

Endoscopy for Vitreoretinal Surgeons

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The first endoscope is credited to Philipp Bozzini. In the early 1800s, he introduced a device equipped with an eyepiece, a housing with a candle, a mirror that reflected the light inside the body, and open tubes to be inserted into body orifices.¹ The modern era of ocular endoscopy began in 1934 with Dr. Harvey Thorpe's development of a 6-mm straight tube scope for extraction of nonmagnetic foreign bodies.² The tube was cumbersome and difficult to use, as it could not be bent.

Over the years, technological improvements and optical advances permitted significant miniaturization as well as improved illumination, image magnification, fused glass fiber flexibility, and video storage capabilities. In the 1990s, ocular endoscopy became a useful tool for glaucoma and vitreoretinal surgeons.³⁻⁷

At present in ophthalmology, the endoscope is most commonly used for endoscopic cyclophotocoagulation by anterior segment and glaucoma surgeons, as direct visualization of the ciliary body and retroirideal area is possible by displacing the iris anteriorly with viscoelastic material. However, this review focuses on vitreoretinal procedures in which endoscopy might be of value. Most commonly, endoscopy is employed when visibility through the operating microscope is compromised or when it is necessary to visualize the peripheral retina and ciliary body behind the iris (Fig. 1).

Compromised Visibility

Endoscope-assisted surgery (EAS) has been utilized for years when viewing with the operating microscope is compromised at any time during vitreoretinal repair.

Planned use. EAS may be scheduled for cases with preexisting obstacles to visualization, such as corneal edema; suboptimal anterior chamber anatomy, such as a small pupil; iridocorneal or iridolenticular synechiae, which may be complicated by neovascularization; iris-fixated IOLs or IOL rim distortions; cortical lens remnants; lens capsular opacities; the presence of a cataract; or even persistent anterior chamber bleeding.

Impromptu use. This might occur if, during air-fluid exchange, small bubbles in the posterior segment enter the anterior chamber via peripheral iridectomies or other communicating sites. Other ad hoc applications include sudden loss of pupillary dilation, significant air-capsular glare, and IOL tilt or displacement. Although these are correctable complications, they extend surgical times and can compromise completion of posterior manipulations. EAS may facilitate efficient surgical completion without the necessity of reestablishing view with the surgical microscope.

Corneal obscurations. If one uses an operating microscope and corneal opacification prohibits adequate visualization for required vitreoretinal procedures, a temporary keratoprosthesis may be employed, and corneal



1 FULLER VIEW. Endoscopic view of the ciliary processes and a sclerotomy site with the trocar cannula.

transplantation is then required following vitreoretinal repair. This extensive surgery is associated with substantial risks and recovery time.

In contrast, EAS may permit sparing of the native cornea, for example, in cases of retained nuclear fragments and retinal detachment after complicated cataract surgery.⁴ This may allow time for potential spontaneous corneal clearing with topical treatment.

Anterior chamber obscurations. Endophthalmitis often results in corneal edema and in visually obstructive material inside the anterior chamber that may be difficult or impossible to clear. EAS permits another portal for viewing surgical manipulations as well as for observing retinal status for repair or prognosis.^{4,5}

Penetrating trauma and intraocular foreign bodies may impair visualization of posterior structures when the central cornea is involved. EAS adds to

the surgeon's armamentarium of visualization techniques.⁴

Retinal detachment. In addition to allowing a surgeon to repair a retinal detachment in an eye with a compromised view, EAS provides an enhanced ability to identify previously undetected retinal breaks in patients with rhegmatogenous retinal detachment.⁶

Visualizing the Peripheral Retina and Ciliary Body

It can be challenging to use an operating microscope to view the far peripheral retina, ora serrata, pars plana, and ciliary body regions. Even with wide-angle systems, scleral depression is often required. Knowledgeable surgical assistants are essential to even the most experienced surgeons. Any anterior obscurations such as those described above may further lessen the peripheral view. Filtering blebs, iris cysts, penetrating keratoplasties, or keratoprotheses preclude aggressive scleral depression and add to the surgeon's difficulties in visualizing the posterior segment. EAS becomes an essential tool, not only for viewing but also for acting as a surgical "second hand" for manipulations or laser delivery through the endoscope or a separate handpiece.

Scleral fixation of subluxed or dislocated IOLs. EAS provides visualization of suture placement and haptic position, especially in situations of traumatically altered anatomy. The identification of the sulcus for proper suture placement can be challenging, with only 55 percent of IOLs ending up in the sulcus when sutures are placed ab externo.⁸

Diabetic retinopathy with vitreous hemorrhage and tractional retinal detachment. Surgical success is dependent on the release of vitreoretinal traction forces, thorough dissection of neovascular membranes, and laser photocoagulation of the retina. EAS allows for the completion of these maneuvers in the retinal periphery up to the pars plana and permits visualization of the retroirideal space.⁷

Neovascular glaucoma. The view of the retina and the retroirideal space

is often compromised due to corneal edema, hyphema, and eye anatomy. EAS allows for complete panretinal photocoagulation and endoscopic cyclophotocoagulation, given multiple sclerotomies.

Pediatrics. EAS has been useful in cases in which there is poor visibility through a surgical microscope and when en face views are not sufficient for surgical manipulations. Descriptions of EAS for persistent fetal vasculature syndrome (PFVS) have focused on advantages of a side or perpendicular view to aid in identifying nonvascular sites for appropriate stalk amputation. Other pediatric posterior segment surgeries have been described utilizing EAS as a tool for far anterior viewing and more complete surgical dissection of tractional elements in retinopathy of prematurity, familial exudative vitreoretinopathy, and PFVS.³

Pitfalls and Pearls

Basic caveat. EAS is meant to serve as an adjunct to standard microscope-guided vitreoretinal surgery. Whether the endoscope is used on a planned or unplanned basis, the operating microscope remains the standard for pars plana vitreoretinal surgery. Conversion to EAS depends upon viewing needs.

Training needed. Because EAS does not provide stereopsis, the surgeon must become familiar with monocular cues. Understanding image registration and second instrument manipulations requires practice. The learning curve varies but is usually mastered quickly by surgeons familiar with vitreoretinal techniques. Laboratory practice with cadaver eyes is essential prior to operating room experience, and training courses and wet labs are good starting places for learning to perform EAS. OR staff and those responsible for storage, care, and cleaning of equipment must be properly educated to prevent inadvertent torsion of the fragile glass fiber scopes.

Pearls for use. Once the surgeon is in the OR, it might be advisable to start with using the endoscope as a light pipe and noting the endoscopic image on the display screen through-

out the surgery. A next step might be to use the endoscope with an integrated laser. Subsequently, a laser can be used as a second instrument in the opposite hand. With experience, surface retinal work with second accessory instruments, such as forceps or scissors, becomes possible. One must remember to keep the instruments inserted in the eye within the field of the endoscope at all times. Lighted accessory instruments might be useful until the surgeon becomes familiar with the technique.

In addition to the loss of depth perception, the shadows are difficult to judge endoscopically, as the light and video ports are coaxial. Changes in light intensity and cone of light diameter provide a sense of proximity but require frequent adjustment to obtain optimal imaging.

Conclusion

Endoscope-assisted vitreoretinal surgery continues to evolve. Surgical need, operator experience, imaging improvements, and availability are expected to guide increasing use. ■

MORE ONLINE: In mid-June, visit the EyeNet home page to view videos illustrating EAS use. And for technical information on the instrument, see the online edition of this article at www.eyenet.org.

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