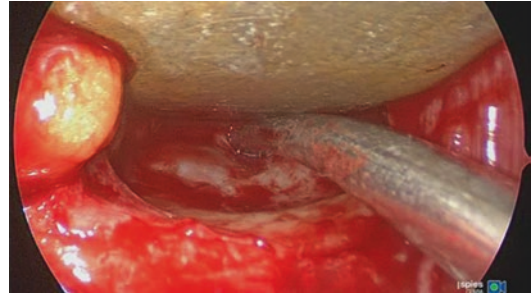


Fig. 37.16 Left orbital floor exposed using inferior transconjunctival approach

The infraorbital nerve is found in the floor of the orbit and is usually covered by a layer of bone. The orbital floor can be resected, inferior orbital tumours removed or the infraorbital nerve followed back in malignant pathologies, according to the pathology that needs to be addressed.

The floor can be reconstructed with cartilage or polydioxanone sheeting for small defects and preformed bare titanium implants covered with 0.25-mm polydioxanone sheeting for larger defects. It is usually not necessary to close the incision. A temporary tarsorrhaphy suture can be placed in patients with chemosis.

Postoperative Management

Specific postoperative care is essential to ensure good outcomes and reduce recovery times. Local lubricant eye ointment is used to prevent dry eye. Ice packs are used directly over the eye for a few minutes every hour for 24 h to reduce swelling and orbital ecchymosis.

A small suction drain is recommended to prevent a lateral orbital haematoma when using the superior lateral approach, unless a CSF leak has been repaired, when a suction drain is contraindicated [6].

Postoperative care of excessive chemosis (usually encountered preoperatively with proptosis) is treated with a suspension (Frost) suture. Postoperative antibiotic prophylaxis is given for 24 h if both the orbit and nasal cavity are entered during the procedure. An ophthalmology clinical review is required postoperatively to assess vision.

Complications

Only a few units perform regular transorbital surgery and few complications have thus far been reported. In the author's experience, complications are only likely to occur due to the following:

- Too much retraction on the eye by the assistant trying to provide a wider surgical corridor. It is important that the surgeon check the pupil regularly for changes in shape and size and relax the retraction every few minutes. Excessive retraction during the superior lateral approach can lead to a superior orbital fissure syndrome with CN III, IV and VI palsies and blindness if the optic nerve itself is damaged by a retractor.
- Upper eyelid retraction can lead to temporary damage of the levator palpebrae muscle with ptosis. Dissection through the orbital septum can lead to permanent damage to the muscle that will require a blepharoplasty.
- CSF leaks can ensue if the anterior cranial fossa is breached during the precaruncular or superior approach and the middle cranial fossa during the lateral approach.
- Enophthalmos can occur if reconstruction of the floor or medial orbit is required post resection of these walls in patients without exophthalmic conditions (such as thyroid eye disease). The need for orbital wall reconstruction needs to be discussed and considered both preoperatively and intraoperatively.
- The lacrimal system can be injured if the dissection is too superficial during the precaruncular approach. Inserting probes into the canaliculi can prevent injury.

Areas of Controversy

Transorbital surgery for sphenoid wing meningiomas is a relatively new approach. There is no doubt that an optic nerve decompression prior to resection of the intracranial and lateral

orbital component enhances postoperative visual improvement [7, 8]. There is uncertainty whether complete surgical resection is possible with the transorbital route alone when compared to a pterional approach. Which patients should be offered transorbital surgery versus a craniotomy is not clear, and further studies with long-term outcomes need to be examined to ascertain the role of transorbital surgery for these lesions.

Access to the anterior and middle cranial fossa through the superior lateral approach is relatively easy, but whether neurosurgeons can utilize these portals to address pathology of the frontal and temporal lobes remains to be seen.

Key Learning Points

- Multidisciplinary input is essential if transorbital surgery is contemplated.
- Before embarking on transorbital surgery, training is essential and special instruments/retractors are required.
- Multiportal surgery allows resection of lesions crossing surgical boundaries.
- A subperiosteal tissue plane preserves neurovascular structures and orbital muscles.
- Suturing of the periosteum is important to avoid ptosis and lateral canthal dystopia.

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