Novel Applications for Endoscopy

With a 23-gauge probe now available, indications are expanding.

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Since its introduction more than 20 years ago,[1,2] ophthalmic endoscopy has become an important tool for many anterior segment surgeons, especially for performing endocyclophotocoagulation (ECP) in conjunction with cataract surgery. Although adoption has been slower among vitreoretinal surgeons, endoscopy is steadily gaining acceptance for use in many posterior segment surgical applications.

This trend may accelerate now that the technology is available in a 23-gauge instrument (E2 Laser and Endoscopy System, Endo Optiks) that includes high-resolution video imaging, laser, and light source in 1 probe. The triple-function 23-gauge unit works with modern cannula-based vitrectomy systems, passing easily through valved and non-valved cannulas alike. The 23-gauge probe offers a 90° field of view through a 6000-pixel fiber optic bundle.

Traditionally, indications for endoscopy included cases in which there was a lack of visibility through the anterior segment, whether the cornea, anterior chamber, pupil, lens, or some combination of these. While this is still true, vitreoretinal surgeons are finding that endoscopy can be helpful even when the media are clear. The probe provides views that cannot be easily obtained with conventional widefield surgical viewing systems, and allows treatment in locations that would otherwise be difficult to access. This article describes some less widely used applications for endoscopy that posterior segment surgeons may find valuable.

COMPLICATIONS OF CATARACT SURGERY

Posteriorly dislocated lens fragments after complicated cataract surgery are often benign but can cause inflammation, elevated intraocular pressure, and cystoid macular edema (CME). These adverse effects are indications for vitrectomy and removal of the retained lens material. At the end of surgery, the 23-gauge endoscope can be inserted to visualize and, with the vitreous cutter, remove any additional lens fragments that may be concealed anteriorly, behind the iris. This may help diminish the likelihood of persistent CME postoperatively.

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Obtaining a good history is key to preparing for a second surgery after complicated cataract extraction. Try to understand from the anterior segment surgeon whether a single chunk fell to the posterior pole or multiple cortical fragments were dispersed throughout the vitreous cavity. In the clinic beforehand, a careful depressed examination will reveal much information—but not all. The endoscope provides a view of the hidden spots behind the iris that may conceal lens fragments causing persistent CME. It can also be helpful if a small lens chunk escapes from the fragmatome during vitrectomy and lands unseen in anterior peripheral vitreous.

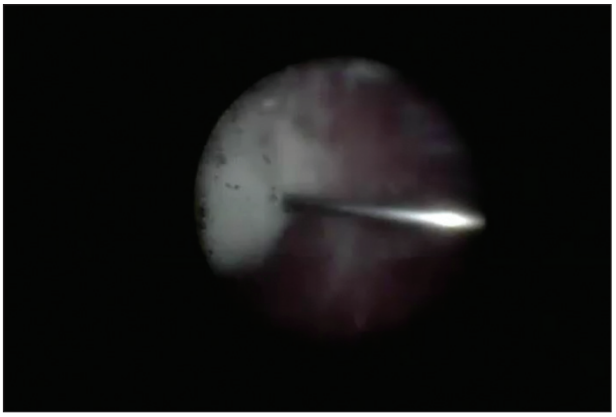

Figure 1. In an eye with acute endophthalmitis, the endoscope revealed numerous anterior pus pockets and anterior vitreous membranes, which were carefully removed under endoscopic view

The 23-gauge endoscope can be inserted through any existing 23-gauge cannula, whether valved or nonvalved, eliminating the need to enlarge the sclerotomies. This makes its use at the end of a case both safe and efficient. In addition, the endoscope can easily be switched from the temporal side to the nasal side, to ensure that all areas have been thoroughly examined.

VITRECTOMY AFTER ENDOPHTHALMITIS

In the management of endophthalmitis, whether in the acute or subacute setting, endoscopy can play a valuable role.

While endophthalmitis is still an uncommon complication, as the number of intravitreal injections increase, so too does the incidence of postinjection endophthalmitis. In comparison to postcataract endophthalmitis, postinjection infections are much more likely to be caused by *Streptococcus* spp.[3,4] These infections can be particularly virulent; ring infiltrates often develop in the cornea, and fibrin can cloud the pupil and deposit on the lens, further obscuring the view of the posterior segment. This may sway some surgeons to delay vitrectomy, regardless of the visual acuity, as a "blind" vitrectomy with limited visibility through the anterior segment is difficult, and, by necessity, incomplete. With the endoscope, it is less daunting to tackle these cases because the surgeon can look directly into the vitreous cavity. Whether a prompt vitrectomy in these hypervirulent infection cases improves visual outcomes is unknown, as the causative organism's endotoxins may acutely—and permanently—damage the retina and optic nerve. Regardless, endoscopic visualization allows a more thorough vitrectomy to be completed and may help to preserve vision—or the globe itself—in these challenging cases.

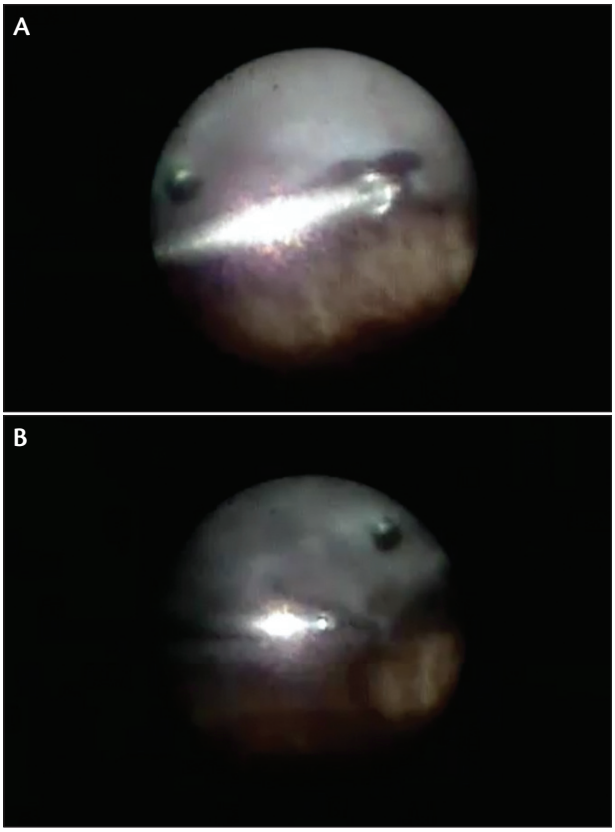

Figure 2. In a hypotonous eye with anterior PVR, endoscopic view aids use of the cutter to remove PVR (A) and retinal scissors to dissect and relieve anteroposterior traction.

In the subacute setting, when the primary infection has been largely treated but dense vitreous opacities and low-grade inflammation can limit visual recovery, the endoscope can again be helpful. In these cases, the view is often sufficient with traditional widefield viewing systems to perform a thorough core vitrectomy. Using the endoscope at the end of these cases facilitates further removal of the peripheral anterior debris, which can be a nidus for smoldering postoperative inflammation. It is not uncommon in these cases to find pockets of necrotic material or even abscesses that can remain culture positive weeks after the initial presentation.[5] Endoscopy can help to locate and remove this residual material (Figure 1).

SURGERY AFTER RUPTURED GLOBE REPAIR

Trauma severe enough to rupture a globe can be accompanied by additional damage to the ocular structures, including hyphema, vitreous hemorrhage, choroidal hemorrhage, lens dislocation, and retinal detachment. In these complex cases, the first surgery often involves repairing only the ruptured globe to close

CASE REPORT: RETINAL DETACHMENT AFTER OPEN GLOBE TRAUMA

A patient was referred after ruptured globe repair. Twenty sutures were present in the cornea, with no view to the posterior segment. A preoperative ultrasound showed choroidal hemorrhage, a dislocated crystalline lens, and a shallow retinal detachment.

In this case, the 20-gauge endoscope was used, as the fragmatome was going to be needed for lens removal. In addition, because of the choroidals, a 6-mm infusion line was used. The endoscope was used to ensure that the infusion cannula was indeed in the vitreous cavity. Then, working slowly anteriorly to posteriorly, the cutter was used to remove the vitreous. Multiple peripheral retinal breaks were identified.

Then the fragmatome was introduced and used to remove the lens under endoscopic visualization. Perfluorocarbon liquid was then used to flatten the retina, and peripheral laser was applied. After completing the air-fluid exchange, a small amount of fluid collected posteriorly, although without any retinal slippage. This was removed with a small drainage retinotomy, which was then surrounded with laser. The vitreous cavity was then filled with silicone oil, and the sclerotomies were sutured closed. The entire case was performed under endoscopic visualization.

the eye and restore some structural stability. Addressing the remaining pathology can be challenging when the view through the anterior segment is compromised, whether from sutures in the cornea, blood staining, an irregular iris or pupil, or a dislocated lens. All of these factors impede good visibility by traditional means. In these types of cases, the endoscope can be helpful (see *Case Report: Retinal Detachment After Open Globe Trauma*). In the setting of a ruptured globe with a detached retina, proliferative vitreoretinopathy (PVR) is prone to develop. If the endoscope can help intervene more promptly in these cases, the outcomes may be improved.

HYPOTONY AND ANTERIOR PVR

Despite successful anatomic reattachment of the retina in cases of complicated PVR, hypotony can occasionally still develop and contribute to a poor visual outcome, chronic pain, and even the development of phthisis. In these cases, anterior PVR in the form of a cyclitic membrane can contract and cause tractional ciliochoroidal detachments, exacerbating the hypotony. Here again, the endoscope can be helpful, allowing the surgeon to visualize the anterior PVR in its normal anatomic position and identify the traction points. Then, using the vitreous cutter in combination with retinal scissors and forceps, this traction can be relieved and the anterior PVR safely removed (Figure 2). Although scleral depression has been used to push this anterior scar tissue into view through the pupil, this maneuver distorts the natural anatomy and limits the surgeon's ability to identify both where the traction is being placed on the ciliary body and any natural surgical planes that can be exploited to remove the pathologic scar tissue.

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CHALLENGING CASES

Endoscopy is often useful in unusual cases to provide views that would not be possible via traditional means. In many such instances, the endoscope plays a helpful role during part of the surgery but is not used for the entire case.

For example, recurrent vitreous hemorrhage after prior vitrectomy is sometimes secondary to a sclerotomy bleed. A traditional viewing system can be used to visualize and, with the cutter, remove the hemorrhage. The endoscope can then be used to view the sclerotomies in the pars plana to identify any sources of blood. Treatment with endodiathermy is then relatively straightforward under endoscopic guidance.

In a recent case, a patient with albinism had a dislocated intraocular lens (IOL) that had been sutured in place after cataract surgery approximately 20 years earlier. The IOL was dislocated because the temporal scleral suture was broken while the nasal suture was still intact. With the endoscope it was easy to identify the remaining suture, cut it, and remove the IOL atraumatically.

Sometimes during air fluid exchange in a pseudophakic eye with an open capsule, condensation can form on the IOL and hamper the view. When the endoscope is readily available, it can be introduced to finish the air fluid exchange and add laser if needed. Although

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viscoelastic can be used to coat the posterior surface of the IOL, this adds expense to the case and can lead to postoperative inflammation or elevated intraocular pressure when not completely removed.

Another application for endoscopy in glaucoma, aside from its frequent use for ECP, is in pars plana tube shunt placement. These tubes can become plugged with vitreous, especially if the tube is being repositioned from the anterior chamber. It can be helpful, whether in conjunction with the glaucoma surgeon at the time of tube placement or secondarily, to perform a close peripheral anterior vitreous shave and ensure at the end of the case, with the tube sitting in its final position, that no vitreous is plugging the tube.

GETTING THE FEEL

Like vitreoretinal surgery in general, there is a learning curve for endoscopy. The eye-hand coordination is different because the surgeon is looking at a 2-dimensional screen and lacks the stereopsis that comes with operating at the surgical microscope. Therefore, the surgeon needs to use other clues to become oriented in the eye and get a feel for the relative depth of structures in the video image.

Perhaps for the younger retinal surgeons who grew up playing video games and manipulating objects on screens the learning curve will not be as steep. I am fortunate to have learned endoscopy simultaneously with learning vitreoretinal surgery. When you train, as I did, with Jeffrey S. Heier, MD, 1 of the busiest endoscopic retina surgeons in the country, you become comfortable with endoscopy quickly. The staff he works with in the OR always keeps the endoscope nearby and is familiar with the equipment, which minimizes any delays in setup or use.

By having the endoscope readily available, I started using it on straightforward cases to get a feel for orienting the image in the eye and then moving around with a second instrument in view. In my opinion, doing this a few times removes a lot of stress, because the overall success of the surgery is not dependent on instant mastery of the endoscope. This might be, as mentioned above, during an air-fluid exchange with a cloudy IOL, or after a retained lens fragment case to make sure there is nothing hiding behind the iris.

Learning endoscopy is like learning traditional vitrectomy; it is important to work slowly and know where you are in the eye. The retina can be unforgiving, and iatrogenic complications can make a routine case difficult. As carpenters say, "Measure twice, cut once."

To get oriented, it is helpful to start by locating the optic nerve, then scanning over to the macula. Doing this helps to determine the orientation of the probe, as twisting the probe rotates the image on the screen. Once this initial orientation is achieved, the surgeon must maintain that orientation and be mindful to not let the probe twist. The second instrument can then be inserted and the endoscope backed out until the instrument is visualized. The surgeon can then continue to move the 2 instruments slowly inside the eye, especially when first starting, to get the feel of the instruments moving in conjunction with each other. It is not altogether different from learning to move them together during conventional widefield vitrectomy.

Another option, especially for people who have been out of training for a while and may not be familiar with the technology, is to attend a wet lab. These are often offered at major ophthalmic meetings such as the American Academy of Ophthalmology's Annual Meeting.

CONCLUSION

Endoscopy is not a new technology, but its most recent iterations—coupled with improvements in small gauge vitrectomy systems— facilitate its use in a broad array of indications. When the endoscope is available in the OR, and the surgeon and staff are comfortable with its use, the number of situations in which it is applicable will continue to expand. ■

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