

Which Shape Is Best for the Scleral Flap?

Glaucoma Today asked several surgeons which configuration they prefer for trabeculectomy and why.

**BY LOUIS B. CANTOR, MD; JONATHAN G. CROWSTON, MBBS, PhD;
LEON W. HERNDON, MD; NILS LOEWEN, MD, PhD; AND TONY WELLS, MD**

LOUIS B. CANTOR, MD

There are as many approaches to glaucoma surgery as there are glaucoma surgeons. Different surgeons use a range of conjunctival incisions, shapes, and thicknesses of the scleral flap, methods of applying mitomycin C, steps for controlling the early postoperative outflow, and techniques for conjunctival closure. Despite this tremendous variability, the outcomes that different ophthalmologists achieve from glaucoma surgery are generally similar when published. The sum total of all the steps that an individual surgeon uses determines the outcome.

I prefer a limbus-based conjunctival flap and construct a rectangular scleral flap for trabeculectomy that is approximately 3 × 3 mm at the twelve o'clock position. I dissect the flap at 1/2 to 2/3 scleral thickness and into clear cornea. I subsequently remove a rectangular trabeculectomy block, perform a peripheral iridectomy, and suture the superficial rectangular scleral flap down with two 10-0 nylon sutures. The edges of the block are thus parallel to the edges of my dissected flap, which I feel allows me better control over how much leakage occurs from underneath the flap. I can gauge leakage on the table by injecting balanced salt solution into the anterior chamber through a paracentesis tract and making adjustments with my sutures or cautery. In general, I like to see relatively equal leakage from both sides of the rectangular scleral flap and for the anterior chamber to remain formed spontaneously but also for the eye to be soft. In short, I want the eye to appear as I would like to see it after it has healed. I then fill the anterior chamber with a high-molecular-weight viscoelastic without placing additional sutures in the scleral flap.

JONATHAN G. CROWSTON, MBBS, PhD

There appears to be little consensus or research to guide us as to the best size and shape for scleral flaps. Birchall et al demonstrated that good IOP control can be achieved in experimental models with various scleral flap sizes.¹ As such, flap shape is often based on the surgeon's training experience and personal preference. My standard scleral flap for a primary trabeculectomy is a rectangular flap, which is wide and relatively short. Average flap dimensions are around 4 × 2.5 mm, but I do not actually measure the bleb's width in most cases. I use a guarded feather blade to maintain consistent flap thickness at 0.3 mm. I close the flap with two releasable 10-0 nylon sutures to the posterior edge of the flap. Occasionally, I will add a third central releasable suture if the former do not adequately close the flap. I release any corneal traction sutures prior to assessing scleral flap closure. My choice of flap architecture is guided by a few simple principles to try to ensure adequate flow resistance and maintain posterior flow of aqueous.

1. Create side cuts with a margin approximately 1 mm from the limbus to reduce the lateral flow of aqueous.
2. The shortest distance from the sclerostomy to the flap's edge is in the posterior direction.
3. Maximize the lateral distance from the sclerostomy to the flap's sides to encourage posterior flow.

For some repeat trabeculectomy and other cases where access is limited, I will occasionally use a triangular flap with three sutures.

LEON W. HERNDON, MD

Glaucoma surgeons evolve and are constantly trying to perfect their techniques. I have tried rectangular and

triangular configurations of my scleral flap in the past, but for the last 10 years, I have favored a trapezoidal flap with my trabeculectomy/trabeculectomy Ex-Press Glaucoma Filtration Device (Alcon Laboratories, Inc.) cases. The reason that I use a trapezoidal flap is simply speed. I need four sutures to close a rectangular flap and three sutures to close a triangular flap. With a trapezoidal flap, I typically require just two 10-0 nylon sutures to close the flap.

I think that there is no difference in terms of the long-term outcome of the trabeculectomy related to the flap's geometry, but a recent study tackled this issue.² Tse et al developed computer-based models and simulations to determine the relative effects on aqueous outflow of various shapes and dimensions of the scleral flap and size of the sclerostomy. The simulations indicated that the optimal flow rate through the operation site is achieved with a square flap and a larger flap-to-sclerostomy ratio. This finding strikes me as counterintuitive; I typically create a smaller flap with the Ex-Press, because I want the posterior edge of the device to be near the posterior edge of the scleral flap to facilitate posterior flow. The evolution continues.

NILS LOEWEN, MD, PhD

When I have to perform a trabeculectomy, I use a short, triangular flap. I find it to be simpler, smaller, and faster than a rectangular flap. A triangle has only two sides in addition to the base of the flap, and it is easier to regulate flow and have an even distribution of tension by placing flap sutures closer to the tip. As a result, there is almost no misalignment of the sides. Compared to a rectangular flap, it is also easier to stay in one plane when dissecting the flap, because the area gradually increases as I go forward. As a result, I can make a small triangular flap and keep the conjunctival incision to less than 3 mm, allowing me to use only two conjunctival wing sutures for a watertight closure (Figure).

Glaucoma Today's selection of the flap's creation as a topic for an article highlights a serious problem of trabeculectomy: it is impossible to have a standardized, repeatable technique not just among surgeons but also intraindividually. This results in a wide range of outcomes and complications. I therefore almost always use ab interno trabeculectomy with the Trabectome (NeoMedix Corporation) as my first line of surgical treatment.

TONY WELLS, MD

The research that my colleagues and I published as part of refining the Moorfields Safe Surgery System

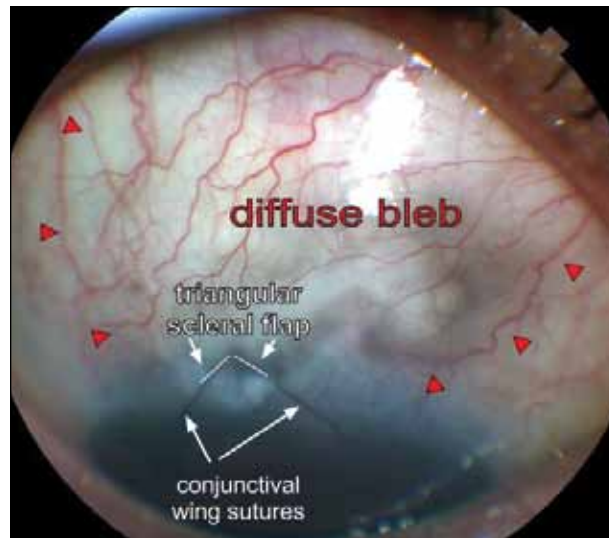


Figure. Diffuse bleb at 6 months with a small triangular flap and a 3-mm conjunctival incision sealed with two 10-0 nylon wing sutures.

clarified how scleral flap-suture complexes function, and now guides my construction of the scleral flap.^{1,3-8} Critical to effective IOP control in the early postoperative period are the ability to generate appositional force on the flap-bed interface and to then be able to exert fine control over this force. In the first weeks after trabeculectomy, at least two sutures with overlapping force vectors are required to simultaneously permit strong control of the IOP, minimizing the risk of hypotony, while also allowing adjustability.

I believe that two other important aspects of flap design minimize the risk of adverse outcomes with regard to the bleb. First, the base should be wide enough to keep the edges of the flap away from the edges of the sclerostomy, which should prevent full-thickness drainage (so-called aqueous jet) from contributing to the formation of a cystic bleb. Second, the posterior flow of aqueous should be encouraged by making resistance to flow in this direction less than in the lateral direction.

To meet these design targets, a triangular flap would need a wide base and would extend too far posteriorly, so my preferred shape is a trapezoid that has a 4-mm base (centered over a sclerostomy with a maximum width of 1 mm) and tapers to 3 mm at a distance of 2.5 mm behind the limbus. The posterior edge of the flap is slightly curved toward the sclerostomy to encourage posterior flow, so overall, the flap ends up being slightly W-shaped, a hybrid of a triangle and a rectangle but closer to a rectangle.

When I create the flap, I start with the curved pos-



terior edge, tunnel forward using a crescent blade, and then cut the sides. I find that this approach produces consistent flaps and allows excellent control of the flap's thickness. ■

Section Editor Richard A. Lewis, MD, is in private practice in Sacramento, California. Dr. Lewis may be reached at (916) 649-1515; rlewisemd@yahoo.com.

Louis B. Cantor, MD, is chair and professor of ophthalmology, the Jay C. and Lucile L. Kahn professor of glaucoma research and education, and director of the Glaucoma Service at the Indiana University School of Medicine in Indianapolis. Dr. Cantor may be reached at (317) 278-2651; lcantor@iupui.edu.



Jonathan G. Crowston, MBBS, PhD, is the Ringland Anderson Professor and Head of Ophthalmology at the University of Melbourne and the director of the Centre for Eye Research in Melbourne, Australia. Dr. Crowston may be reached at crowston@unimelb.edu.au.



Leon W. Herndon, MD, is an associate professor of ophthalmology at the Duke University Eye Center in Durham, North Carolina. He serves on the glaucoma advisory board of and receives speaker honoraria from Alcon Laboratories, Inc. Dr. Herndon may be reached at (919) 684-6622; leon.herndon@duke.edu.



Nils Loewen, MD, PhD, is an assistant professor of ophthalmology and director of the Glaucoma and Anterior Segment Surgery Service at the University of Pittsburgh School of Medicine in Pittsburgh. He is a Trabectome trainer. Dr. Loewen may be reached at (412) 647-2152; loewenna@upmc.edu.



Tony Wells, MD, is a professor at Wellington School of Medicine and in private practice in Wellington, New Zealand. Professor Wells may be reached at tw@eyetext.net.

1. Birchall W, Wakely L, Wells AP. The influence of scleral flap position and dimensions on intraocular pressure control in experimental trabeculectomy. *J Glaucoma*. 2006;15(4):286-290.
2. Tse KM, Lee HP, Shabana N, et al. Do shapes and dimensions of scleral flap and sclerostomy influence aqueous outflow in trabeculectomy? A finite element simulation approach. *Br J Ophthalmol*. 2012;96(3):432-437.
3. Wells AP, Bunce C, Khaw PT. Flap and suture manipulation after trabeculectomy with adjustable sutures: titration of flow and intraocular pressure in guarded filtration surgery. *J Glaucoma*. 2004;13(5):400-406.
4. Ashraff NN, Wells AP. Transconjunctival suture adjustment for initial intraocular pressure control after trabeculectomy. *J Glaucoma*. 2005;14(6):435-440.
5. Birchall W, Bedgood A, Wells AP. Do scleral flap dimensions influence reliability of intraocular pressure control in experimental trabeculectomy? *Eye (Lond)*. 2007;21(3):402-407.
6. Birchall W, Wells AP. The effect of scleral flap edge apposition on intraocular pressure control in experimental trabeculectomy. *Clin Experiment Ophthalmol*. 2008;36(4):353-357.
7. Gale J, Wells AP. Medium-term outcomes of safe surgery system trabeculectomies. *Br J Ophthalmol*. 2008;92(9):1232-1235.
8. Ang GS, Chan KC, Poostchi A, et al. Comparison of standard trabeculectomy versus microtrabeculectomy as a surgical treatment for glaucoma: a randomized clinical trial. *Clin Experiment Ophthalmol*. 2011;39(7):648-657.