1

Endoscopic Orbital Surgery: The Rhinologist's Perspective

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The specialties of otolaryngology and ophthalmology are separated by little more than the width of the lamina papyracea. This paper-thin bone that forms the boundary between the orbital and sinonasal cavities serves as a metaphor for the aligned interests of two specialties whose practitioners often find themselves operating in close anatomic proximity. Indeed, cooperative surgical endeavors between otolaryngologists and ophthalmologists have risen rapidly since the introduction of nasal endoscopes to treat patients with orbital disorders.

Endoscopic Dacryocystorhinostomy

Before the endoscopic age, attempts to surgically treat orbital disease through a transnasal approach were often fraught with poor visualization and poor outcome. The best documented attempt to perform a dacryocystorhinostomy (DCR) through the nose was described in 1921 by Harris P. Mosher, who then served as chairman of the Department of Otology and Laryngology at Harvard Medical School.[1] Using a headlight and nasal speculum, he described the drainage of pus from the infected lacrimal sacs of 12 patients. Although this intranasal approach avoided the need for a facial incision, a postoperative orbital infection developed in one patient who almost lost her eye, prompting Mosher to abandon the procedure in favor of a combined external-intranasal approach. In his words, "Where light is possible it is folly to work in the dark. The best surgery is done by sight." For the next 70 years, DCRs were performed almost exclusively in an external manner through a medial canthal incision, and largely by ophthalmologists.

With the advent of small-diameter, high-resolution nasal endoscopes for sinus surgery in the mid-1980s, a renewed interest developed in the possibility of accessing orbital pathology through the nose. Otolaryngologists found themselves routinely operating in the vicinity of the lacrimal sac as they cleared disease from adjacent ethmoid air cells under excellent visualization. While doing so, the potential to readily access the medial orbital structures via a transnasal approach became readily apparent, and early reports in the literature supported the concept.[2]

In 1989, I was approached by Daniel Townsend, an ophthalmologist at Massachusetts Eye and Ear Infirmary, who had recently performed an external DCR on a 52 year-old woman, only to have her troublesome tearing return 3 months later. When I examined the patient in the office with a nasal endoscope, a dense scar band could be seen overlying the region of the lacrimal sac along the lateral nasal wall. She appeared to be an ideal candidate to revisit Mosher's intranasal DCR approach, this time with the necessary "light" and visualization to perform a safe and effective surgery.

The trip to the operating room proved to be a fruitful one. The ophthalmologist passed lacrimal probes through the canaliculi to localize the obstructed lacrimal sac while I resected the scar tissue and made a wide opening around the probes into the sac. The patient tolerated the 90-minute procedure well, and her epiphora has not returned in more than 30 years.

The early success of endoscopic DCR led to its relatively rapid adoption by other surgeons at our hospital and across the country. The benefits of avoiding a facial incision and reducing patient morbidity offered by endoscopic DCR were obvious. However, not so obvious at the time were the subtleties of patient selection and surgical technique that affected clinical outcome.

One such example was the use of surgical lasers, which were quite popular at the time, for the performance of endoscopic DCR.[3] Although laser fibers could be passed through either the tear duct or nose to remove bone overlying the lacrimal sac, their use led to postoperative scar formation and restenosis. Laser endoscopic DCR had a success rate of 78% compared with a rate of more than 90% for conventional DCR. Because of these early setbacks, endoscopic DCR lost favor among many ophthalmologists who continued to perform conventional external DCR. Nevertheless, with increasing clinical experience, the performance of endoscopic DCR was refined and its adoption grew worldwide. Numerous reports over the past decade have described the safety and efficacy of this technique with results comparable to those of external DCR.[4]

Key Concepts and Lessons Learned

Over the past 30 years, personal experience supported by evidenced-based studies has taught me many lessons regarding the performance of endoscopic DCR. These lessons have been reinforced by the more than two dozen referring ophthalmologists with whom I have shared this journey. The following list enumerates some of the lessons learned.

1. **The benefits of a team approach.** Patients who undergo endoscopic DCR are best served when their care is provided by both an ophthalmologist and otolaryngologist. The complementary skill sets of these specialists allows for optimal treatment of these patients, including preoperative irrigation of the lacrimal

apparatus, intraoperative intubation of the canaliculi, and postoperative debridement of the surgical site.

2. **Starting with revision cases.** When learning to perform endoscopic DCRs, keep in mind that revision cases are usually easier than primary ones, because the thick bone overlying the sac has already been removed. In addition, ophthalmologists are more likely to refer one of their patients in whom external DCR with recurrent epiphora has failed. Such initial cases often lead to happy patients and a happy referring ophthalmologist.
3. **Adequate exposure of the lacrimal sac**. The technique used to remove thick bone overlying the lacrimal sac—drill, rongeur, ultrasonic aspirator—is not nearly as important as the location and amount of bone removed. The important thing is to remove the thick bone anterior to the maxillary line to provide adequate exposure of the entire medial sac wall.
4. **Placement of lacrimal stents.** Although placement of a stent through the newly created internal lacrimal ostium at the conclusion of endoscopic DCR may not be necessary in most cases, doing so has low patient morbidity and may help with postoperative debridement and healing.
5. **Visualization of the internal common punctum at the conclusion of surgery.** The goal of endoscopic DCR is nasalization of the internal common punctum. This punctum is visible as the opening through which the lacrimal stent enters the lateral sac wall. If this punctum is visible at the conclusion of surgery, the chances are high for a successful surgical outcome.
6. **Performance of septoplasty at time of endoscopic DCR.** If a superior septal deflection limits access to the region of the lacrimal sac, the practitioner should have a low threshold for performing septoplasty immediately before endoscopic DCR. Adequate visualization and exposure are key to safe and effective endoscopic surgery.
7. **Postoperative debridement.** Removal of tissue and debris from the surgical site under endoscopic guidance 1 week after surgery is just as important after DCR as it is after sinus surgery. Movement of the lacrimal stent with blinking as seen on endoscopy at the time of debridement suggests patent tear flow and is a positive prognostic sign for successful surgery.
8. **Intranasal causes of DCR failure.** The most common causes of DCR failure, whether performed through an endoscopic or external approach, are due to intranasal pathology. Such pathology, including adhesions and obstructing turbinates, can be readily visualized on postoperative endoscopic examination and addressed at the time of revision endoscopic DCR.

Endoscopic Orbital Decompression

Not long after the successful introduction of endoscopic DCR, sinus surgeons began to consider other possibilities for transnasal treatment of orbital pathology. At the completion of routine ethmoidectomy for chronic rhinosinusitis, the skeletonized lamina papyracea was in full view, yet its penetration was assiduously avoided for fear of exposing orbital fat and causing injury to intraorbital structures.

Those of us who trained in otolaryngology before the endoscopic era were familiar with the Walsh-Ogura transantral approach for treatment of patients with exophthalmos from Graves' disease.[5] Surgery started with a transoral incision to open the maxillary and ethmoid sinuses. The bony orbital floor and lamina papyracea were then removed, resulting in orbital decompression with immediate reduction in proptosis. But could similar surgery be performed through an endoscope? The answer came in 1990 when David Kennedy and his ophthalmologic colleague, Neil Miller, at Johns Hopkins described the successful treatment of eight patients with Graves' orbitopathy using an endoscopic technique.[6] Two of the patients underwent simultaneous Walsh-Ogura procedures to verify that adequate bone had been removed endoscopically along the orbital floor.

Later that year, I was approached by John Shore, an innovative ophthalmologist at Massachusetts Eye and Ear, who had a 38-year-old patient with a severe case of Graves' orbitopathy. He was particularly concerned about impending vision loss in this individual who had already had a vision-threatening corneal abrasion and was in need of a thorough decompression, including the region of the orbital apex, which can be difficult to visualize through a conventional approach.

When we took this first patient to the operating room, the ophthalmologist was amazed at the excellent visualization in the region of the orbital apex afforded by the endoscope. After removal of the entire lamina papyracea, I incised the periorbita in a posterior-to-anterior direction, resulting in immediate prolapse of orbital fat and reduction in the patient's proptosis. A tense orbit was now soft, and the referring physician was now sold on the advantages of an endoscopic approach to the medial orbit. A week after surgery, the patient's exophthalmos was 8 mm less than its preoperative level, but he did not have the postoperative facial swelling, numbness, and ecchymosis associated with nonendoscopic approaches to the orbit. The enhanced visualization and reduced patient morbidity afforded by the approach to the medial orbit led to a rapid growth in the number of endoscopic decompressions performed nationwide during the 1990s.[7]

Within the first 5 years of performing orbital decompressions, however, an unanticipated problem became evident: development of new-onset diplopia that was difficult for the strabismus surgeons to correct. We had known for many years that double vision was an expected sequela to orbital decompression in many patients, but the severity and incidence of the diplopia was troubling. An analysis of our results suggested that the problem was due to the thoroughness of medial orbital decompression when performed with endoscopic instrumentation compared with conventional transantral or transorbital approaches. Removal of the entire lamina papyracea and periorbita resulted in a greater prolapse of orbital fat and herniation of the medial rectus muscle into the sinonasal cavities than occurred with conventional approaches. This finding was particularly apparent in patients who had undergone only medial decompression without a concurrent lateral decompression.

Similar findings were reported by other authors who recommended the use of a "balanced decompression" technique with concurrent medial and lateral decompressions at the same operative setting.[8] This balanced decompression resulted in a significantly lower incidence of postoperative diplopia. It made sense that the lateral decompression relieved inward pressure on the orbital contents, resulting in less medial displacement of the orbital contents, including the medial rectus muscle, and thereby caused less double vision. Balanced decompressions are now performed on the majority of patients with Graves' disease in my practice who require surgical decompression. Only those with relatively mild proptosis and no optic neuropathy undergo medial decompression alone.

Another procedure developed to reduce the incidence of postoperative diplopia in patients with Graves' orbitopathy is known as the "orbital sling" technique. A 10-mm wide strip of the periorbita overlying the medial rectus muscle is preserved to prevent medial displacement of the muscle during surgery. Orbital fat is free to herniate above and below the fascial sling, providing adequate decompression of the orbital contents. When a balanced technique is used in the majority of patients, supplemented by the use of an orbital sling in select patients, the results of endoscopic orbital decompression are comparable to those of transantral and transorbital techniques, including the degree of decompression achieved and relatively low incidence of postoperative complications.[9,10]

Unlike endoscopic DCR, ophthalmologists gravitated relatively quickly to the concept of endoscopic orbital decompression. They realized the obvious advantages of endoscopic instrumentation for such surgery, including better visualization along the skull base and a more complete removal of the lamina papyracea than could be achieved with conventional approaches. The majority of orbital decompressions performed today use a team approach. It is common for the ororhinolaryngologist to perform the medial portion of the decompression while the ophthalmologist follows with the lateral decompression.

Key Concepts and Lessons Learned

Specific techniques used for orbital decompression are dependent on the individual patient's pathology and the surgeon's preferences. Nevertheless, personal experience over the past three decades, combined with evidenced-based studies, has led to a general set of principles that I apply in the treatment of patients requiring endoscopic orbital decompression:

1. **Endoscopic orbital decompression is only the first step in the rehabilitation of many patients with Graves' orbitopathy.** Once the proptosis has been successfully reduced, a series of additional surgical procedures performed by the ophthalmologist are often necessary to achieve the desired degree of normal function and appearance. These procedures may include lowering the position of the upper eyelid, which is often elevated in Graves' disease, and strabismus surgery to address any residual diplopia.
2. **A balanced decompression decreases the incidence of postoperative diplopia.** Postoperative diplopia is an expected sequela, not a complication, of endoscopic orbital decompression in many patients. Nevertheless, the incidence of double vision can be reduced by the performance of concurrent medial and lateral orbital decompression in the same operative setting.
3. **The use of an orbital sling technique can further decrease the incidence of postoperative diplopia in select patients.** Preservation of a 10-mm wide strip of the periorbita overlying the medial rectus muscle helps to stabilize the muscle position and function, particularly in patients without preexisting diplopia.
4. **Patients who present with optic neuropathy should have complete removal of lamina papyracea in the region of the orbital apex.** Decompression of the orbital apex region effectively removes pressure on the optic nerve and leads to improved vision in many patients with visual loss from optic neuropathy.
5. **Preserve the anterior, not posterior, inframedial orbital strut (IOS).** The anterior portion of the IOS (located anterior to the maxillary ostium) is routinely left in place during endoscopic medial orbital decompression. Preservation of the posterior portion of IOS makes decompression technically more difficult and alters postoperative diplopia only to the degree that it reduces the degree of orbital decompression.
6. **Revision orbital decompression is beneficial in select patients.** In cases of persistent or recurrent proptosis after decompression surgery, removal of any remaining bone along the medial orbit wall or floor may result in the additional desired degree of decompression.

Endoscopic Optic Nerve Decompression

Endoscopic optic nerve decompression is a natural extension of orbital decompression. Bone removal along the posterior orbit is continued into the sphenoid sinus following the optic canal as it courses along the lateral sphenoid wall. In the 1990s, a relatively large number of optic nerve decompressions were performed on patients who lost vision after head trauma, particularly during motor vehicle accidents. There was much debate at the time as to the best surgical approach to use to decompress the optic nerve in patients who lost vision after head trauma—endoscopic, open, transorbital, or transcranial. The debate ended when high-dose steroids were found to be just as effective as surgical decompression of the optic canal in these patients.[10]

Most individuals who present with optic neuropathy as a component of Graves' orbitopathy do very well after endoscopic orbital decompression alone. Provided adequate bone is removed to decompress the region of the orbital apex, their neuropathy, including the associated color blindness and visual field loss, usually resolves. Some ophthalmologists, however, do favor decompression of the optic canal at time of endoscopic orbital decompression in patients with severe optic neuropathy.

Endoscopic optic nerve decompression remains an excellent procedure in those patients whose visual loss is due to compression of the optic nerve within the sphenoid sinus from neoplasms, such as meningiomas, or osseous lesions, such as fibrous dysplasia. Experience has shown that unroofing the bony canal in the affected area is sufficient to restore vision in most cases. Incision of the optic nerve sheath is not necessary.[10]

Endoscopic Resection of Orbital Tumors

The inferior and medial rectus muscles are routinely exposed during endoscopic orbital decompression. Manipulation of these muscles to gain access to the intraconal region of the orbit was a natural extension of this surgical approach. Successful endoscopic removal of tumors of the medial orbit has been described by a number of authors.[11] Most of the early experience was with resection of orbital hemangiomas, which are not only the most common intraorbital tumor encountered but also are well encapsulated, facilitating their dissection from surrounding orbital contents. As experience with these techniques has advanced, the size, location, and pathology of orbital tumors successfully resected through an endoscopic approach have also advanced.

Future Directions

The history of endoscopic orbital surgery over the past 30 years reflects a natural progression of surgical exploration: from superficial to deep, from medial to lateral. As both the techniques and technologies associated with endoscopic orbital surgery advance, so too will the indications, extent, and success of these procedures. I foresee the day when otolaryngologists will work with ophthalmologists to perform surgery on extraocular muscles—retrieval of lost muscles during strabismus surgery, and remodeling of diseased muscles from Graves' disease. Endoscopic instrumentation also has potential benefits in the field of neuroophthalmology—placement of retinal and optic nerve implants, fenestration of the optic nerve for treatment of patients with visual loss from intracranial hypertension, and decompression of the optic nerve in patients with ischemic neuropathy.

Conclusion

The fields of otolaryngology and ophthalmology were once a single specialty. The advent of endoscopic techniques to treat patients with orbital disorders has served to foster the collaborative efforts of surgeons in these two specialties once again. With the growing use of endoscopic instrumentation to treat orbital disease, the future of endoscopic orbital surgery is a bright one, enabling surgeons and their patients to truly "see the light."

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