

The Role of Endoscopy in Vitreoretinal Surgery Today

Current technology brings advantages along with some tradeoffs.

BY JORGE G. ARROYO, MD, MPH

The use of endoscopy in ophthalmology dates back as early as 1934,¹ when Thorpe described an instrument for removing nonmagnetic foreign bodies from the vitreous. This was followed by the description of an endoscope with a 1.7-mm diameter (between 13 and 14 gauge) shaft in 1978 by Norris and Cleasby.² By 1990, endoscopy using a 20-gauge probe that provided views on a video monitor was in use,^{3,4} and shortly thereafter laser application through an endoscope was performed.^{5,6}

The current state of endoscopy technology in ophthalmology is represented by the E2 Laser and Endoscopy System (EndoOptiks), incorporating illumination, and laser capability in endoscopy probes as thin as 0.57 mm (23 gauge). The laser output and pulse width, the aiming beam intensity, and the light source can be controlled from a touch pad or a footpedal. The diode laser operates in the near infrared at 810 nm, and the xenon light source can be either 175 or 300 W. The device includes a high-resolution camera and is autoclavable.

The E2 device is now available with the traditional 19.5-gauge or a 23-gauge endoscopy probe. The 19.5-gauge probe originally delivered 10 000 pixels with a 125° field of view, and now with the high-resolution camera this has been improved to 17 000 pixels with a 140° field of view. The 23-gauge probe currently offers only 6000 pixels for a modest 90° field of view. Also with this smaller probe the 300 W xenon light source is needed to adequately illuminate structures. The 23-gauge probe to date works best for laser delivery and is of limited use for other applications.

A gradient index (GRIN) lens system that offers higher resolution but a narrower field of view is available at



Figure 1. Endoscopic epiretinal membrane peeling in a patient with a complicated retinal detachment and proliferative vitreoretinopathy.

additional cost. It is less convenient to use, as the camera, attached directly to the handpiece, cannot be autoclaved and therefore must be draped during procedures.

ENDOSCOPY-ASSISTED VITRECTOMY

Endoscopy can provide benefits in vitreous surgery that cannot be obtained with a conventional operating microscope view. Endoscopy allows visualization independent of poor media, with the capability to provide variable perspective and high magnification. The ability to see posterior segment structures despite media opacities makes this technology particularly valuable in eyes with signifi-



Figure 2. Sharp dissection with microvitrectoretinal blade of epiciliary membrane in a patient with hypotony.

cant corneal or anterior segment scarring, hemorrhage, or lenticular opacity. The flexibility of the endoscopic probe allows rapid changes in perspective as vitrectomy surgery progresses. Available field of view varies from 90° to 140°, and the wider fields make the use of this modality more efficacious and safe. High magnification, especially with the probe positioned at close range, facilitates the identification of small retinal breaks and other subtle features.

Indications for which endoscopy-assisted vitrectomy is particularly useful include ischemic retinopathies, such as proliferative diabetic retinopathy and central retinal vein occlusion, as well as uncontrolled glaucoma and neovascular glaucoma. After complicated cataract surgery, endoscopy can be helpful in recovering subluxated nucleus material or a dropped intraocular lens (IOL).⁷ It can also assist in managing severe endophthalmitis.⁸

At our center, we have found the use of endoscopy to be crucial in the care of certain patients with permanent keratoprotheses, as well as in cases of trauma with corneal opacification and endophthalmitis. We are gathering data in these areas with interest in publishing in the future.

Peeling of epiretinal and internal limiting membranes can be accomplished through the endoscope (Figure 1), although the lack of stereopsis and limited field of view can introduce challenges not encountered with a standard coaxial operating microscope. On the plus side, the endoscopic view can assist in the safe injection of dyes for visualization, and the high magnification can aid in the identification of membrane borders for peeling.

HYPOTONY

It is often thought that once an eye becomes hypotonous, options for saving that eye may be limited. But in

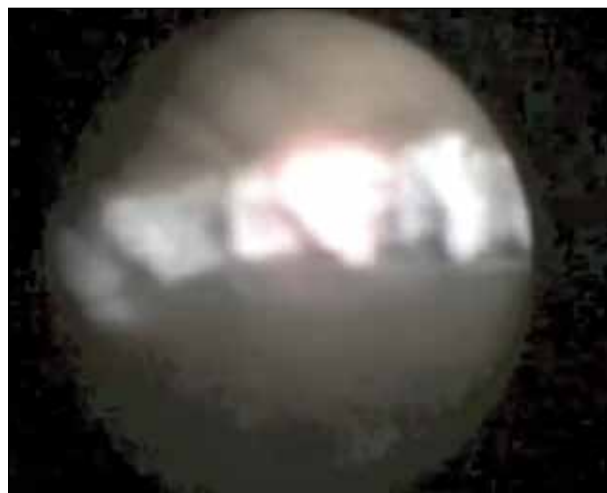


Figure 3. Endoscopic cyclophotocoagulation (ECP) in patients with glaucoma is one of the most common uses of endoscopy in ophthalmology.

eyes in which the hypotony is due to an epiciliary body membrane, endoscopy allows the surgeon to carefully peel that membrane (Figure 2). Thus, by improving the view of the ciliary body, the endoscope allows a new approach to what had been a heretofore very difficult problem to treat with conventional methods. This is another area that we are evaluating with great interest.

ECP AND PRP

Perhaps the most common use of endoscopy in ophthalmology to date has been for endoscopic cyclophotocoagulation (ECP) in patients with glaucoma. Cyclodestructive procedures were historically largely reserved for refractory or end-stage glaucomas, but the ability to apply relatively mild laser treatment to the ciliary processes endoscopically has broadened the indications for this treatment approach (Figure 3).

When ECP is performed in patients with concomitant cataract, it is typically performed at the time of cataract surgery. In this setting, the endoscopic probe can be inserted through the cataract wound, with ample injection of a viscoelastic substance between the lens and iris, and the laser can be used to treat the anterior ciliary processes. This mode of access usually allows treatment of about 8 clock hours of the ciliary processes. If a greater extent of treatment is desired, creation of a second limbal wound is necessary.

Another option for ECP is via pars plana access, which allows much more extensive treatment of the ciliary processes. This approach first requires vitrectomy, after which the endoscope is inserted through the sclerotomy. The probe allows visualization of the ciliary processes



Figure 4. Endoscopic panretinal photocoagulation (PRP) in a patient with severe ischemic proliferative diabetic retinopathy.



Figure 5. Peripheral endoscopic PRP between the equator and ora serrata in a patient with neovascular glaucoma.

and the pars plana, and laser in continuous mode can be applied at a power setting of 0.35 W.

Treatment at close range results in a moderate blanching of the ciliary tissue. Laser is typically applied as far anteriorly and posteriorly as possible. To achieve 12 clock hours of treatment, a second sclerotomy is called for, usually about 6 hours from the first port.

In our experience, 12 hours of treatment in patients with neovascular glaucoma lowers intraocular pressure without resulting in hypotony.

In certain situations, such as in patients with heavy pigmentation, when the laser power is set too high, or when the laser probe is too close to the ciliary processes, vapor bubbles can form due to conversion of aque-

ous into steam. If this occurs, decreasing the power or increasing the distance between the probe and the tissue being treated can resolve the problem.

Pars plana access also allows application of panretinal photocoagulation (PRP) almost confluent from the equator to the ora serrata around 360° (Figures 4 and 5). It should be noted that the 810 nm diode laser produces an intense laser burn. It is possible to connect an argon laser to the endoscopic probe to deliver the familiar argon green wavelength endoscopically.

CONCLUSIONS

Current technology for ophthalmic endoscopy delivers undoubted advantages in certain surgical situations but still entails some tradeoffs. It provides excellent visualization in eyes with compromised view through the cornea, anterior segment, or lens. It facilitates excellent peripheral PRP in the patients with peripheral ischemic retinopathies. It allows ECP in patients with glaucoma, either at the time of cataract surgery or as a standalone procedure.

Among potential drawbacks are the learning curve involved in adopting this method of visualizing the posterior segment, the lack of stereopsis, and the limited view with the current 23-gauge endoscopy probe. The endoscopic probe is also currently only marginally adequate for membrane peeling. Also, the 810-nm diode laser produces intense burns, although this can be mitigated by attaching an argon laser to the fiberoptic probe.

In the future, we can hope for improved functionality in the 23-gauge endoscopic probe. This reduced-gauge instrument could be an extremely helpful tool for surgeons and could offer a route for retinal vascular cannulation or for delivery of cells or other therapeutic agents subretinally. ■

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