ENDOSCOPIC SURGERY OF THE ORBIT AND RELATED STRUCTURES

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Introduction

In recent years, there has been a growing trend towards the use of minimally invasive techniques in surgery. This is, for the most part, governed by the objective of achieving a better cosmetic outcome while reducing the morbidity rate associated with extensive tissue dissection. Endoscopic surgery exemplifies these attempts and has been enthusiastically adopted by the ear nose throat (ENT) surgeons. Endoscopic surgery of the orbit is a challenging frontier which is becoming the standard of surgical care for pathologies within and around the orbit.

Endoscopic orbital and paraorbital surgery, however, has evolved over the years and is performed primarily via sinonasal approaches by ENT surgeons. Transnasal endoscopic approaches are well established for dacryocystorhinostomy, orbital decompression, orbital medial wall fracture repair and optic canal decompression.

In this pictorial manual we will demonstrate the surgical steps of the most common diseases we have managed comfortably with the aim of helping the practicing intermediate level endoscopic sinus surgeon to easily reproduce these maneuvers.

The following endoscopic procedures will be demonstrated in this booklet:

- Dacryocystorhinostomy (DCR)
- Orbital Decompression
- Optic Nerve Decompression
- Management of Intraorbital Tumors
- Management of Orbital Floor Fractures

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Endoscopic dacryocystorhinostomy (DCR)

Endoscopic dacryocystorhinostomy (DCR) is indicated for patients with lacrimal sac obstruction or nasolacrimal duct obstruction (NLDO).

NLDO is common, and presenting symptoms include epiphora and dacryocystitis (infection). Endoscopic DCR is usually considered for patients who have been refractory to conventional treatment such as probing and flushing of the nasolacrimal duct.

Established advantages of the endoscopic approach include the absence of external incision and scar formation, preservation of the orbicularis oculi pump mechanism, preservation of medial canthal anatomy, improved visualization, decreased operating time, less intraoperative bleeding, and the ability of the surgeon to address concurrent intranasal pathology, including septal deviations and ethmoid disease.

Endoscopic DCR is also useful to revise failed external DCR. The nasal endoscope directly visualises the cause(s) of failure such as an inadequately sized osteotomy and nasal synechiae, allowing to provide more specific treatment.

The success rates of the external approach have been reported to range above 90%. Endonasal laser-assisted approaches were found to yield lower success rates from 60% to 86%, probably due to thermal scarring of the fistula. The advent of powered drilling instruments to remove the hard bone adjacent to the lacrimal sac has improved the success rates of endoscopic DCR to 95%.1–3

Technique

There are various methods to successfully perform EDCR. Thus, it is advisable to use a method that is easily performed, in the shortest time and with good results. We describe a method that we have been using for the last 9 years with a mean success rate of 94.5% and average operating time of 25 minutes.4–5

Endoscopic DCR is usually performed under general anesthesia. Collaboration with an ophthalmic surgeon is recommended as most cases are seen by them and their help in cannulating the punctum is invaluable for a beginning surgeon. We manage our cases together with the ophthalmologist. The nasal cavity is first packed with patties or ribbon gauze soaked with a decongestant. A lacrimal fiberoptic light probe is passed through a dilated and probed lacrimal punctum which aids in endonasal diaphanoscopic localization of the outline of the lacrimal sac (Figs. 1–5).
The bone adjacent to the lacrimal sac is fully exposed after elevating the mucosal flap.

The cutting burr is used for creating the initial osteotomy.

The diamond burr is used to finally thin the lacrimal bone.

Wide osteotomy with lacrimal sac tented.

Once the sac has been identified, a mucosal flap is elevated, prior to which the area is injected with a standard marcaine-adrenaline mixture via a dental syringe. This will allow the lacrimal bone to be demonstrated with the sac brightly lighted, defining clearly the outline and margins of the sac. The bone overlying the illuminated sac is removed in one of the next operative steps.

The bone at the superior margin of the osteotomy is often very thick and angled in a position that makes it awkward for removal by a Kerrison ronguer. Thus, a curved DCR diamond-tipped burr is employed for this, and is applied until the lacrimal sac can be seen. The bone is drilled to such an extent that all margins of the illuminated sac are clearly seen. The latter is tented up with a No. 3/0 Bowman probe placed horizontally through the inferior canaliculus (Figs. 6–11).

A corresponding vertical or C-shaped incision is made along the entire length of the lacrimal sac and its posterior flap is apposed to that of the nasal mucosa. The anterior flaps of both mucosal linings are then positioned to cover the raw bony edges of the osteotomy. Both upper and lower canalicular stenting using (O’Donaghue or Jones) tubes is performed to maintain patency of the DCR site, and the stents are removed 12 weeks later (Figs. 12–20).
Pulling through the punctum probe.

A single Jones tube has been pulled through the fistula.

Double Jones tubes secured with Liga clips.

Jones tubes in position without tension in the inter-palpebral fissure.

The nasal mucosa has been repositioned over the Liga clips.

Intranasal aspect of cut ends of Liga clips.

The nasal cavity may be left without packing as in most cases the bleeding is very minimal. The post-operative regimen is similar to that of external DCR surgery (the avoidance of strenuous activities, straining, blowing the nose, sneezing and pulling on the stent). Patients are also put on nasal decongestants, antibiotics and eye drops.

Advantages of Endoscopic DCR

- Easy identification of the lacrimal sac which can be difficult without using an external light probe, as in some cases the lacrimal sac can be sclerotic due to repeated infections and abscess formation.
- The illuminated sac allows easy identification of its borders. The entire sac can be easily exposed by “just following the light”.
- The ophthalmologist is directly involved in the surgery hence improving the relationship between departments and facilitating the setting up of a “Lacrimal Clinic”.
- Bone is removed or drilled according to the transilluminated area thus minimizing accidental exposure and iatrogenic injury to the orbit.
- In our experience of about 100 cases, the use of tubes for cannulating the punctum was shown to be associated with minimal complications. We had only 2 cases of tube extrusion in children. Almost all patients are comfortable with the tubes in situ.
- The method, in our opinion, is the easiest and fastest (average of 25 mins) with excellent results (94–95% success), and has the added benefit of a quick learning curve.

References

Orbital Decompression

History of the Procedure
Graves disease, originally called Graves-Basedow disease, was first described as the triad of hyperthyroidism, goiter, and exophthalmos in 1835. Dollinger, who described lateral orbital decompression, initially advocated surgical decompression of the orbit for thyroid ophthalmopathy in 1911. Naftziger described an intracranial approach to orbital decompression in 1930. This technique was not widely adopted because of the morbidity associated with the procedure and postoperative intracranial complications (eg, meningitis, transmission of CNS pulsations to the orbit).

Otolaryngologists became involved in orbital decompression in 1936 when Sewall described an external ethmoidectomy approach for decompression of the medial orbital wall. This involvement continued with the development of the Walsh-Ogura technique, presented in 1957, which involved a transantral approach to remove both the medial and inferior orbital walls of the bony orbit. The Walsh-Ogura technique became the mainstay of surgical treatment for Graves disease. Even though effective decompression can be achieved with this method, the incidence of newly onset postoperative diplopia can be high.

In 1993, Garrity et al. monitored 428 patients undergoing orbital decompression for Graves ophthalmopathy and reported a 64% incidence of recurrent onset postoperative diplopia. Although the reported incidence rate is often lower, newly onset diplopia is a concern for all patients faced with orbital decompression. The advent of advanced endoscopic techniques has enabled surgeons to decompress the orbit endoscopically, providing effective decompression with less morbidity. This is primarily a result of circumventing a gingival incision and a low incidence of cranial nerve V2 hypoesthesia. Although an endoscopic approach to the medial and inferior walls can be performed in isolation, a balanced approach, incorporating a lateral decompression with repositioning of the lower lid, can be required.

Endoscopic Orbital Decompression
Orbital decompression for the treatment of Graves’ orbitopathy is an invaluable technique for patients with proptosis, exposure keratopathy and optic neuropathy. The expanding role of transnasal endoscopic surgery leads to a natural extension of the management of selected orbital tumors and fibro-osseous lesions with orbital extension. Traditional open approaches that have been described over the past century are limited by suboptimal visualization and carry the morbidity of incisions within the facial skin, oral cavity or conjunctiva. Endoscopic orbital decompression allows for safe and effective decompression of the medial and inferior orbital walls with minimal morbidity to the patient.

Indications

- Endocrine Graves’ Orbitopathy (associated with exophthalmos, exposure keratopathy, diplopia, and optic neuropathy).
- To gain access to the orbit for removal of benign orbital tumors, biopsy of lesions or as palliative therapy for malignant tumors causing visual symptoms.
- As an approach to tumors located medial to the optic nerve, as well as sinonasal or skull base tumors with extension into the orbital compartment.
**Objective**

The objective of endoscopic orbital decompression is the removal of the entire medial orbital wall and the medial portion of the orbital floor up to the infraorbital nerve.

**Preoperative Examination and Surgical Planning**

CT (Axial + Coronal) is mandatory as a baseline and roadmap for surgery. Visual and eye movement assessment is also vital.

**Patient Positioning and Preoperative Setup**

The patient is positioned supine on the operating room table similar to the surgical set-up for endoscopic sinus surgery. A slight extension of the head may help in visualizing the orbit during surgery. Topical vasoconstriction is achieved with either oxymetazoline (0.05%) or cocaine (4%). The eyes are left uncovered and lubricated with a topical antibiotic as it will be “balloted” during surgery to help identify the orbit endoscopically. The mucosa of the middle turbinate and lateral nasal wall are infiltrated with lidocaine (1%) and epinephrine (1:100,000) (Fig. 1).

If a septal deviation obstructs visualization of the middle meatus, a septoplasty is performed before commencing orbital decompression.

**Technique**

Initially, an uncinectomy is performed to obtain access to the middle nasal meatus. A large middle meatal antrostomy (MMA) is then carried out to visualize the floor of the orbit. The surgical boundaries extend from the posterior border of the nasolacrimal duct up to the posterior wall of the maxillary antrum and inferiorly flush with the inferior turbinate (to provide access to the orbital floor). A large medial meatotomy is also important so that the prolapsed orbital contents do not occlude the maxilla.

A complete ethmoidectomy (anterior and posterior ethmoidectomy) is performed with skeletonization of the lamina papyracea as far posterior as to the orbital apex to create adequate space for the herniated orbital contents and provide landmarks of the sphenoid ostia and ethmoid roof for maximal decompression (Figs. 2–3).
The lamina papyracea is then elevated with an elevator or ball-tipped probe from a few millimeters posterior to the posterior margin of lacrimal sac all the way to the anterior wall of sphenoid (Fig. 4). In this way, the entire periorbita is exposed allowing to visualize a large medial meatal antrostomy (Fig. 5). The bony fragments can be removed with a Blakesley forceps. Bone can be removed superiorly up to the skull base, and usually the entry of both anterior and posterior ethmoidal arteries into the orbit can be visualized (Fig. 6).

The inferomedial portion of the orbit floor is removed by downfracturing the bone with a heavy curette. Subsequently, the floor or the orbit is removed as far as the infraorbital nerve. This challenging step can be managed with the aid of a 30° HOPKINS® endoscope and angled forceps assisting in the bone removal. A buttress of bone is preserved anteriorly at the juncture of the inferior and medial orbital walls to avoid excessive inferior herniation of the globe (Fig. 7).

Following removal of the lamina papyracea and medial orbital floor, a sickle knife is used to make 3–4 horizontal incisions along the exposed periorbita up to the posterior limit of decompression (anterior sphenoid sinus wall). Care must be taken not to plunge the tip of the sickle knife as there is a risk of iatrogenic injury to the orbital contents (Figs. 8–9). Other sharp instruments can also be used e.g., pterygium knife.

The horizontal incisions are made in a posterior-to-anterior direction, starting inferiorly and proceeding superiorly, so that the prolapse of herniated fat does not obstruct visualization. The periorbita can be removed between incisions to maximize prolapse of orbital contents into the nasal cavity. Palpating the globe externally can help identify these bands and facilitate prolapse or fat herniation (Figs. 9–11).

Nasal packing is not done to avoid pressure to the orbital apex and optic nerve.

**Postoperative Care**

Patients are kept overnight to observe for hemorrhage and are discharged with a 10-day course of broad spectrum antibiotics and instructed to douche the nose with saline solution twice a day, to clear mucus and debris. The rest of the follow up is similar to those who have undergone standard endoscopic sinus surgery.
Results and Complications

Successful outcome of orbital decompression is defined by the indication of surgery. Accordingly, for patients with optic neuropathy secondary to compressive pathology, recovery of vision indicates the success while in cases with exposure keratopathy or severe proptosis, cosmetic appearance and resolution of exposure keratitis is the goal.

The clinical scenario dictates the extent of orbital decompression required. In endoscopic orbital decompression, the medial wall and part of the inferior orbital wall are removed. In the authors’ experience of around 40 cases, this provides an ocular reduction of proptosis of 3.0 mm. Complications include diplopia and epistaxis. Diplopia can be prevented to some extent by preserving an anterior bony strut that will prevent the orbit from rotating medially. The authors had only one case of diplopia with this technique.

Conclusions and Clinical Cases

Endoscopic orbital decompression provides successful treatment for patients with Graves’ orbitopathy (Figs. 12–15). Excellent visualization of the orbital apex and skull base allow for effective reduction in proptosis with minimal patient morbidity. The expanding role of transnasal endoscopic sinus and skull base surgery leads to a natural extension for the management of selected orbital tumors and fibro-osseous lesions with orbital extension. These advanced procedures should be performed by surgeons who have significant experience in endoscopic techniques. An example of endoscopic tumor excision and orbital decompression of extensive ossifying fibroma in a 6 year old child is illustrated in Figs. 16–18.
Endoscopic Surgery of the Orbit and Related Structures

Postoperative Views

CT Images – Preoperative Views

CT Images – Postoperative Views

References

Endoscopic Optic Nerve Decompression (EOND)

Endoscopic decompression of optic nerve is indicated in cases of traumatic and/or inflammatory compression or damage to the optic nerve in the area of the orbital apex, the optic canal or along its course in the walls of the posterior ethmoid bone and the sphenoid sinus. In our setting, the decision-making for EOND is developed jointly with the ophthalmologist and/or neurosurgeon.

Optic nerve decompression can be performed as a stand-alone procedure or in combination with orbital decompression.

**Recommended Indications**

- Treatment of papilledema accompanying pseudotumor cerebri (idiopathic intracranial hypertension).
- Surgical treatment of traumatic optic neuropathy is indicated, if
  - visual acuity does not improve to 20/400 or better despite 24–48 hours of steroid therapy or
  - if visual acuity is 20/200 or better, but deteriorates during or after completion of steroid therapy.
- Non-arteritic anterior ischemic optic neuropathy (NAION).

**Surgical Steps**

The use of an image-guided navigation system is not compulsory, however the system offers the advantage of anatomical identification. The entire surgical procedure can be performed with a HOPKINS® 0°-telescope and involves that the patient is placed in the supine position with the head slightly extended.

A standard sphenoethmoidectomy is performed (anterior ethmoidectomy, posterior ethmoidectomy and transethmoidal sphenoidotomy), the optic nerve and the prominence of the internal carotid artery are identified in the sphenoid sinus (Fig. 1).

The sphenoid sinus is enlarged laterally, flush with the orbital apex (Fig. 2).

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1. Anatomy of the left orbital apex region, view of the sphenoid via transethmoid sphenoidotomy.
2. Dissecting the left orbital apex region.
Next, the lamina papyracea is entered with a small curette or Freer elevator, 1 cm anterior to the sphenoid face. The lamina is removed posteriorly towards the optic nerve using curettes and Blakesley forceps. The thick bone (of the optic canal) posteriorly can usually be removed with a curette, however in 10% of cases, the bone is thick and can make drilling with a diamond burr mandatory (Figs. 3–5).

The optic nerve with its sheath is exposed for a distance of approximately 10–15 mm (Fig. 6). The bony opening created in this way should expose at least 120° of the nerve’s circumference (Fig. 7). Some authors advocate a longitudinal incision of the annulus of Zinn in order to open the optic nerve sheath. Clinical indications for opening these structures have not been clearly defined. Once the bony canal has been removed and the sheath has been incised, the procedure is concluded. No intranasal packing is placed. As mentioned earlier, the optic nerve can be decompressed as an adjunct procedure to that of orbital decompression, however it is advisable to incise the periorbita secondary to optic nerve decompression.

Figs. 8–10 show images of endoscopic orbital and optic nerve decompression performed in a patient with tuberculosis and concomitant loss of vision. Figs. 11a–d are images of endoscopic optic nerve decompression in a patient with marked vision loss (optic neuritis) after radiotherapy for nasopharyngeal carcinoma.
**Tips**

The orbit is shaped like an ice cream cone that tapers posteriorly, medially and slightly inferior as well. To identify the optic nerve, just follow the orbit as it tapers posteriorly guiding you to the optic nerve. A sphenoidotomy is important as the optic canal seen within the sphenoid will facilitate identifying the orbital apex.

References


Endoscopic Transnasal Repair of Orbital Blow-out Fractures

Background

This procedure must be carried out in collaboration with an ophthalmologist. Nasal endoscopy provides direct visualization of the orbital floor fracture and unimpeded access to the target site of repair which involves complete reduction of herniated orbital soft tissues in addition to release of the entrapped muscle without globe retraction.

This approach averts the need for lower eyelid incisions and their associated risk of complications (eyelid malposition, enophthalmos).

This procedure is ideal for management of trap door and medial blow-out fractures. However, this technique can be augmented with a trans-antral endoscopy via a sub-labial antrostomy for anterior placed fractures.

Technique

This procedure commences with a standard uncinectomy and wide middle meatal antrostomy (Figs. 1, 2).

The maxillary mucosa is then dissected off the fracture site with a ball probe or another suitable instrument and the demarcation between fracture edges and prolapsed orbital content is identified. The orbital contents can then be released from the fracture edges and additionally reduced with a ball probe or gauze back into the orbital cavity.
The rectus muscle can be tested via a forced duction test to assess the mobility and to check if it is entrapped. If the muscle is entrapped, it can then be released with a ball probe from the fractured edges until its free movability is confirmed by using again the forced duction test (Figs. 3–10).

The bony fragments are repositioned and secured in place with a saline-filled (15 ml) Foley balloon catheter in the maxillary sinus, positioned under direct vision at the fracture site. The balloon is left in position for two weeks (Figs. 11–15). If the orbital pressure is too high, a few milliliters of saline can be drained off.
Management of Intraorbital Tumors

Background
Endoscopic orbital decompression is an excellent minimally invasive technique permitting access to orbital tumors (infero-medial to the optic nerve) and para-orbital tumors (with orbital extensions) for diagnostic and therapeutic uses. This technique improves visualization with minimal manipulation of tissues allowing adequate exposure of the operative site, yet avoiding undue pressure on the globe and unnecessary compromise of its neurovascular supply.

Technique
Following a standard exposure of orbital walls using the aforementioned technique of orbital decompression, the lamina papyracea (can be selectively) removed to permit access to the tumor.

By elevating the orbital fat and retracting the recti muscles, access is obtained to the intra-conal lesions posterior to the globe.

Albeit, care must be taken to avoid injury to the optic nerve as well as a number of important structures contained in the posterior orbit, namely the ophthalmic artery, vein, and the ocular muscles with their motor nerves.

The use of interactive image-guidance can be helpful in identifying landmarks, but should not be solely relied on as the orbital contents shift with decompression maneuvers.

This technique leads to an excellent cosmetic result and reduced morbidity which is found to be associated with bleeding secondary to an open procedure.
In the following presentation of clinical cases, a sinonasal tumor extending into the right orbit and skull base (extradurally) (Figs. 1–5) was surgically managed by standard endoscopic excision of tumor with removal of the intraorbital lesion. Next, the tumor was debulked and cleared intraorbitally (until the medial rectus was free of tumor). In another case, endoscopic excision of sinonasal malignancy with optic nerve decompression was performed to restore visual acuity (Figs. 6, 7).
In another clinical case, a schoolgoing child presented with proptosis of the right globe. A lesion, shown on CT scan in the superomedial aspect of the orbital rim, above the orbit, was found to compress the superior rectus muscle.

Endoscopically, the orbit and anterior ethmoidal artery were identified and the orbit was pushed inferiorly to visualize and excise the tumor. Histopathology revealed the presence of an Ewing’s sarcoma (Figs. 8–12).

Another gentlemen presented with reduced vision and loss of color vision. CT scan revealed an intraorbital tumor compressing on the rectus muscles and impinging on the optic nerve. Endoscopically, after removing the periorbita, the tumor was extirpated completely until the rectus muscles came into view. Vision and color vision returned to normal within 24 hours after surgery (Figs. 13–16).
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