

# Ab Interno Trabeculectomy With a Dual Blade: Surgical Technique for Childhood Glaucoma

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**Purpose:** To introduce a technique using the Kahook Dual Blade for treatment of childhood glaucoma.

**Patient and Method:** An infant developed glaucoma after cataract extraction and anterior vitrectomy. Ab interno trabeculectomy was performed in both eyes using a dual-blade device.

**Results:** Description of technique to treat childhood glaucoma. Intraocular pressure reduced from 35 to 17 mm Hg in the right eye and from 52 to 18 mm Hg in the left eye after 7 to 10 weeks. There were no complications.

**Conclusions:** This was a successful, minimally invasive procedure for treatment of childhood glaucoma.

**Key Words:** Kahook Dual Blade, ab interno trabeculectomy, childhood glaucoma

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Childhood glaucoma is a group of diseases characterized by high intraocular pressure (IOP) causing optic nerve damage. It can present with the classic triad of blepharospasm, epiphora, and photophobia. Examination may reveal enlarged corneas, cloudy corneas, breaks in Descemet's membrane called Haab striae, and a high cup-to-disc ratio. A subset of childhood glaucoma is aphakic glaucoma, which develops in as many as half of children who had cataract extraction without intraocular lens implantation.<sup>1</sup> Why these postsurgical patients are at risk of developing glaucoma is unclear, although inflammation and altered anatomy may contribute.

Management of childhood glaucoma is challenging because pharmacologic therapy is usually inadequate and iridocorneal angle surgery is typically needed to facilitate aqueous humor outflow. If the cornea is clear enough to allow visualization of angle structures, goniotomy, which involves an incision through the maldeveloped trabecular meshwork (TM), can be performed. If the cornea is cloudy, ab externo trabeculectomy is an alternate way of incising the TM. The success rate of angle surgery is 70% to 90%.<sup>2–7</sup> For cases resistant to angle surgery, aqueous tube shunt or cyclophotocoagulation may be necessary.

In 2015, an ophthalmic knife known as the Kahook Dual Blade (New World Medical, Rancho Cucamonga, CA) received Food and Drug Administration approval for use. This stainless steel device consists of a pointed tip used to pierce the TM, a ramp that lifts and stretches the TM as the device is advanced, and 2 thin blades at the edges of the ramp to incise the TM. In this report, we describe a successful technique using the device to treat childhood glaucoma.

## PATIENT AND SURGICAL TECHNIQUE

An 11-month-old male infant presented with bilateral corneal clouding suspicious for childhood glaucoma. He was born with bilateral cataracts and underwent cataract extraction and anterior vitrectomy for both eyes at age 2 months. He subsequently developed a secondary cataract in the left eye, and thus underwent a membranectomy and anterior vitrectomy at age 7 months. The pediatric ophthalmologist who referred the patient for management of the glaucoma noted elevated IOP with corneal haze.

Under light anesthesia, the IOPs were 35 mm Hg right eye and 52 mm Hg left eye. Examination under general anesthesia of the right eye was notable for 2+ corneal haze with cataract surgery corneal scars, aphakia, and an optic nerve cup-to-disk ratio of 0.55 vertical and 0.40 horizontal. Examination of the left eye revealed, 2+ corneal haze, aphakia, and optic nerve cup-to-disk ratio of 0.9 vertical and horizontal. Decision was made to operate on the left eye first.

The surgical technique was recorded (video, Supplemental Digital Content 1, <http://links.lww.com/IJG/A122>). The infant's head was rotated away from the surgeon, who was seated temporally, and the microscope was tilted about 30 degrees to optimize view of the nasal iridocorneal angle. A side-port blade was used to create a 1 mm paracentesis inferiorly, then a main incision 1.5 mm



FIGURE 1. Ab interno trabeculectomy right to left.

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in width temporally. Acetylcholine chloride 1:100 was injected into the anterior chamber to constrict the pupil. Aqueous humor was let out to reduce the pressure in the eye. Cohesive ophthalmic viscoelastic device (Amvisc; Bausch and Lomb, Rochester, NY) was injected into the anterior chamber. Using a gonioscopic lens (Ocular Hill surgical gonioscope, left handed; Ocular Instruments, Bellevue, WA) under direct view, the nasal angle appeared immature with no clear distinction of angle structures. The dual blade was introduced through the temporal corneal wound into the nasal angle. Starting from the angle's superonasal quadrant, with the tip oriented parallel to the iris root and to the left in surgeon's view, the blade tip (facing inferiorly) was advanced into the TM anterior to the scleral spur (Fig. 1). The dual blade was advanced circumferentially (right to left in the surgeon's view), excising a small strip of TM from superior-nasal angle toward the inferior-nasal angle. As that movement was completed and the blade was lifted, the strip of superior-nasal excised TM was visualized with a remaining inferior-nasal attachment (Fig. 2). The blade was then moved to the inferior-nasal angle and the tip rotated in the opposite direction (facing superiorly). The tip was advanced from the inferior-nasal quadrant from left to right in surgeon's view to connect with the previously separated strip (superior-nasal). This released an approximately 100-degree strip of TM (Fig. 3). During the dual blade movement, the footplate rested against the outer wall of Schlemm's canal but did not incise it. Reflux of blood from Schlemm's canal occurred (Fig. 4). The viscoelastic was washed out of the anterior chamber using balanced salt solution. A 10-0 Vicryl suture was tied to ensure that the temporal corneal wound was watertight. The patient was started on moxifloxacin hydrochloride 0.5% ophthalmic solution (Vigamox, Novartis, East Hanover, NJ) 4 times a day, prednisolone acetate 1% ophthalmic suspension (Pred Forte, Allergan, Parsippany, NJ) 4 times a day, and atropine sulfate 1% ophthalmic solution (Alcon, Fort Worth, TX) in the left eye. Dorzolamide hydrochloride-timolol maleate 2%/0.5% twice a day was started in the right eye.

Four weeks after the left eye surgery, an ab interno trabeculectomy was similarly performed in the right eye using the dual blade. The postoperative eye drop regimen was the same. Seven weeks after the second surgery, IOP under light anesthesia was measured to be 17 mm Hg in the right eye and 18 mm Hg in the left eye.

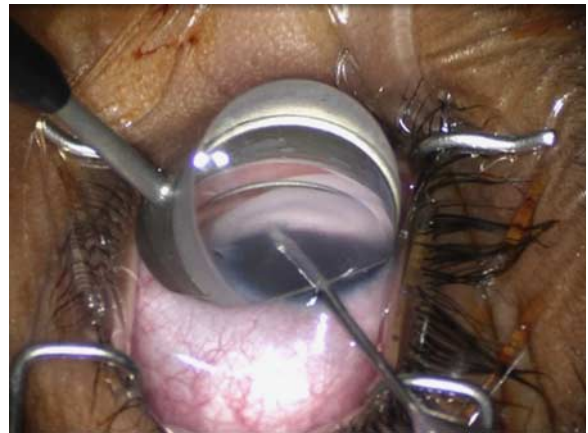


FIGURE 3. Ab interno trabeculectomy left to right.

**DISCUSSION**

This is the first report describing successful use of the Kahook Dual Blade for childhood glaucoma. The device allowed for removal of a TM strip in a minimally invasive procedure through a small 1.5 mm clear corneal incision. The technique demonstrated > 50% reduction in IOP 7 to 10 weeks later.

The device was easy to use with TM successfully stripped. Most surgeons traditionally perform childhood goniotomy using a retinal microvitreoretinal (MVR) blade. The dual blade tip is designed to effortlessly pierce the TM and its ramp is angled to allow excision of a TM band as the blade is circumferentially advanced. The footplate of the dual blade serves as a guard and prevents deeper incisions into the outer wall of Schlemm's canal (which can readily occur with deeper penetration of an MVR blade). As the blade was advanced, the ramp lifted the TM that was excised against the 2 side blades with ease. The footplate acted as a protective barrier preventing deeper penetration into the outer wall of Schlemm's canal and the collector channels. Whether the procedure was performed correctly could be easily confirmed with visualization of the TM strip as the blade was advanced. This advantage was not possible with traditional goniotomy using an MVR knife that produces a single incision in the TM.



FIGURE 2. Partially separated strip of trabecular meshwork (gray tissue at tip of the blade).



FIGURE 4. Post ab interno trabeculectomy with reflux of blood from Schlemm's canal.

Previous histologic analyses have shown that goniotomy with a MVR blade resulted in minimal removal of TM tissue and injury to deeper and adjacent sclera. Trabectome ablation of the TM resulted in thermal injury with residual TM tissue. In contrast, the Kahook Dual Blade resulted in more complete removal of TM without damage to surrounding tissues.<sup>8</sup> The absence of residual TM tissue may be beneficial, because it decreases the chance of obstructing aqueous humor access to the Schlemm's canal in the future. The lack of damage to adjacent structures may induce less inflammatory response compared with other surgical techniques such as goniotomy and trabectome ablation. This is optimal, as fibrosis of the iridocorneal angle can increase IOP. These characteristics of the dual blade may be key to long-lasting IOP control that is particularly important in the management of childhood glaucoma.

In summary, Kahook Dual Blade ab interno trabeculectomy can serve as an alternative to goniotomy for treatment of childhood glaucoma. The device is easy to use, provided that the cornea is clear enough for visualization of angle structures, with minimal damage to adjacent tissues. Significant IOP reduction can be achieved. Whether this effect is longer lasting compared with other surgical options remains to be investigated.

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