

Don't Let Angle Surgery Back You Into a Corner!

Minimizing and managing the complications associated with this group of procedures.

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Emerging angle-based glaucoma surgeries are intended to lower IOP by enhancing the eye's natural trabecular outflow pathway. These procedures take a different approach than more frequently performed outflow-enhancing surgery such as trabeculectomy and the insertion of aqueous shunts in that they do not create a full-thickness passage through the wall of the eye.¹ With novel operations come new complications (and some traditional ones as well). It behooves the practitioner considering incorporating new angle procedures into his or her surgical armamentarium to consider strategies by which to prevent and manage their associated complications. The angle-based surgeries discussed herein include ab interno trabeculotomy (Trabectome; NeoMedix Corporation, Tustin, CA), canaloplasty (iScience Interventional, Menlo Park, CA), and the iStent trabecular microbypass stent (Glaukos Corporation, Laguna Hills, CA; not available in the United States).

AB INTERNO TRABECULOTOMY

The Trabectome system functionally achieves a partial trabeculotomy via an internal approach through the selective removal of trabecular meshwork (TM) and the inner wall of Schlemm canal.² The 19.5-gauge instrument is equipped with a tip that uses high-frequency electrocautery to ablate the target tissue.² The pressure-lowering mechanism of action results from the creation of a direct communication between the anterior chamber and collector channels. The mechanism of failure is unknown. We hypothesize that failure is likely a consequence of (1) the growth of a fibrous membrane or scarring that occludes the collector channels (common) or (2) the formation of peripheral anterior synechiae (less common).

The potential complications of Trabectome surgery include the creation of a cyclodialysis cleft (Figure 1), injury to the lens or cornea, hyphema, and elevated post-operative IOP due to retained viscoelastic. The rare but potentially serious complication of an iatrogenically creat-

ed cyclodialysis cleft results when the muscle fibers of the ciliary body are disinserted from the scleral spur.³ This allows aqueous humor to flow from the anterior segment into the suprachoroidal space and can result in chronic hypotony and its many secondary complications.⁴ The avoidance of iris manipulation and careful, direct gonio-visualization of the Trabectome's tip in the appropriate tissue of the TM are important in preventing the creation of a cleft. In eyes with little TM pigmentation, it is possible to mistake the ciliary body band for TM pigment. Likewise, surgeons must take care to allow the electrocautery tip to do the work of the procedure; they should avoid undue pushing or pulling forces, even when the instrument is in the correct plane. Depending on the size and clinical consequence of the cleft, the approaches to its management vary widely and include medication, laser photocoagulation, cryotherapy, and surgical repair.⁴

Surgeons can decrease the risk of hyphema by having patients discontinue anticoagulants, including aspirin and vitamin E, at least 2 weeks prior to surgery; appropriately pressurizing the eye at the end of the procedure to keep expected reflux bleeding into the anterior chamber to an



Figure 1. An iatrogenically induced cyclodialysis cleft in Trabectome surgery after inadvertent movement by the patient.

appropriate level; and minimizing reflux by creating robust wound architecture and suturing the wound if necessary.⁵ A well-sealed eye also serves to minimize the risk of infection. In one series of patients who underwent treatment with the Trabectome, although hyphema was noted in 59% on the first postoperative day, it cleared within about a week on average.⁵ In this same series, only one recurrent hyphema was noted in a patient whose wound was not sutured and who experienced blunt trauma 4 weeks postoperatively.⁵

Surgeons can avoid injuring the crystalline lens and cornea through careful intraocular manipulation of the handpiece. Specifically, they must remain cognizant of the location and orientation of the tip at all times. The authors recommend inserting the probe into the eye, past the pupil, and positioning it over the iris contralateral to the corneal incision (ie, nasal iris for a temporal corneal wound) under direct visualization of the operating microscope before placing the gonioscope on the cornea. The appropriate use of viscoelastic during the procedure is likewise valuable in preventing damage to adjacent intraocular structures. Although much of the viscoelastic is usually removed as a result of the I/A function of the Trabectome's handpiece, the potential complication of elevated postoperative IOP is easily avoidable with a few moments of judicious removal near the end of the case. It is best to use a viscoelastic with a low molecular weight such as OcuCoat (Bausch + Lomb, Rochester, NY).

CANALOPLASTY

In canaloplasty, the surgeon uses a fiber optic microcatheter to place a permanent suture under tension in Schlemm canal. Canaloplasty creates an intrascleral reservoir. The procedure is ultimately designed to enhance aqueous humor outflow via dilation of Schlemm canal and stretching of the TM.¹ This surgery does not require the formation of a conjunctival bleb, but blebs may form as a consequence of the procedure. The operative technique has been described in detail.^{6,7} Canaloplasty's pressure-lowering mechanism of action is not precisely known, but it may involve enhanced uveoscleral outflow enabled by the presence of the intrascleral reservoir, dilation of Schlemm canal, chronic stretching of the TM induced by the Prolene suture (Ethicon, Inc., Somerville, NJ), and if present, the formation of a conjunctival bleb.

This nonpenetrating procedure may offer certain advantages over traditional penetrating glaucoma surgeries.¹ Many authors have reported favorable pressure-lowering outcomes and low complication rates.⁶⁻⁸ Nonetheless, canaloplasty's level of complexity affords numerous opportunities for complications, but many

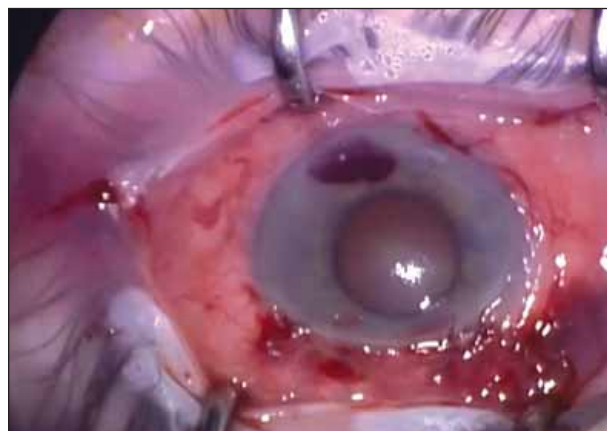


Figure 2. Hemorrhagic detachment of Descemet membrane in canaloplasty.

are preventable. Potential complications include perforation or detachment (Figure 2) of Descemet membrane, insertion of the catheter into the suprachoroidal space or anterior chamber, suprachoroidal hemorrhage, the surgeon's inability to find or completely catheterize Schlemm canal, and amputation of the flap. Like Trabectome surgery, canaloplasty can result in hyphema and the creation of a cyclodialysis cleft. The former is typically self-limited, and some have hypothesized that early postoperative microhyphema may indicate adequate tension on the TM.⁸ As with Trabectome surgery, the appropriate pressurization of the eye at the end of canaloplasty can minimize the risk of postoperative hyphema.

A thorough knowledge of angle anatomy coupled with meticulous dissection will generally enable the surgeon to avoid many of the complications mentioned. Grieshaber and coauthors discussed a strategy of applying slight counter-pressure over the distal tip of the catheter on the limbus when passing the microcatheter is difficult.⁸ In some cases, surgeons can address the inadvertent perforation of Descemet membrane by converting to trabeculotomy and ensuring the appropriately secure closure of the flap and conjunctiva. Although a bleb may form in canaloplasty, the rate was 2.5% at 36 months in a study presenting 3-year results in 134 eyes. All of the blebs were described as flat and diffuse.⁹ The timely withdrawal of the microcatheter, as viscoelastic is injected into Schlemm canal, substantially reduces the risk of detaching Descemet membrane.

No cases of endophthalmitis after canaloplasty have been reported in the literature, suggesting a low rate. Alternatively, the absence of a report of this complication may simply be due to the relatively small number of patients who have undergone canaloplasty compared

with the larger number of patients who have undergone procedures that have been around longer.

TRABECULAR MICROBYPASS STENT

The iStent is an implantable titanium device that creates a direct opening between the anterior chamber and Schlemm canal.¹ Patency of this pathway is maintained by the stent. This procedure may share many potential complications with canaloplasty and Trabectome surgery. Although some preliminary testing holds promise,¹⁰ at present, this device is limited to investigational use in the United States.

CONCLUSION

The expansion of angle-based surgical interventions presents patients and surgeons with increasing options for glaucoma management. By familiarizing themselves with strategies to prevent and manage the complications associated with these procedures, surgeons can mitigate these interventions' risks and maximize their benefits. □

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