

Glaucoma Surgery Suturing Techniques

10

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Key Points

Surgical Indications

- Trabeculectomy and drainage devices
- Progressive glaucomatous optic nerve damage and uncontrolled intraocular pressure

Instrumentation

- Colibri forceps
- French forceps (dressing forceps)
- Straight and curved tying forceps
- Fine needle holder
- Westcott and Vannas scissors
- 10-0 Nylon suture 9001 G needle
- 7-0 Prolene suture
- 8-0 Vicryl J547 needle
- 9-0 Vicryl BV100 needle

Surgical Technique

- Careful, delicate handling of the conjunctiva
- Partial-thickness suture passes through sclera

Complications

- Buttonholing of conjunctiva
- Piercing sclera full-thickness on passing sutures

10.1 Introduction

This chapter introduces the beginning surgeon and refreshes the experienced surgeon on suturing techniques used in glaucoma surgeries, including trabeculectomies and drainage devices. A key tenet of glaucoma surgery is careful and delicate handling of the conjunctiva in all procedures. The following pages present descriptions of techniques used in closing the conjunctiva in both trabeculectomy and drainage device implantation. Suturing the trabeculectomy flap, the drainage device, and pericardial tissue/donor sclera is also covered in this chapter.

10.2 Surgical Indications

Glaucoma surgery is indicated in cases of progressive glaucomatous optic nerve damage and uncontrolled intraocular pressure despite medical management [1]. Trabeculectomy is the preferred surgical procedure to obtain the lowest achievable intraocular pressure. However, implantation of a drainage device may be chosen in cases of glaucoma secondary to neovascularization of the anterior chamber angle, uveitic processes, prior penetrating/lamellar keratoplasty, prior failed trabeculectomy, or aphakia [2].

10.3 Instrumentation and Equipment

As mentioned, careful handling of the conjunctiva is of utmost importance in successful glaucoma surgery. Use of proper instrumentation facilitates every step of surgery. Nontoothed forceps, such as French forceps, are preferred when handling conjunctiva, as they limit the risk of perforation of the delicate tissue by the forceps teeth [3]. Toothed forceps, such as Colibri forceps, are designed to grasp and steady tissue and may be used to assist in stabilizing the trabeculectomy flap when passing sutures.

10.4 Surgical Techniques

10.4.1 Suturing the Trabeculectomy Flap (the Partial-Thickness Scleral Flap that Overlies the Trabeculectomy Site)

Suturing the flap may be performed in different manners. A standard 3-1-1 knot or a slipknot may be used at the apices of a rectangular trabeculectomy flap. Alternatively, a releasable suture may be placed instead of locking sutures. As shown in Fig. 10.1, suturing the trabeculectomy flap requires first passing a half-thickness

scleral bite at each apex of the trabeculectomy flap with a 10-0 nylon suture. Colibri forceps may be used to grasp the flap and stabilize the tissue as the needle is passed through the flap. The goal of suture placement and tying is to allow the flap to sit in its dissected scleral bed, without distortion of the wound edges. Each suture should be placed symmetrically and equidistant from each corner of the flap. Prior to tying the knots used to secure the trabeculectomy flap, the intraocular pressure should approximate normal physiologic pressure by refilling the anterior chamber with balanced salt solution. Tying sutures on a trabeculectomy flap in a hypotonous eye may cause the suture tension to be too tight. This may result in a trabeculectomy flap that prohibits adequate filtration from the trabeculectomy site, corneal astigmatism and/or wound distortion. If the sutures are too tight and there is inadequate aqueous filtration, early suture lysis can be used to improve filtration through the site. If filtration is appropriate for the eye, despite the tight sutures, the resulting corneal astigmatism and/or wound distortion.

The flap should be sutured at each corner, with equal tension to allow adequate flow of aqueous from under the flap. Using straight tying forceps to grasp one end of the suture, three loops of suture are thrown over the curved tying forceps. The curved tying forceps are then used to pull the trailing end of suture through the triple loop. This first throw of suture should then be pulled to the appropriate tension, positioning the trabeculectomy flap so the knot lies flush against the sclera. To place the second throw, the straight tying forceps are used to throw one loop over the curved tying forceps, and the knot is pulled in the opposite direction of the first triple-throw suture

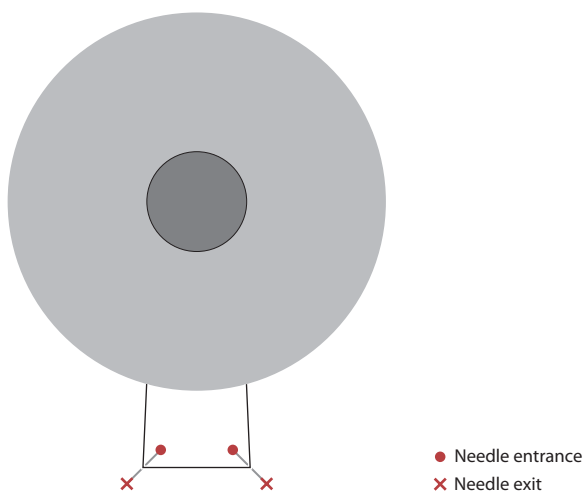


Fig. 10.1 Placement of trabeculectomy flap sutures using 10-0 nylon. Each suture is passed at a 50% depth of the sclera. The suture may be tied with a 3-1-1 knot or a slip knot. ● Needle entrance, × needle entrance

pass. The second throw will determine the final tension of the suture knot, and should be thrown taking care not to disrupt the tension of the first triple-throw suture or to lift the first triple-throw suture off the sclera and thereby loosen the tension. The third throw of the suture is placed in the same manner as the second throw but pulled in the opposite direction to form a square knot and lock the suture knot in place.

An alternative way to suture the trabeculectomy flap, which may facilitate achieving equal tension at each corner of the trabeculectomy flap, is the slipknot, described by Dangel and Keates [4]. Using the straight

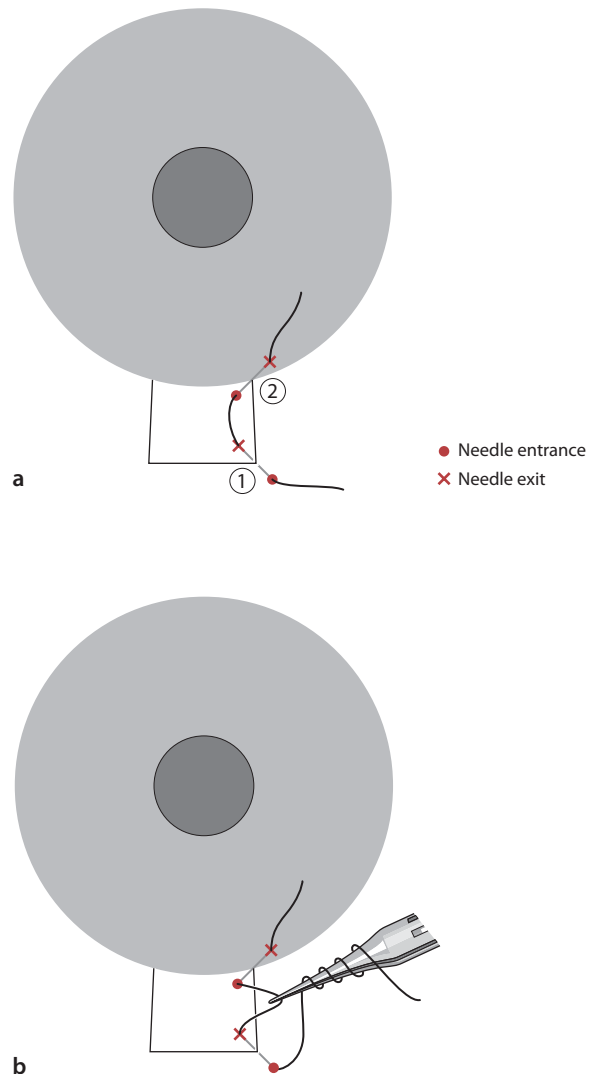


Fig. 10.2 **a** Placement of a releasable suture using 10-0 nylon. Each pass of the suture is at approximately a 50% depth of the sclera or cornea. **b** Tying the releasable suture. Four throws of suture are thrown over the tying forceps prior to grasping the loop to pull through the four throws. The loop is then laid on top of the trabeculectomy flap. ● Needle entrance, × needle entrance

tying forceps to grasp one end of the suture, one loop of suture is thrown over the curved tying forceps. The single loop is then pulled to the appropriate tension to lie flush against the sclera. Without releasing the hold on the end of the suture with the straight tying forceps, another single loop is thrown over the curved tying forceps in the same direction as the previous loop. The curved tying forceps are then used to grasp the trailing end of the suture. The ends are then pulled in the same direction as the first throw. This creates a slipknot that can move to adjust the tension of the knot and adjust the position of the trabeculectomy flap. The third locking throw will be held in reserve until the other sutures in the trabeculectomy flap have been preplaced as slipknots, and both loops of suture have been thrown. After the sutures have been tied with two loops of suture in the same direction, the tension of each suture may be adjusted, loosened or tightened, prior to throwing one more throw to lock the slipknot. In this technique, the tension on the trabeculectomy flap and the position of the tissue can be meticulously adjusted.

An alternative technique for suturing the trabeculectomy flap is a releasable suture, described by Cohen and Osher [5]. The releasable suture may be removed using jeweler's forceps at the slit lamp. A releasable suture is ideal in eyes where difficulty in finding the sutures postoperatively is expected, such as eyes with heavily pigmented conjunctiva, thick Tenon's tissue, or a large amount of subconjunctival hemorrhage intraoperatively.

As seen in Fig. 10.2a, the needle of a 10-0 nylon suture is passed first into the sclera just posterior to the apex of the scleral flap and then through the flap. The needle is then passed through the base of the scleral flap near the limbus, and finally through the peripheral cornea. The releasable suture is then tied with a quadruple-throw slipknot (Fig. 10.2b). A rectangular flap can be closed with two releasable sutures at the apices, whereas a triangular flap can be closed with two releasable sutures on the sides and one permanent suture at the apex. A second pass of the needle is made into the peripheral cornea. The end of the suture is cut flush to the corneal suture. The portion of the suture in the peripheral cornea may be grasped to remove the suture, typically 1 to 10 days postoperatively.

10.4.2 Suturing the Conjunctiva in a Fornix-Based Trabeculectomy

The conjunctiva can be reapproximated at the limbus with a 9-0 or 10-0 Vicryl or nylon wing suture at each end of the peritomy. One end of the conjunctiva is grasped using nontoothed forceps and pulled to its original position at the limbus. The suture is then

passed in a forehanded fashion, partial-thickness through the sclera to create a 1-mm purchase of sclera that anchors the suture. The needle then exits immediately adjacent to the conjunctival incision. The conjunctiva is then draped over the needle (Fig. 10.3). The suture is then tied with a 3-1-1 locking knot, as the tissue is under tension and a slipknot would not be appropriate when the tissue is under tension. The other side of the conjunctiva is then reapproximated at the limbus, ensuring that it is pulled taut against the superior limbus. The needle is then passed through the sclera in a similar manner as the first wing suture, and then conjunctiva is passed over the needle, pulled taut against the superior limbus and tied in a locking 3-1-1 knot. Occasionally, if the conjunctiva remains retracted after the placement of the two wing sutures, a mattress suture may be placed at the center of the retracted conjunctiva at the limbus, to ensure proper closure of the conjunctiva. Alternatively, a running mattress closure may be performed with a noncutting 9-0 Vicryl suture (BV 100 needle), as described by Lerner and Parrish [3]. A BV 100 needle is a vascular needle that creates a hole the same diameter as the suture, unlike cutting or tapered needles, which create holes that are larger than the suture. The advantage of the vascular needle is that the risk of leakage of aqueous at the suture hole is minimized (Fig. 10.4). The needle is passed forehand through the anterior Tenon's capsule and conjunctiva at one end of the conjunctival flap. It is then directed in a backhand pass through the conjunctiva and Tenon's capsule to enter the limbus and exit through the peripheral cornea. The needle is then passed from the peripheral cornea into the limbus near

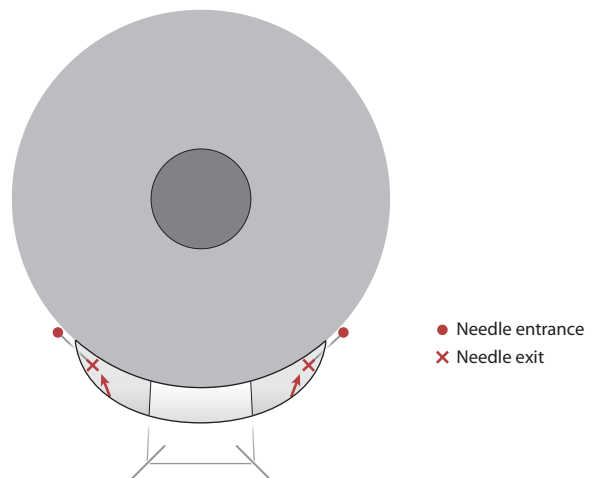


Fig. 10.3 Placement of the winged sutures used to close the conjunctival flap in a fornix-based trabeculectomy using either 10-0 Vicryl or 10-0 nylon sutures. The needle should exit immediately adjacent to the conjunctival incision. A 3-1-1 knot is used to secure the wound. • Needle entrance, × needle exit

the original suture site, and this pattern is then repeated across the conjunctival flap. Alternatively the mattress suture is tied and additional mattress sutures are placed in a similar fashion across the length of the conjunctival flap to achieve watertight closure.

10.4.3 Suturing the Conjunctiva in a Limbus-Based Trabeculectomy

A running 9-0 Vicryl suture is used to close the conjunctiva at the fornix. A cutting or tapered needle can be used because each bite includes Tenon's capsule, and the risk of leakage at the suture hole is less if Ten-

on's capsule is present at the wound. When tension on the conjunctiva makes closure more difficult with a simple running suture, a single interrupted suture may be placed through the conjunctiva in the middle of the wound edges to be closed. This does not require an episcleral bite. A running suture may then be started at one end of the wound edge with 9-0 Vicryl (preferably on a BV needle) using the same suture, incorporating Tenon's capsule with each purchase of conjunctiva (Fig. 10.5). No episcleral bite is required at the start of the running suture. A 3-1-1 knot is thrown to start the running suture, one end of which is cut short while the other end is used to create a running closure. Alternatively, the Tenon's capsule layer may be closed separately, prior to closing the conjunctiva. Each pass of the running suture through the conjunctiva should be equally spaced, approximately 1 mm between each bite. The needle may be passed through the tissue, or the tissue may be carefully draped over the needle that is stabilized by the needle driver. Another alternative is to lock every other bite or every bite. To lock the suture, the suture is passed through both edges of the wound and then passed under the suture loop that is created prior to tightening the suture. The long suture end is then pulled and the bite is locked.

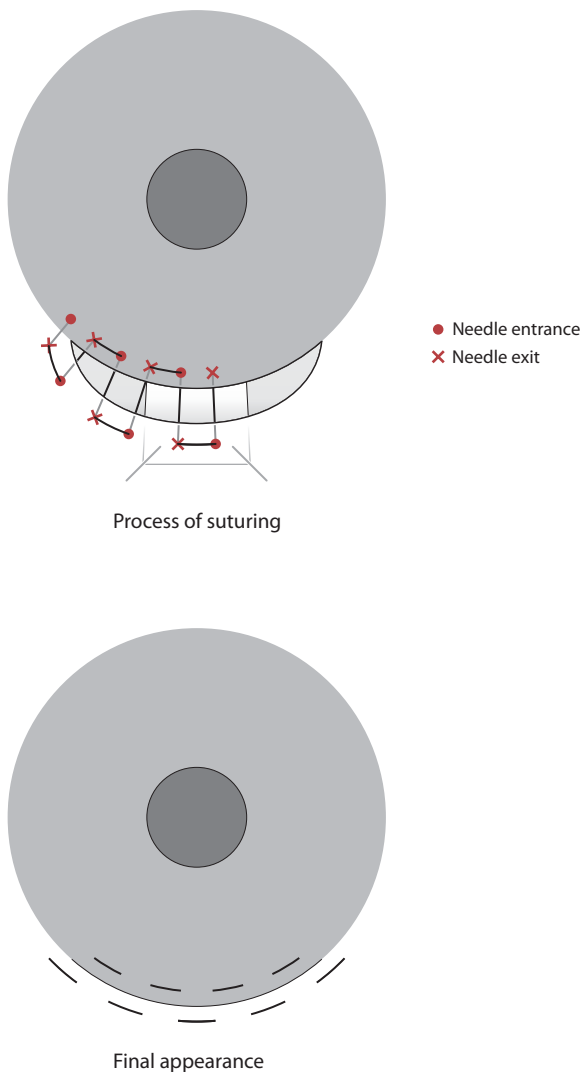


Fig. 10.4. Placement of a horizontal mattress suture to close the conjunctival flap in a fornix-based trabeculectomy using either 9-0 or 10-0 Vicryl or 10-0 nylon sutures. • Needle entrance, × needle entrance

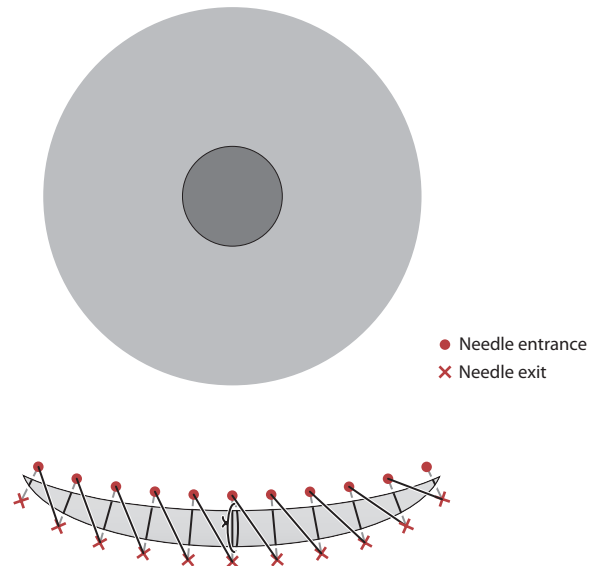


Fig. 10.5. Placement of a running suture to close the conjunctival flap in a limbus-based trabeculectomy using a 9-0 Vicryl suture. A single interrupted 9-0 Vicryl suture may be placed in the middle of the conjunctival flap prior to the running suture if excessive tension of the conjunctiva makes closure difficult. • Needle entrance, × needle entrance

10.4.4 Suturing the Drainage Device

After the drainage device is positioned approximately 8 mm from the limbus, it is sutured to the sclera. A nonabsorbable suture is used, such as 7-0 Prolene, 8-0 nylon, or 5-0 Mersilene. The nonabsorbable suture ensures that the plate will not move anteriorly, posteriorly, nasally, or temporally. The formation of fibrous tissue through the eyelets of the drainage device requires for the implant to be immobile for at least 2 weeks. If the plate were to move anteriorly from its intended position, it could cause the tube to touch the lens, causing a cataract, or touch the cornea, causing corneal endothelial damage. An anteriorly located plate also causes erosion of the overlying conjunctiva, which could predispose the eye to infection. If the plate were to move posteriorly, the plate could injure the optic nerve. Finally, if the plate were to move either nasally or temporally, it could cause scarring of the adjacent extraocular muscles, resulting in strabismus. The needle should pass partial thickness through the sclera, being careful not to penetrate the sclera. A retinal tear/detachment could result from a full-thickness pass of the needle. After the partial-thickness scleral passes are made, the needle is then passed through the eyelets of the drainage device, and a 3-1-1 knot is used to secure the device in place.

10.4.5 Suturing Pericardial Tissue/Donor Sclera over the Tube

The pericardial tissue should be cut to the appropriate dimensions to cover the tube completely, with approximately a 1-mm margin to overlay the tube. The pericardial tissue may be secured to the sclera with two to four Vicryl sutures according to the surgeon's preference. The 8-0 or 9-0 Vicryl suture may be placed at two or four corners of the pericardial tissue/donor sclera, passing partial-thickness bites of sclera and tying with 3-1-1 locking suture knots. Less than four sutures may be needed to secure the patch graft because it has fibrous adhesions to the episclera within 2 weeks.

10.4.6 Closing the Conjunctiva after Placement of a Drainage Device

Two French forceps (or other nontoothed forceps) should be used to grasp the conjunctiva and reapproximate it at the limbus. Two wing sutures may be used to close the conjunctiva at the limbus in the same manner as described in fornix-based trabeculectomy surgery

(Fig. 10.6). As much of the pericardial tissue should be covered as possible; this limits the amount of exposed pericardial tissue that needs to be re-epithelialized postoperatively. If needed, the Tutoplast may be trimmed at the limbus. Additional interrupted sutures may be placed to close the conjunctival peritomy if a radial extension of the conjunctiva has developed.

10.5 Complications and Future Challenges

Complications may arise with rough manipulation of the conjunctiva. If toothed forceps are used to grasp the conjunctiva, a buttonhole or tear may be created, which could cause a leak postoperatively. It is essential to use nontoothed forceps and to handle the conjunctiva in a delicate manner in all cases, especially in eyes with minimal Tenon's capsule. If there is a buttonhole in the conjunctiva, this hole can be closed with a 9-0 Vicryl suture on a BV needle or a 10-0 nylon suture on a tapered needle. Care should be taken to handle the conjunctival tissues gingerly. The hole may be closed with a mattress suture or a cross-stitch. The cross-stitch is done where the first pass of the suture is parallel to the edge of the wound. The second pass of the suture is parallel to the other edge of the wound in the same direction. A 3-1-1 locking knot secures the suture. Buttonholes should always be closed if detected intraoperatively, especially when doing a trabeculectomy. Not closing a buttonhole can result in a persistent leak and ocular hypotony.

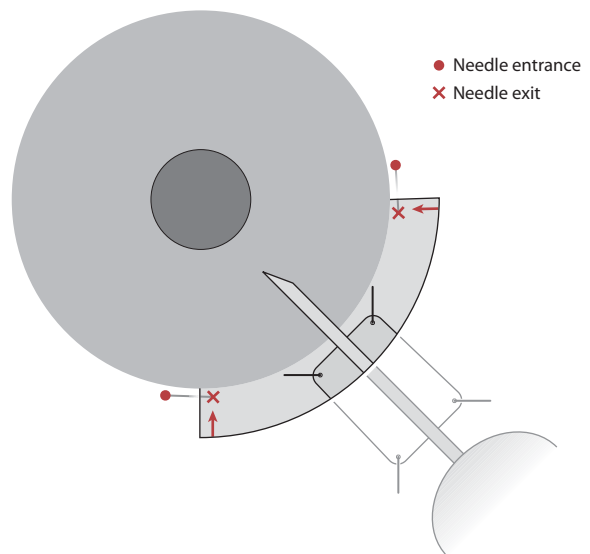


Fig. 10.6. Closure of the conjunctival flap after placement of a drainage device with 9-0 or 10-0 Vicryl. Radial conjunctival incisions may be closed with interrupted 9-0 Vicryl sutures. • Needle entrance, × needle entrance

Partial-thickness scleral passes can be difficult for the beginning surgeon. The needle should be passed at approximately 50% depth through the sclera to obtain a strong purchase of tissue. Bites that are too shallow may not hold a drainage device in place and could lead to anterior migration of the plate postoperatively. Bites that are too deep can penetrate the sclera and lead to retinal tears and/or detachments. You should be able to see the faint outline of the needle under the scleral tissue. If the needle tip appears with a blob of vitreous or pigment on it, there is a very strong possibility of a scleral perforation. Indirect ophthalmoscopy and scleral depression should be done.

10.6 Conclusions

For both the expert and novice surgeons, glaucoma surgery can be a challenge because of the variability in the tissue quality of individual eyes. This variability requires the surgeon to be able to use suturing techniques in tissues that are so fragile that they easily tear if the surgeon does not treat them with great respect. In this chapter, we have covered in detail many of those surgical techniques. We stress that the surgeon who does glaucoma surgery must learn to be gentle, careful, and meticulous especially when handling the conjunctiva.

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