

Commentary: Ocular endoscopy: An eye into the eye

Optimal visualization and ease of surgical manipulation remains the cornerstone for successful surgical outcomes. Despite remarkable development and technical advancement in the viewing systems of the modern operating microscopes, certain structures remain inaccessible either due to opaque intervening media or by virtue of their location itself. The ability of the endoscope to circumvent anterior segment opacities and access regions such as the ciliary body gives it a unique advantage in surgeries involving structures in the ciliary body region as well as vitreoretinal surgeries in eyes with damaged and opaque anterior segments.

Microendoscopes can be fibreoptic or non-fibreoptic. In the fibreoptic version, optical fibres for illumination, imaging and optional laser photocoagulation extend from their console interfaces through a handpiece to the distal end of an intraocular probe. The high-resolution optical image from the intraocular tip is relayed via the fibreoptic image guide to its proximal end, which is interfaced with a digital video camera. In a non-fibreoptic or Gradient index (GRIN) lens-based microendoscope, conventional objective and relay lenses are replaced with small diameter GRIN lenses which are fabricated with flat ends to facilitate their use in multiple-lens systems and bonding to fibreoptic components. In this system the video camera or viewing eyepiece is directly attached to the GRIN lens handpiece-intraocular probe, hence the system is more fragile.^[1]

The coaxial optical property of the ocular endoscope confers a better view of the vitreous as it appears more opaque in contrast to the dissociated viewing of conventional imaging system.^[2] Intraocular

depth of field ranges from roughly 0.75–40 mm, permitting high magnification when the endoscope probe is adjacent to tissues and a panoramic intraocular view when it is close to the sclerotomy site.

The ability to bypass anterior segment media opacities makes it an effective instrument for timely intervention of vitreoretinal procedures precluding the need for combining with keratoplasty or keratoprosthesis and allowing a better surgical and functional outcome.^[3] Due to better visualization of the anterior retina, vitreous base, pars plana and ciliary sulcus without structural distortion, the utility of endoscopy in advanced pathology like endophthalmitis where the anterior segment changes preclude visualization of the vitreous cavity, anterior proliferative vitreoretinopathy (PVR), pediatric tractional retinal detachment (TRD), retained lens matter in sulcus is inevitable. The use of ophthalmic endoscopes in eyes with damaged anterior segment where direct visualization of the retina and optic nerve has helped decide on performing or avoiding complex surgical procedures in eyes with uncertain visual potential.^[4]

Endoscopy facilitates diagnosis and treatment of anterior segment diseases related to ciliary body, angle of anterior chamber, posterior iris epithelium, intraocular lens (IOL) position, and capsular support—difficult to access and visualize with a conventional microscope.^[5] Endoscopic cyclophotocoagulation via anterior approach or via pars plana approach is demonstrated to be a successful treatment modality for glaucoma patients obviating the need for early filtration surgeries and is a useful alternative to more invasive glaucoma procedures. It is also a suitable option for candidates not fit for filtration surgeries or those with a prior history of failed trabeculectomy. Its role in the management of congenital and pediatric glaucoma is well established reducing the need for early filtration surgeries and related complications.

Hypotony of the eye either as a sequelae of surgery or trauma is another challenging situation to treat due to the limited view of the ciliary body and its related anatomy through a conventional viewing system. The endoscope has the capability to directly access and visualize ciliary body pathology such as traction, detachment or effusion, cyclitic membranes, etc. and allows the meticulous dissection of membranes leading to a more predictable surgical outcome.

Similarly, its capacity to accurately assess retroirideal structures specially capsular support and cilio-zonular attachment makes it a useful tool in the management of dislocated or subluxated IOLs and placement of secondary IOLs. A better understanding of the haptic location and zonular support through an endoscope enables a surgeon to plan the appropriate procedure for placement of IOL which will minimize complications like hemorrhage, retinal detachment, and ciliary body detachment especially where scleral fixation is planned.

A more detailed review of current indications and applications of endoscopy is published in this issue.^[6]

As with all benefits of a technique, there are hurdles to be overcome. Two-dimensional (2D) images, lack of stereopsis, rigid instruments, dissociation between the surgeon's hand movement and the intraoperative view are major limitations. Distance from tissues needs to be assessed on 2D video monitor images with non-stereoscopic clues such as target tissue size and structure, motion parallax, and changes in color or consistency. From a surgeon's perspective, orientation of side-on view with ophthalmic endoscope compared to top-down (bird's eye) view of conventional viewing system offers a steep learning curve. To adapt to the change, initial training on an artificial eye in a wet lab for intraocular orientation and ease of manoeuvrability with an endoscope is recommended. Inability to perform bimanual procedures with endoscopy restricts its use in complex PVR cases, diabetic TRDs requiring bimanual manoeuvres. The limited field of view in comparison to a wide-angle viewing system makes it as a useful supplement to conventional imaging technology in difficult surgeries but not yet a replacement. With the advent of 23-gauge and 25-gauge probes, it is possible to use endoscopes during microincisional vitrectomy surgery (MIVS). However, smaller calibre microendoscopes have fewer image guide optical fibres, lower resolution and smaller imaging fields.

Recent innovations include reconstructing a 3D endoscopy system with the help of a 3D converter^[7] and replacing optical fibre image guides with video microchips mounted on the distal end of endoscope probes that facilitate smaller calibre endoscopy. Ophthalmic microendoscopes traditionally have either rigid straight or curved intraocular probes depending on use for posterior or more anterior surgery. Single-use illumination and laser probes with extensible curved fiberoptic bundles that are housed within a rigid intraocular probe are also available. Potentially, the illumination and imaging channels can be colour-filtered to perform endoscopic monochromatic ophthalmoscopy or even fluorescein angiography. Though still in the developmental stage it is likely that intraoperative OCT data

could be made available during microendoscope procedures from sources such as microscope integrated OCT systems, independent intraocular OCT probes or very small diameter OCT probes integrated into microendoscopes.

Intraocular endoscopy for complex pathology is an exciting development that is still a work in progress. However in its current form, it forms more of a valuable addition to the surgeon's inventory of instruments for complex procedures involving the posterior segment and the ciliary body region.

Muna Bhende, Subham Sinha Roy

Shri Bhagwan Mahavir Vitreoretinal Service, Medical Research Foundation, 18 College Road, Chennai, Tamil Nadu, India

Correspondence to: Dr. Muna Bhende,

Shri Bhagwan Mahavir Vitreoretinal Service, Medical Research Foundation, 18 College Road, Chennai - 600 006, Tamil Nadu, India.

E-mail: drmuna@snmail.org

References

1. Ajlan RS, Desai AA, Mainster MA. Endoscopic vitreoretinal surgery: Principles, applications and new directions. *Int J Retina Vitreous* 2019;5:15.
2. Wong SC, Lee TC. Pediatric retina. In: Hartnett ME, editor. Chapter 13. Philadelphia: Lippincott Williams & Wilkins; 2013. pp. 125-30.
3. Wong SC, Lee TC, Heier JS, Ho AC. Endoscopic vitrectomy. *Curr Opin Ophthalmol* 2014;25:195-206.
4. Pappuru RR, Tyagi M, Paulose RM, Dave VP, Das T, Chhablani J, et al. Role of diagnostic endoscopy in posterior segment evaluation for definitive prognostication in eyes with corneal opacification. *Am J Ophthalmol* 2017;176:9-14.
5. Francis BA, Kwon J, Fellman R, Noecker R, Samuelson T, Uram M, et al. Endoscopic ophthalmic surgery of the anterior segment. *Surv Ophthalmol* 2014;59:217-31.
6. Dave VP, Tyagi M, Narayanan R, Pappuru RR. Intraocular endoscopy: A review. *Indian J Ophthalmol* 2021;69:14-25.
7. Kita M, Kusaka M, Yamada H, Hama S. Three-dimensional ocular endoscope system for vitrectomy. *Clin Ophthalmol* 2019;13:1641-3.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Access this article online	
Quick Response Code:	Website: www.ijo.in
	DOI: 10.4103/ijo.IJO_1966_20

Cite this article as: Bhende M, Roy SS. Commentary: Ocular endoscopy: An eye into the eye. *Indian J Ophthalmol* 2021;69:25-6.