

MIGS IN KIDS

Recent advances may reshape the traditional paradigm.

BY TA CHEN PETER CHANG, MD



The management of childhood glaucoma differs from that of adult-onset glaucoma. Instead of offering surgery after conservative therapies have proven inadequate, surgery is often the first-line treatment in cases of childhood glaucoma. Many recent advances—especially microinvasive glaucoma surgery (MIGS) procedures—have

increased the number of options available to the glaucoma surgeon. Although no high-quality evidence supports the use of MIGS for managing childhood glaucoma, many of the innovations offer theoretical advantages over the traditional surgical approach.

CURRENT SURGICAL PARADIGM

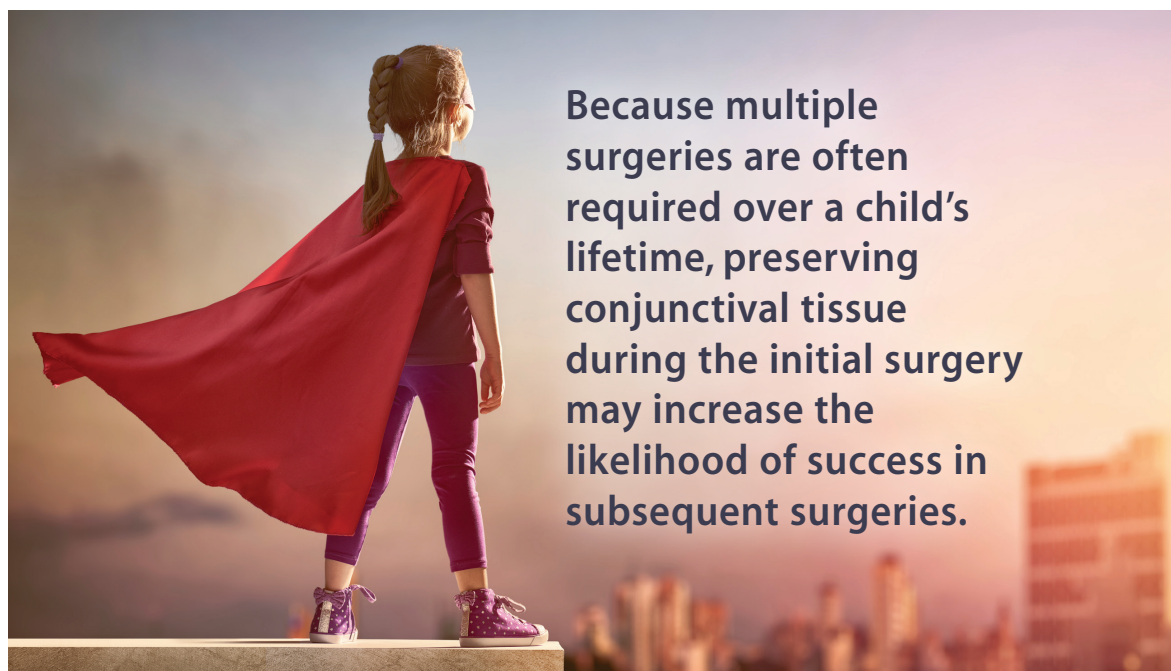
Over time, the IOP-lowering effect of all glaucoma surgeries decreases, while the cumulative risk of complications increases. This dictum is highlighted in children with glaucoma, as they have long life expectancies. Because multiple surgeries are often required over a child's lifetime, preserving conjunctival tissue during the initial surgery may increase the likelihood of success in subsequent surgeries. Several large, prospective trials in adult patients suggest that most late postoperative complications are associated with either hardware implantation (eg, persistent corneal edema, persistent diplopia, tube erosion, tube obstruction) or the presence of an anterior filtering bleb (eg, bleb leak, hypotony maculopathy, endophthalmitis).¹ For this reason, most pediatric glaucoma specialists choose to perform goniotomy or trabeculotomy initially, followed by glaucoma drainage device (GDD) implantation or a filtering procedure once the angles have been treated

maximally.² Transscleral cyclophotocoagulation is sometimes offered when the IOP remains uncontrolled despite GDD implantation.³

POTENTIAL ENHANCEMENTS

Traditional goniotomy and ab externo rigid-probe trabeculotomy techniques have several limitations. The former requires adequate direct visualization of the angle and may not be feasible when severe corneal edema or haze is present. Ab externo rigid-probe trabeculotomy requires a conjunctival incision and scleral dissection, which may decrease the likelihood of success in subsequent bleb-forming procedures in the same quadrant. Neither of these procedures treats the angle circumferentially in one setting, whereas circumferential angle surgery has been shown to result in a higher success rate than partial angle surgery.^{4,5}

The use of an intraocular endoscope can circumvent corneal opacity and allow visualization and angle surgery through a corneal incision.⁶ Joos and Shen described the technique of endoscope-assisted goniotomy in the treatment of an eye with infantile-onset glaucoma and a cloudy cornea. They used a coaxial endoscopic goniotomy needle to



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incise the angle, which could not be visualized directly with a gonioscopy. A variation of this technique using a coaxial, endoscopic free-electron laser instead of a goniotomy needle has been described in animal models of childhood glaucoma,⁸ but there have been no reports of the treatment of human eyes.

The use of a flexible suture or illuminated microcatheter in ab externo trabeculotomy allows circumferential treatment of the entire angle during the initial surgery.^{9,10} As recently described by Grover and colleagues, gonioscopy-assisted transluminal trabeculotomy (GATT) permits ab interno circumferential angle surgery without incising the conjunctiva or creating a scleral flap.¹¹ Although GATT spares the conjunctiva and sclera, it involves significant intraocular manipulation using a microforceps and thus increases the risk of injury to the corneal endothelium and the lens compared with ab externo techniques. An ab interno filament trabeculotome (Trab360; Sight Sciences) can incise the anterior chamber angle in a pseudocircumferential fashion through a corneal incision. Using a retractable filament, this device requires minimal intraocular manipulation and thus may offer the advantages of GATT while conferring a lower risk of iatrogenic injury to intraocular structures. All ab interno trabeculotomy techniques require direct visualization of the anterior chamber angle, however, and may not be feasible when the cornea is opaque. In an email conversation in July 2015, James Brandt, MD, said, theoretically, this problem can be circumvented by coupling the Trab360 with endoscopic visualization (in either a bimanual or coaxial fashion), which would allow conjunctiva-sparing, circumferential angle surgery independent of corneal clarity. This proposed approach has not yet been tried in humans.

Several gonio-ablative instruments such as the electro-surgical trabeculectomy device (Trabectome; NeoMedix) and the dual-blade trabeculectomy device (Kahook Dual Blade; New World Medical) enhance the traditional goniotomy approach by ablating or excising—instead of merely incising—the trabecular meshwork and the inner wall of Schlemm canal, which theoretically decreases the risk of postoperative cicatricial closure of the trabecular cleft. Neither device allows circumferential treatment of the anterior chamber angle, however, and both require direct visualization of the angle. Thus, the benefit may not justify the greater cost compared with traditional goniotomy. In a conversation with Alana Grajewski, MD, in July 2012, she mentioned that the Trabectome has been used in eyes with glaucoma associated with Axenfeld-Rieger anomaly and offers the benefit of releasing iridocorneal adhesion to expose the angle and allow angle surgery.

Once the angle is maximally treated and further surgery is warranted, a majority of surgeons will implant a GDD,

while a smaller proportion will perform a filtering procedure augmented by an antiscarring agent.^{2,12} In adults, there is an approximately 5% risk of endophthalmitis/blebitis 5 years after trabeculectomy augmented with mitomycin C,¹ and the cumulative risk in children can be presumed to be much higher, owing to the long life expectancy. It is not known whether alternative antiscarring agents such as bevacizumab or a biodegradable collagen matrix implant (Ologen; Aeon Astron) alters the risk/benefit profile of filtering procedures in children. Similarly, other implantable channeling devices made of collagen (Xen45; Allergan; not FDA approved) or styrene-block-isobutylene-block-styrene (InnFocus MicroShunt; InnFocus; not FDA approved) offer the theoretical benefit of a fixed channel size and thus decrease the risk of hypotony, although the long-term risk/benefit profile over traditional trabeculectomy augmented with mitomycin C in children is unknown.

POTENTIALLY TRANSFORMATIVE ADVANCES

When children present with angle closure, as seen in some cases of glaucoma following cataract surgery or glaucoma associated with retinal ablation for retinopathy of prematurity and/or spherophakia, surgical options are traditionally limited to either a filtering procedure or the implantation of a GDD. With recent advances in microsurgical instrumentation, however, goniosynechialysis under direct gonioscopic visualization combined with endoscopic



AT A GLANCE

- Although no high-quality evidence supports the use of microinvasive glaucoma surgery for managing childhood glaucoma, many of the innovations offer theoretical advantages over the traditional surgical approach.
- Recent innovations may improve the surgical treatment of children with glaucoma by improving ophthalmologists' view through an opaque cornea, thus allowing complete angle treatment in one setting without the need to incise the conjunctiva or dissect the sclera.
- Suprachoroidal stents may provide an alternative for patients in whom angle surgery is not or is no longer an option.

cyclophotocoagulation and, when appropriate, lensectomy can offer IOP control in angle-closure glaucoma without GDD implantation or bleb creation, thus decreasing the long-term risk of postoperative complications. The long-term outcome of this approach is not known, however, although it probably does not preclude later filtration or GDD procedures if they are needed.

There has been a recent resurgence of interest in surgically accessing the suprachoroidal space as a means of lowering IOP.¹³ Ab interno suprachoroidal shunts such as the CyPass Micro-Stent (Alcon) and iStent Supra (Glaukos; not FDA approved) may offer blebless alternatives to filters or GDDs in pediatric patients after circumferential angle surgery has failed.

CONCLUSION

Recent innovations may improve the surgical treatment of children with glaucoma by improving ophthalmologists' view through an opaque cornea, thus allowing complete angle treatment in one setting without the need to incise the conjunctiva or dissect the sclera. Suprachoroidal stents may provide an alternative for patients in whom angle surgery is not or is no longer an option. ■

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