A Practice Model for Trabecular Meshwork Surgery

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Models for practicing ophthalmic surgery are a necessary part of all ophthalmic training. Herein, we describe a method for preparing human donor cadaveric eyes with direct visualization of the anterior chamber angle for practicing trabecular meshwork surgery. This model can be adapted for use with both fresh and formalin-fixed eyes. The use of formalin-fixed eyes decreases the risk of infection transmission inherent with human cadaveric eyes, allows prepared eyes to be stored indefinitely, and can be reused until all of the trabecular meshwork has been exhausted in surgery. We describe the application of this model for the technique of ab interno trabeculectomy using the Trabectome system for treating open-angle glaucoma.


Videos available at www.archophthalmol.com

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METHODS

Human donor cadaveric eyes (phakic and pseudophakic) not suitable for transplantation were obtained from the Minnesota Lions Eye Bank. A long, thin strip of gauze was wrapped around the equator of the eye enough times to allow it to sit without wobbling in the eye socket of a surgical model mannequin head (Iatrotech, San Diego, California). This was positioned under the operating microscope. The corneal epithelium was gently removed with a No. 64 blade, and remaining perilimbal conjunctiva was scraped. With the use of a handheld trephine 0.5 to 1.0 mm smaller than the diameter of the hard contact lens to be used, the central cornea was trephined and the cut completed with right and left cornea scissors. The remaining corneal edge and surface were dried meticulously with cellulose sponges (Figure 2). The fit of the hard contact lens (factory rejects obtained from the local supplier; we used 8.5-mm diameter polymethyl methacrylate contacts, though other sizes may be tried as well) over the corneal opening was checked to be certain that the lens overlapped the edges of the corneal opening. The contact lens was removed. Using the fine edge of a wooden applicator stick snapped in half, 12 very small dots of cyanoacrylate glue gel were applied to the outer surface of the corneal edge. The contact lens was then carefully positioned over the corneal opening with the glue contacting the edges. A steady stream of 150mM sodium chloride solution was directed onto the surface of the contact lens and allowed to flow over the glued edges to speed curing of the glue. The surface was then meticulously dried again with cellulose sponges. The areas between the spots of glue applied previously were then filled in with additional intervening dots of glue to achieve a good seal. The surface was again irrigated with 150mM sodium chloride solution to hasten curing. A No. 75 blade was used to construct a clear corneal limbal paracentesis port through which the anterior chamber was filled with viscoelastic. While the prepared eyes may be used fresh at this point, we prefer the greater stability of eyes fixed with neutral buffered formalin, 10% (Figure 3).

To perform an ab interno trabeculectomy using this eye model, a limbal clear corneal incision was constructed with a No. 75 blade to accommodate the handpiece. The anterior chamber was then filled with additional viscoelastic. The Trabectome handpiece was inserted into the anterior chamber with direct visualization through the operating microscope (Figure 4). Additional viscoelastic was placed on top of the contact lens to act as a coupling agent for the gonioscopy lens. The modified Swan-Jacobs gonioscopy lens could then be used to visualize the Trabectome handpiece tip and guide it toward the trabecular meshwork (Figure 5).

RESULTS

Ablation of the trabecular meshwork using the Trabectome handpiece could be carried out with ex-
cellent visualization, comparable with that of in vivo surgery. Tactile feedback upon engaging the meshwork is minimal in this procedure, but in the model it is similar to in vivo surgery (Figure 6) (a video is available at http://archophthalmol.com). The eye could then be rotated 90° to 180° to allow visualization of the untreated trabecular meshwork for further practice. Each formalin-fixed eye could be reused until all the trabecular meshwork had been ablated.

Few difficulties were encountered with this technique. For the preparation, the anterior chamber must be filled prior to fixation; otherwise, the angle structures are not visible. During surgical manipulation of the eye, the adhesion of the contact lens to the corneal rim may loosen. Slight loosening was found to be inconsequential to the surgical technique. A constant fluid infusion through the Trabectome handpiece maintained the anterior chamber. Problematic loosening (movement of the contact lens with introduction of air bubbles into the anterior chamber) would occur with excessive torquing of the eye during manipulations. This could be remedied by drying the eye and applying additional cyanoacrylate glue.

**COMMENT**

The technique we describe represents an economical method for preparing donor eyes for practicing anterior chamber angle surgical techniques. The ability to use these eyes after fixation provides 2 main benefits: it allows the same eye to be used multiple times and decreases the risk of infectious disease transmission inherent in the use of human cadaveric tissue. Likewise, multiple eyes may be prepared and fixed for later use in a wet-laboratory classroom setting.

As ophthalmologic techniques continue to evolve, there will be an increasing need for surgical model systems to master these techniques. The practice eye model system we describe provides an excellent simulation for the Trabectome system. The clarity of viewing the anterior chamber angle structures would also allow practice for other techniques, such as goniotomy, or laser procedures, such as argon or selective laser trabeculoplasty. Accreditation boards for ophthalmology training programs increasingly require documentation of a graded approach to surgical techniques, and this model system will help meet those needs.

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**Additional Information:** The video is available at http://archophthalmol.com.