Chandelier Endoillumination in Vitreoretinal Surgery

This method of illumination improves visualization in challenging cases and can be used in many different situations.

BY YUSUKE OSHIMA, MD

On the heels of widespread adoption of wide-angle viewing systems and new light sources for small-gauge vitrectomy, a variety of chandelier lighting systems have been developed to provide stationary, wide-angle and uniform endoillumination for obtaining adequate visualization of the retina during surgery. During the past several years, Synergetics, DORC, and Alcon Laboratories Inc. have manufactured a variety of chandelier lighting systems, including a single-fiber system available in 25-gauge (Figure 1) and 27-gauge (Figure 2) formats and a separated 2-fiber system in a 27-gauge (Figure 3) or 29-gauge model (Figure 4).[1-4] In some models, the tip of the chandelier light probes can be placed into the cannula, while others require a separate needle to create an additional sclerotomy for inserting the fiber tip into the vitreous cavity. Generally, chandelier endoillumination with 2 optic fibers,[1] first described by Eckardt as the twin-light chandelier, is more useful than a single fiber system for obtaining homogeneous and more widespread illumination. The 2-fiber system eliminates the need to reposition the fiber and minimizes the shadow seen with single-fiber chandelier endoillumination because the illumination comes from 2 different directions.[2-4,5]

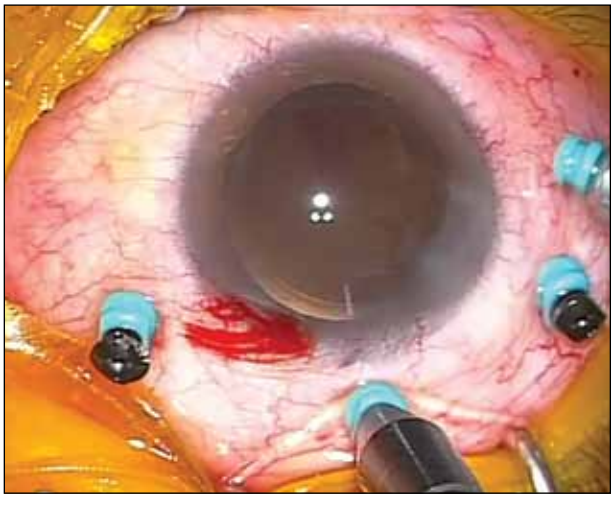

Figure 1. A 25-gauge cannula-guided single-fiber chandelier probe (Alcon Laboratories Inc.). It is simple to set and easy to self-retain transconjunctivally.

BASIC ROLES AND TECHNIQUES FOR CHANDELIER ENDOILLUMINATION

The basic advantages of using chandelier endoillumination have been described in several articles.[1-7] When

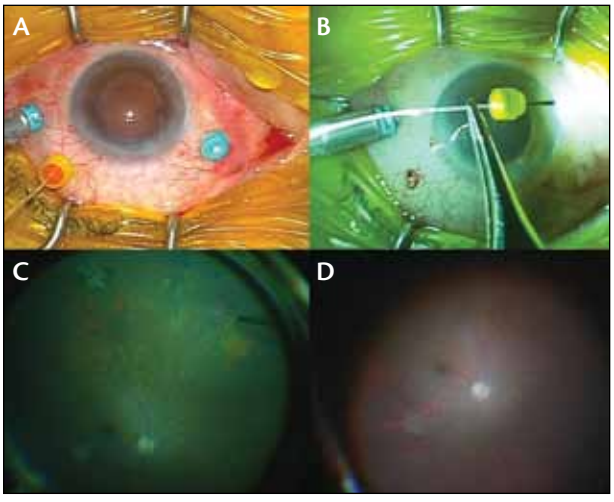

Figure 2. A new 27-gauge single fiber chandelier illumination system (27G-VIVID chandelier fiber) from Synergetics (A). The tip of chandelier light probes can be placed into a specially designed cannula (B). The distal end of the fiber can be connected with mercury vapor (C) or xenon (D) light sources. Sufficient endoillumination can be obtained for wide-angle fundus observation.

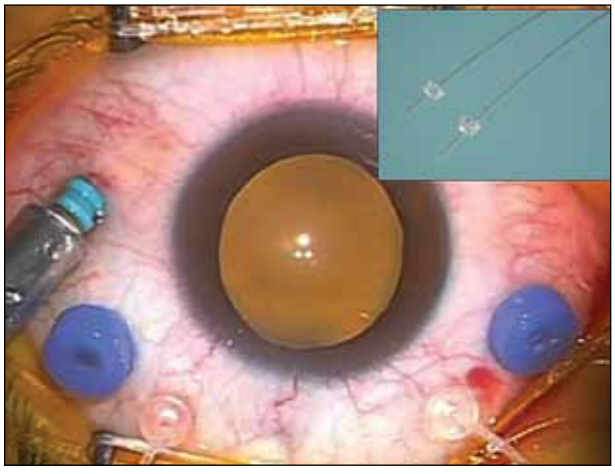

Figure 3. The 27-gauge twin-light chandelier fiber designed by Eckardt, which is compatible with a xenon light illuminator (Bright Star, DORC).

considering retinal phototoxicity, the working distance for light irradiation is important, and holding the light probe as far away from the retina as possible increases safety.[8] For this reason, I use the chandelier fiber for most of my cases. In simple cases such as macular surgery, I hold the chandelier probe with 1 hand in a manner similar to which I would use a light pipe to control the illuminating direction during surgery (Figure 5). In addition to the safety advantage, the self-retaining nature of chandelier endoilluminators frees up my hand from holding a light probe, allowing true bimanual manipulation during surgery. In retinal detachment cases, I can perform scleral indentation and achieve more controlled and smooth peripheral vitreous base shaving without the need for an assistant (Figure 6). For membrane dissections in challenging cases, such as diabetic tractional retinal detachment or proliferative vitreoretinopathy, the freed hand is helpful for holding forceps to grasp the membranes for separation from the retina or for dissection using scissors or a cutter (Figure 7). For cases in which I use a self-retaining chandelier system, I prefer to set up the fiber superiorly—eg, a single fiber at 12 o'clock or dual fibers at 2 and 10 o'clock—to make the instrument shadow appear anteriorly and not interfere with the working area view. Not only is it easy to adjust the optic fiber tips from this angle, but illumination is optimized and glare from the tips of the instruments is minimized. The direction of illumination can be changed from the posterior pole to the periphery by changing the curvature of the chandelier fiber outside the orbit (Figure 8).

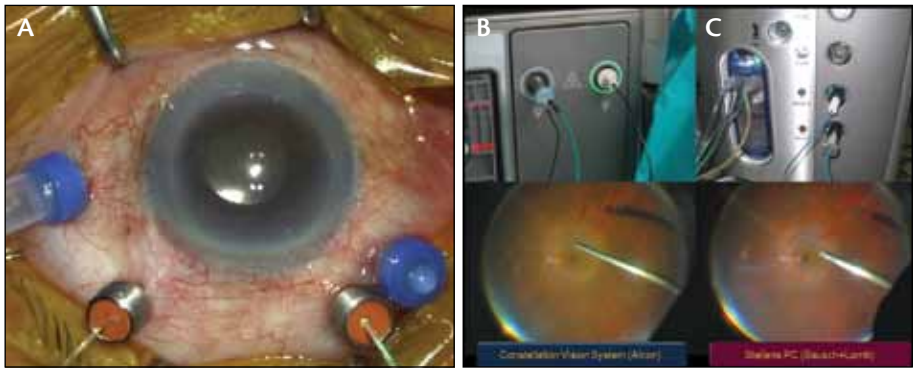

Figure 4. A 29/30-gauge dual-chandelier fiber system (Synergetics). The cannulas are helpful for fiber positioning and to avoid missing the small wounds in cases of inadvertent removal of the fiber during surgery (A). Chandelier endoillumination with two separated ultra–small-gauge fibers provides homogeneous and more widespread illumination than a single fiber. It can be connected with the xenon light sources featured in the new generation machines (Constellation Vision System [Alcon Laboratories, Inc.; B], Stellaris PC [Bausch + Lomb; C]).

IMPROVING ANTERIOR CHAMBER VISUALIZATION FOR PHACO-VITRECTOMY

Case 1: Corneal Opacity

A 71-year-old woman with cornea opacity and dense cataract had a total retinal detachment in her only seeing right eye (Figure 9A, 9B).

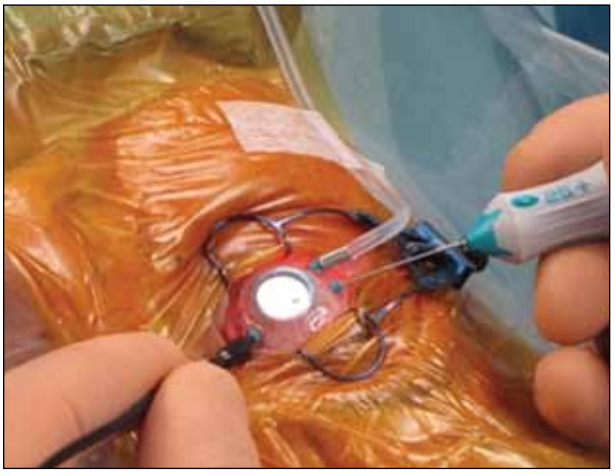

Figure 5. In simple cases, the cannula-guided chandelier probe can be held in a manner similar to a light pipe and used to control the illuminating direction during surgery.

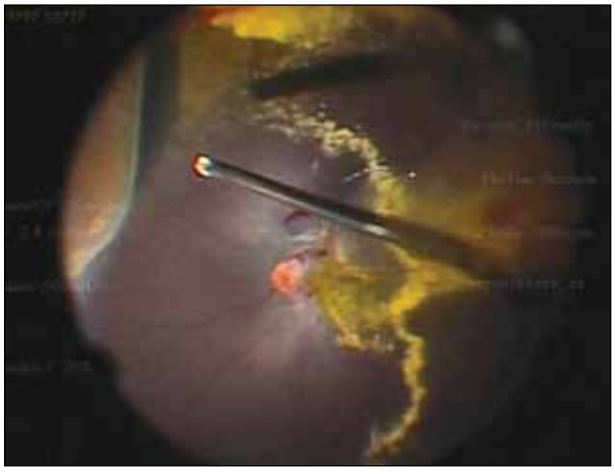

Figure 6. Self-retaining chandelier endoillumination can free 1 hand for scleral indentation, and thereby surgeons will achieve more controlled and smooth peripheral vitreous base shaving by themselves without the need for an assistant.

Although crystalline lens removal is preferable to improve the fundus visualization for safer vitrectomy, capsulorrhexis and phacoemulsification through a hazy cornea are very challenging under the conventional microscopic illumination because of poor visibility of the anterior capsule and crystalline lens. To overcome the difficulty to perform phaco in eyes with corneal haze, retroillumination generated by a chandelier lighting system inserted transconjunctivally into the vitreous cavity is a helpful illumination technique for clearly visualizing the crystalline lens for safer phacoemulsification surgery (Figure 9C, 9D).[9] Once the lens is removed, vitrectomy can be performed sequentially with the chandelier illumination as is (scan QR code for video).

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Case 2: Dense Vitreous Hemorrhage

A 61-year-old man with a cataract had dense vitreous hemorrhage and suspicion of traction retinal detachment due to proliferative diabetic retinopathy in the right eye. A phaco-vitrectomy is preferable in this patient. However, phacoemulsification surgery may be somewhat challenging because severe vitreous hemorrhage often obscures the red reflex from the fundus and interferes with clear visualization of the crystalline lens structure and capsule during cataract surgery. Similar to Case 1, the use of a chandelier lighting system to generate retroillumination in this case can improve visualization of the cataractous lens and its capsule, thereby facilitating safer cataract surgery in selected patients with dense vitreous hemorrhage (Figure 10).[10] Once the lens is safely removed, vitrectomy can be carried out sequentially under wide-angle fundus viewing with chandelier illumination as is (scan QR code for video).

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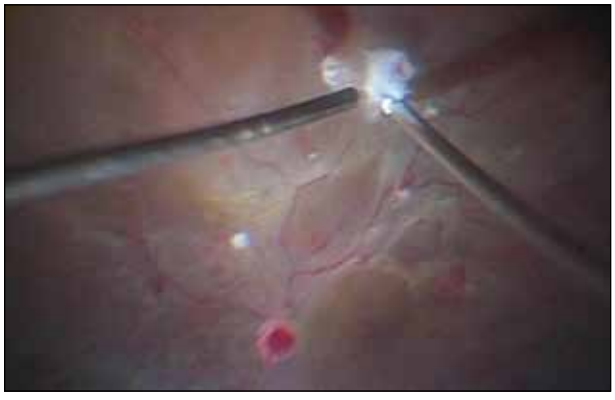

Figure 7. In more challenging cases, the freed hand is helpful for holding forceps to grasp membranes for separation from the retina or for dissection using scissors or a cutter in a bimanual procedure. Setting the chandelier fiber superiorly is helpful, making the shadow go down to the inferior area, which can help in avoiding the instrument shadow coming into the working zone.

SCLERAL BUCKLING UNDER WIDE-ANGLE FUNDUS VIEWING WITH CHANDELIER ILLUMINATION

Scleral buckling is a widely prevalent treatment option for primary rhegmatogenous retinal detachment, and it has usually been carried out with the use of binocular ophthalmoscopy via the aid of a condensing lens. Although most buckling procedures are performed sequentially under surgical microscopic viewing, repeated wearing and removal of

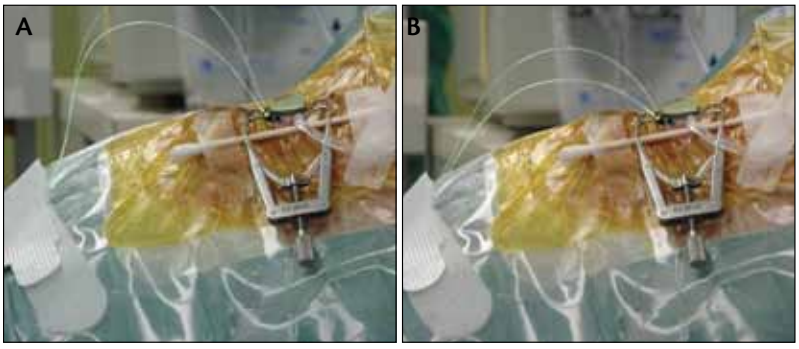

Figure 8. The direction of the illumination focusing on the posterior pole (A) or periphery (B) can be optimized easily by changing the curvature of the chandelier fiber outside the eyeball with this flexible type of chandelier fiber.

the binocular ophthalmoscope for fundus examination is a routine procedure during surgery. The recent widespread use of chandelier illumination in conjunction with a wide-angle viewing system offers wide, excellent visibility of the fundus to achieve safer surgical manipulation during pars plana vitrectomy. The whole surgical procedure can be sequentially performed with viewing through the surgical microscope without the burden of repeated wearing and removal of the binocular ophthalmoscope usually needed during scleral buckling. In addition, adjusting the viewing focus and magnification under the surgical microscope may be more helpful to identify preoperatively unrecognized tears during surgery. To enjoy the advantages seen in vitrectomy, scleral buckling can also be carried out under wide-angle fundus viewing with chan-

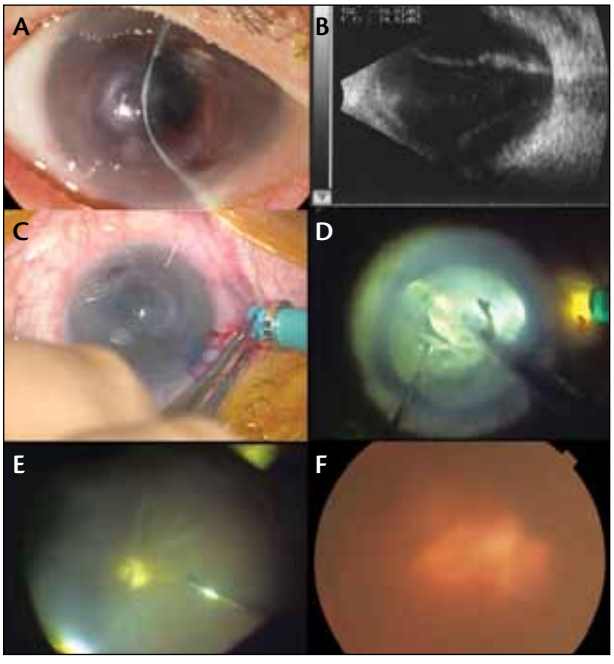

Figure 9. A 71-year-old woman had a cornea opacity and dense cataract obscuring fundus visibility (A). B-scan echography suggested a retinal detachment occurred in her only seeing eye (B). Intraoperative views of chandelier retroillumination-assisted phacoemulsification surgery (C, D). The self-retaining chandelier stays in the inferotemporal pars plana region (C). Retroillumination by chandelier endoillumination from the posterior side offers sufficient lighting to view the crystalline lens clearly without obstruction by the hazy cornea. Phacoemusfication surgery was performed with a bimanual chopping technique as usual (D). Pars plana vitrectomy was sequentially performed to treat a myopic macular hole-induced retinal detachment (E). Postoperative fundus photography through a hazy cornea (F). Retina was attached with visual acuity improvement from counting fingers to 20/200 after surgery.

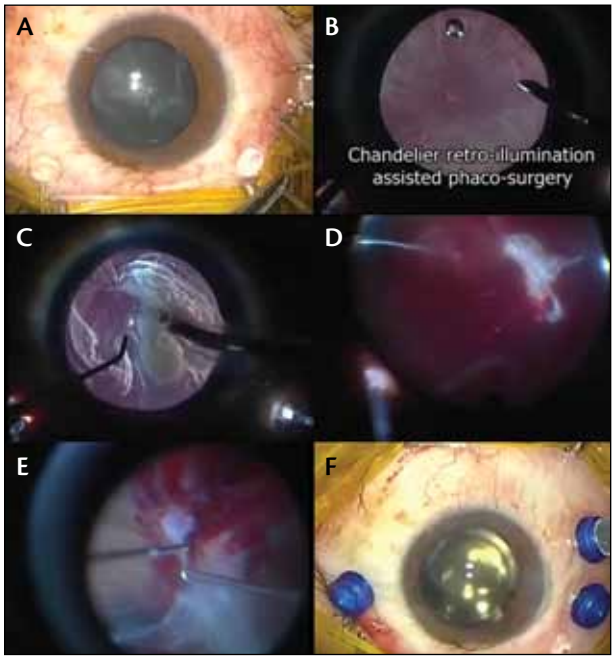

Figure 10. A 61-year-old man with a cataract had dense vitreous hemorrhage obscuring the red reflex from the fundus. A 27-gauge twin-light chandelier fiber was set followed by starting phaco-vitrectomy (A). Retroillumination from the chandelier lighting clearly illustrated the anterior capsule to perform capsulorrhexis (B) and phacoemulscification with a bimanual chopping technique (C). Vitrectomy to remove the dense hemorrhage was carried out sequentially after uneventful lens removal (D). Fibrovascular membrane dissection was performed bimanually under chandelier endoillumination (E). Finally, an intraocular lens was implanted to conclude microinsicion phaco-vitrectomy (F).

delier illumination (Figure 11; scan QR code for video).[11,12] The quality and angle of view of the fundus through a surgical microscope with chandelier endoillumination is at least equal to or much better than that observed through the conventional binocular ophthalmoscope via the condensing lens. The theoretical concerns of the current procedure may include bacterial inoculation into the vitreous cavity during transconjunctival insertion of the chandelier fiber tip and vitreous incarceration to the sclerotomy after the fiber removal. In my opinion, careful disinfection of the ocular surface by repeated irrigation with diluted povidone-iodine and the use of a cannula-compatible smaller gauge fiber would be preferable in this scenario.

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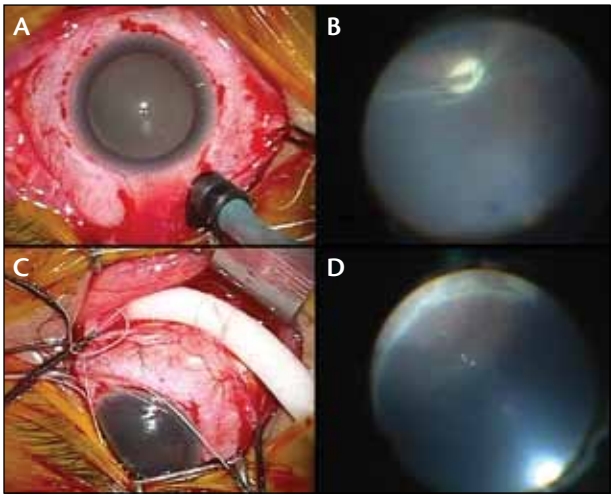

Figure 11. A 27-year-old man underwent scleral buckling to treat primary rhegmatogenous retinal detachment. A 25-gauge Awh chandelier fiber (Synergetics) was settled in the pars plana region opposite the region with retinal tears (A). Cryoretinopexy was carried out under chandelier endo-illumination observed through a wide-angle viewing system (B). After suturing the scleral buckle (C), the position of scleral indentation with the buckle was again examined through the wide-angle viewing system under chandelier endoillumination (D).

Figure 12. A light-emitting diode light source (DORC) developed for illumination during vitrectomy, which is a new platform of illuminator for safer endoillumination.

SUMMARY

The utility and efficacy of chandelier endoillumination in a variety of situations during vitreoretinal surgery has been described herein based on personal experiences and preferences. It is clear, however, that there are many different surgical situations in which chandelier endoillumination is beneficial for improving intraocular visibility and thereby achieving favorable surgical outcomes. Nevertheless, surgeons must still bear in mind that the final goal of illumination is to enhance the efficiency of surgery while maintaining safety. Similar to the introduction of xenon and mercury vapor bulbs in our field, new light-emitting diode light sources (Figure 12) have recently been developed with unique potential. The evolution of next-generation chandelier illumination systems continues and looks promising for the future. ■

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