# 360° Trabeculotomy for Congenital Glaucoma

BY ADAM C. REYNOLDS, MD

## CASE PRESENTATION

A healthy male neonate weighing 6 lb 8 oz was referred to a pediatric ophthalmologist by an obstetrician and a pediatrician, because they noticed differences between his left and right eyes. The patient was the product of a normal pregnancy, and his physical examination was otherwise unremarkable. When the baby was 2 days old, the ophthalmologist's examination found that the patient's horizontal corneal diameters measured 13 mm OS and 10.5 mm OD. The left cornea also appeared slightly cloudy compared with that of the right eye. His IOP measured approximately 40 to 50 mm Hg OS and 15 to 20 mm Hg OD with the Tono-Pen (Reichert Ophthalmic Instruments, Inc., Depew, NY). Indirect ophthalmoscopy revealed cupping of the optic nerve in the patient's left eye and clear crystalline lenses bilaterally. Streak retinoscopy suggested significant myopia in the left compared with the right eye. The posterior pole of the left eye was otherwise normal with an incomplete view of the fundus. The patient was started on Cosopt (dorzolamide hydrochloride and timolol maleate; Merck & Co., Inc., Whitehouse Station, NJ) b.i.d. in his left eye only and was referred to my office.

My examination of the patient 4 days after his birth showed no changes from the pediatric ophthalmologist's evaluation. The baby's IOPs still measured 40 to 50 mm Hg OS with the Tono-Pen. A careful slit-lamp examination of the anterior chamber did not show an obvious corectopia or any other signs that would contradict a diagnosis of unilateral primary congenital glaucoma with a fairly severe presentation and significant findings at birth.

## HOW WOULD YOU PROCEED?

1. Because the patient's cornea was fairly clear at birth, would you proceed with goniotomy or trabeculotomy?
2. Would you prescribe IOP-lowering medications? If so, which drug(s) would you choose?
3. Would you alter your surgical approach based on the severity of the patient's glaucoma?

> "Surgical intervention has long been considered the initial treatment for primary congenital glaucoma."

## SURGICAL COURSE

### Goniotomy Versus Trabeculotomy

Surgical intervention has long been considered the initial treatment for primary congenital glaucoma. The literature shows that opening parts of the trabecular meshwork with traditional goniotomy and trabeculotomy has produced varying degrees of success and good long-term results in 90% of patients who have mild forms of the disease.[1,2] Some clinicians who are trained in both techniques decide to perform goniotomy or trabeculotomy based on the clarity of the patient's cornea. Patients whose corneas are clear enough to permit a gonioscopic view of the angle often undergo goniotomy. Patients who have cloudy corneas are more likely to undergo trabeculotomy. This traditional demarcation has probably resulted in a higher rate of trabeculotomy among patients who have more severe forms of congenital glaucoma. Some practitioners, however, eschew the de facto rule of corneal clarity and always treat this condition with trabeculotomy.

Recently, researchers have explored the idea that they could improve the outcome of surgery for congenital glaucoma and reduce the incidence of immediate and future complications by opening the entire trabecular meshwork through a single surgical site. Ophthalmologists have achieved some success by passing a modified Prolene suture (Ethicon Inc., Somerville, NJ) through 360° of Schlemm's canal. The technique has proven to be technically difficult in many cases, however, because the suture must be passed "blindly." The challenge is especially great if the patient's cornea is too cloudy to provide a clear gonioscopic view of the angle. In these cases, the surgeon can easily misdirect the suture into the suprachoroidal or subretinal space.

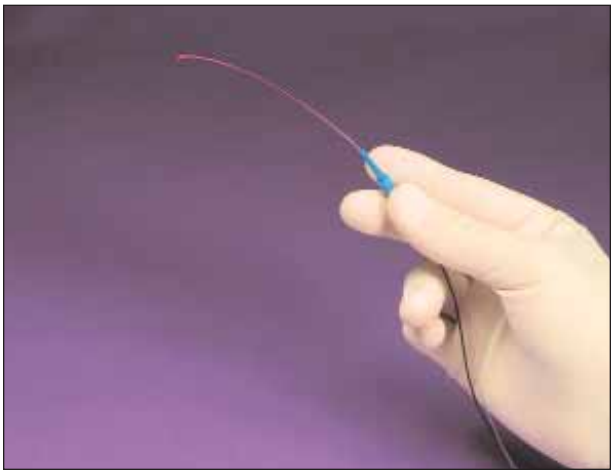

**Figure 1. The outer diameter of the iTrack catheter measures 250 µm.**

The iTrack catheter (iScience Interventional, Menlo Park, CA) is a microcatheter designed to pass through 360º of Schlemm's canal, facilitate the viscodilation of the canal and the collector system, and allow surgeons to place a tensioning suture in the canals of adults with open-angle glaucoma (Figure 1). As the case described herein shows, the iTrack catheter can be adapted to perform a 360º trabeculotomy in pediatric patients who have congenital glaucoma.

**Surgical Intervention**

After considering potential treatment options, I scheduled the 1.5-week-old patient for a 360º trabeculotomy with the iTrack catheter. An examination of the patient under anesthesia showed that his IOPs were 10 to 15 mm Hg OD and approximately 40 mm Hg OS on Cosopt. The horizontal diameter of his corneas measured 10.5 mm OD and 13.5 mm OS, and the lenses of both eyes were clear. I observed faint Haab's striae in the left eye only. Gonioscopy showed a normal infantile angle in the right eye and the typical findings of primary congenital glaucoma in the left (ie, flatter and anteriorly positioned iridal insertion, poorly developed trabecular meshwork, and more obvious peripheral iris "crypts" than usual).[3] The examination also showed asymmetric cupping of the optic nerves (0.1 OD vs 0.5 OS).

The initial steps of the patient's trabeculotomy were very similar to the technique used to perform canaloplasty in adults. First, I created a superonasal limbal/conjunctival incision and accessed Schlemm's canal by cutting two parabolic scleral flaps just posterior to the limbus. The superficial parabolic flap measured 4.5 mm, and the deep flap that unroofed the canal was approximately 3 mm wide.

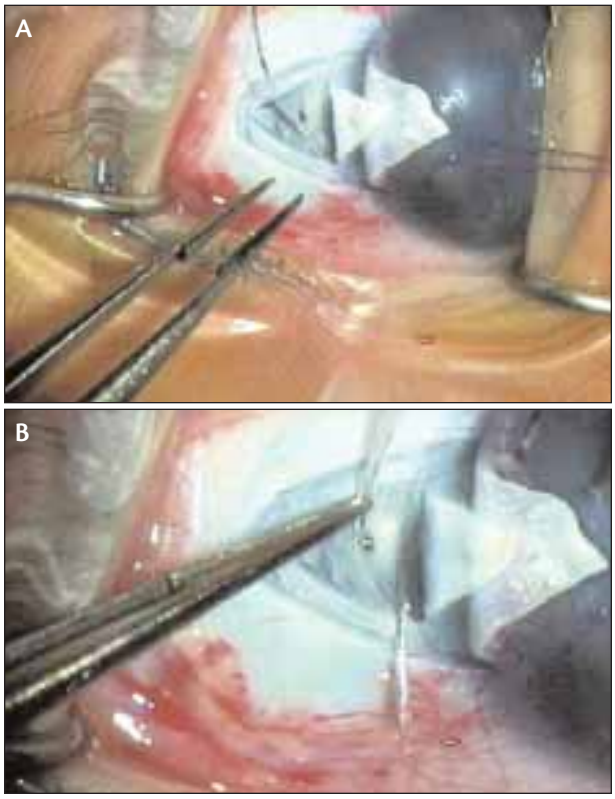


**Figure 2. The surgeon inserts (A) and passes the iTrack catheter through 360º of Schlemm's canal (B).**

Next, I dilated the open ends of Schlemm's canal with a 40-gauge viscocanalostomy cannula and advanced the iTrack catheter through 360º of the canal (Figure 2). When the catheter emerged from the distal end of the canal, I used a small 15º blade to create a small peripheral limbal paracentesis. The anterior chamber was infused with a small dose of Miochol-E (acetylcholine chloride; Novartis Ophthalmics, Inc., Duluth, GA) and then filled with viscoelastic.

To create an opening between the anterior chamber and Schlemm's canal, I grasped both ends of the iTrack with tying forceps and, using tangential force, gently "garroted" all 360º of the trabecular meshwork inward (Figure 3). The tissue initially ruptured inferiorly close to the 6-o'clock position, which is typical in these cases. After I removed the catheter from the newly opened trabecular window, I repositioned the minimally prolapsed iris with viscoelastic. I closed the deep and superficial flaps with three 10–0 nylon sutures and four 8–0 Vicryl sutures (Ethicon Inc.). My goal was to preserve the deep scleral flap (ie, avoid creating a deep sclerotomy) while achieving a watertight scleral closure that would not create a filtering bleb.

Next, I used a 30-gauge steel cannula to irrigate the paracentesis with balanced salt solution and evacuate

the viscoelastic from the anterior chamber. I observed minimal bleeding in the anterior chamber at all stages of the procedure. In addition to administering subconjunctival injections of antibiotics and dexamethasone at the end of the case, I injected 1.0 mL of 0.75% bupivacaine around the surgical site for immediate postoperative anesthesia.

## OUTCOME

On the first postoperative day, the anterior chamber of the patient's left eye was surprisingly clear, and his IOP measured 12 mm Hg with the Tono-Pen. The pediatric ophthalmologist followed the patient closely postoperatively and tapered all of the infant's medications over a period of several weeks.

When the patient was 12 months old, an examination under anesthesia showed corneal diameters of 11 mm OD and 12 mm OS. His IOPs measured 10 to 15 mm Hg OD and 17 mm Hg OS on no medications. Streak retinoscopy revealed refractions of approximately -1.00 D OS and +1.50 D OD. The patient had no obvious strabismus, and he appeared to be doing well with no obvious manifestations of amblyopia. The cupping of his left optic disc was somewhat reversed, and only slight asymmetry with the right eye was noted.

## DISCUSSION

Suture-guided trabeculotomy has several potential advantages over traditional approaches performed with inflexible probes. First, surgeons may have difficulty confirming the placement of the probes within Schlemm's canal. If the instruments are rotated into the anterior chamber from the suprachoroidal space next to the scleral spur, they could disrupt the adjacent tissue and cause a hyphema. Even with correct placement within the canal, typical trabeculotomy can cause an iridodialysis if rotation is too posterior or a detachment of Descemet's membrane if rotation is too anterior. Passing a 6–0 Prolene suture through Schlemm's canal reduces the risk of these complications, because placing circumferential tension on the suture as it is pulled centrally into the anterior chamber probably contributes to its "self-guiding" tendency to tear through the trabecular meshwork in the correct position and direction.

**Figure 3. The iTrack catheter is visible (arrow) in the anterior chamber as the surgeon ruptures the trabecular meshwork to complete the trabeculotomy.**

> "Suture-guided trabeculotomy has several potential advantages over traditional approaches performed with inflexible probes."

Smith first described using a suture to perform a 360° trabeculotomy of Schlemm's canal from an external approach in 1960.[4] In 1987, Lynn et al proposed executing the same procedure through two separate access sites.[5] The latter study suggested that disrupting 360° of the trabecular meshwork increased the likelihood that a single intervention could correct the mechanism underlying the patient's glaucoma. In contrast, goniotomy and traditional trabeculotomy performed through a single site typically disrupt a maximum of 180° of Schlemm's canal.

Furthermore, if a 360° suture-guided trabeculotomy fails, the surgeon can proceed to a filtering or laser-based procedure such as trabeculectomy, the placement of a tube shunt, or cyclodestructive surgery instead of repeating goniotomy or traditional trabeculotomy from a different site. The use of a single ab externo procedure prevents conjunctival scarring that could adversely affect the success of subsequent filtering surgery.

Several studies describe the outcomes of suture-guided trabeculotomy for congenital glaucoma. Although Beck and Lynch successfully completed a full 360° disruption of the trabecular meshwork in 26 eyes of 15 patients, they had to create a cut-down 180° from the original site of entry and thread a second suture in the opposing direction to complete the procedure in 11 of those eyes.[6]

A recent case series presented at the 18th meeting of the American Glaucoma Society showed that the iTrack catheter might facilitate 360° cannulation of Schlemm's canal and the disruption of the trabecular meshwork from a single site in eyes that had not undergone previous surgery.[7] Because the surgeon can visualize the red light integrated into the probe's tip through the patient's limbus throughout the procedure, the ophthalmologist might be less likely to misdirect the catheter into the

subretinal or suprachoroidal space than during suture-assisted trabeculotomy.[8-10] The iTrack also allows surgeons to inject viscoelastic into Schlemm's canal to overcome resistance caused by structural collapse and adhesions. This strategy, as well as mild shaping of the catheter's tip before insertion into the canal in specific cases, has facilitated the catheter's passage through the full 360º of the canal.

The case described herein suggests that the iTrack catheter may be a relatively safe and more consistent method for performing a 360º trabeculotomy in patients with congenital glaucoma. Compared with the tools used to perform traditional trabeculotomy, the iTrack catheter appears to achieve similar technical results more easily and may be less likely to require multiple surgical sites or to cause complications. Currently, it is unknown if trabeculotomy assisted by the iTrack catheter produces better outcomes. Further prospective trials will help to determine the utility of this device for treating congenital glaucoma. ❑

*The procedure described herein is an off-label application of the iTrack catheter.*

*Adam C. Reynolds, MD, is in private practice in Boise, Idaho. He is a consultant to iScience Interventional but acknowledged no financial interest in any products or other companies mentioned herein. Dr. Reynolds may be reached at (208) 608-2476; adamreynolds@cableone.net.*

1. Mendicino ME, Lynch MG, Drack A, et al. Long-term surgical and visual outcomes in primary congenital glaucoma: 360 degrees trabeculotomy versus goniotomy. *J AAPOS.* 2000;4(4):205-210.
2. Ikeda H, Ishigooka H, Muto T, et al. Long-term outcome of trabeculotomy for the treatment of developmental glaucoma. *Arch Ophthalmol.* 2004;122(8):1122-1128.
3. Hoskins HD Jr, Hetherington J Jr. The developmental glaucomas. In: Duane TD, ed. *Clinical Ophthalmology.* 3rd ed. Hagerstown, Md.: Harper & Row; 1986:1-18.
4. Smith R. A new technique for opening the canal of Schlemm. Preliminary report. *Br J Ophthalmol.* 1960;44:370-373.
5. Lynn JR, Fellman RL, Starita RJ. Full circumference trabeculotomy: an improved procedure for primary congenital glaucoma [abstract]. *Ophthalmology.* 1988;95:168.
6. Beck AD, Lynch MG. 360 degrees trabeculotomy for primary congenital glaucoma. *Arch Ophthalmol.* 1995;113(9):1200-1202.
7. Reynolds AC, Debry P, Marcus C, Bothun E. Use of the iTrack catheter for 360 degree trabeculotomy ab externo for infantile congenital glaucoma. Poster presented at: The 18th Annual Meeting of the American Glaucoma Society; March 6, 2008; Washington, DC.
8. Verner-Cole EA, Ortiz S, Bell NP, Feldman RM. Subretinal suture misdirection during 360 degrees suture trabeculotomy. *Am J Ophthalmol.* 2006;141(2):391-392.
9. Neely DE. False passage: a complication of 360 degrees suture trabeculotomy. *J AAPOS.* 2005;9(4):396-397.
10. Gloor BR. Risks of 360 degree suture trabeculotomy [in German]. *Ophthalmologe.* 1998;95(2):100-103.

*To view the procedure described in this article, visit http://eyetube.net/v.asp?rohofo.*

eyetube
Ophthalmic Video Resource