Scleral fixation using suture retrieval through a scleral tunnel

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Scleral fixation of intraocular lenses (IOLs) can be performed under the protection of a scleral flap. A variation of this technique uses a scleral tunnel for suture fixation to the eye. Passage of a double-armed suture through the roof of the scleral tunnel with subsequent retrieval of the suture ends through the external incision for tying facilitates scleral fixation. This modification offers several advantages: A scleral tunnel is easier to construct than a triangular flap and does not require suture closure. It affords a greater surface area for suture placement through an ab externo or ab interno approach. Tying each suture allows the suture knot to pass under the roof of the tunnel, eliminating the need for suture knot rotation. Suture retrieval and scleral fixation through a scleral tunnel incision offers a simplified and elegant method for fixation of IOLs and other intraocular adjunctive devices.

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Options for secondary intraocular lens (IOL) implantation in an eye lacking capsule support include iris fixation[1–3] and transscleral fixation through the ciliary sulcus or pars plana.[4–6] Despite renewed interest in iris fixation of secondary IOLs, eyes lacking adequate iris tissue for IOL fixation or eyes requiring large aniridia prosthetic lenses necessitate an approach using scleral fixation of the implant.

Techniques for transscleral fixation include ab interno methods,[7–11] in which the suture is passed from the inside of the eye to the external surface, and ab externo methods,[12–15] in which the suture is initially passed from the external surface. Common to all the techniques is the need to bury, cover, or rotate the knot created for fixation so conjunctival erosion and endophthalmitis are less likely to develop.[16,17]

We describe a variation of the scleral flap technique that uses a nonperforating scleral tunnel to cover the knot created for scleral fixation. In this technique, a double-armed suture is passed through the roof of the scleral tunnel and into the eye using an ab externo or ab interno approach. Retrieval of the suture ends through the external incision and subsequent tying allows the suture knot to pass under the roof of the tunnel, eliminating the need for suture knot rotation.

SURGICAL TECHNIQUE

Initial preparation involves creation of small limbal peritomies overlying the region for scleral dissection. Calipers dipped in gentian violet are used to mark the locations for the scleral tunnels. The tunnels are created 180 degrees from each other, avoiding the long posterior ciliary arteries at the 3 o'clock and 9 o'clock meridians. A 3.0 to 4.0 mm scleral incision is made 3.0 mm posterior to the surgical limbus at 50% depth with a guarded diamond knife or #64 Beaver blade (#376400, BD Ophthalmic Systems). A scleral tunnel is then dissected using a diamond crescent knife (#60505 Mastel Precision) or a metal crescent blade (990002 A-OK, Alcon Laboratories) (Figure 1). The tunnel is extended to the limbus without penetrating the anterior chamber. Suture placement depends on whether an ab interno or ab externo technique is used. The following example demonstrates use of modified ab externo and ab interno approaches for each haptic of an aniridia IOL.

After scleral tunnels are created at the 10 o'clock and 4 o'clock meridians, a 1.0 mm paracentesis is made at the 12 o'clock or 6 o'clock position for placement of an anterior chamber maintainer, which is inserted and opened for infusion of balanced salt solution. A 300 µm beveled clear corneal incision of the desired length is created at the temporal location using a diamond step knife (#05-5027, Rhein Medical). A small portion of the clear corneal incision is then

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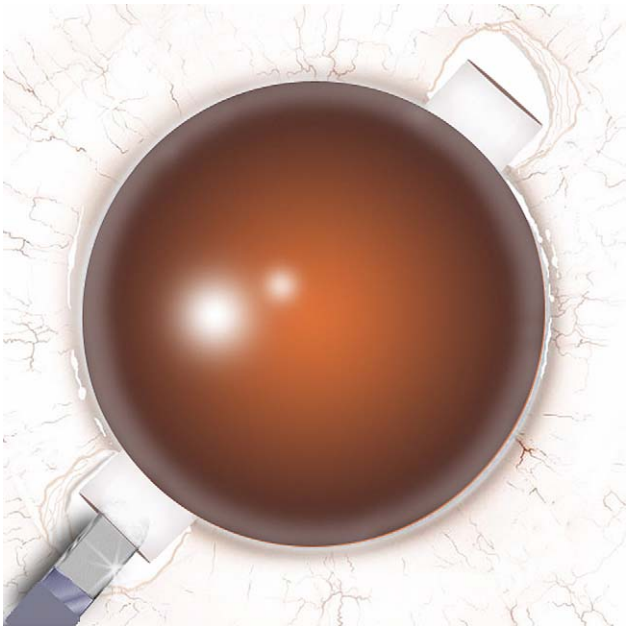

Figure 1. Dissection of 2 scleral tunnels, 180 degrees apart, using a diamond crescent blade.

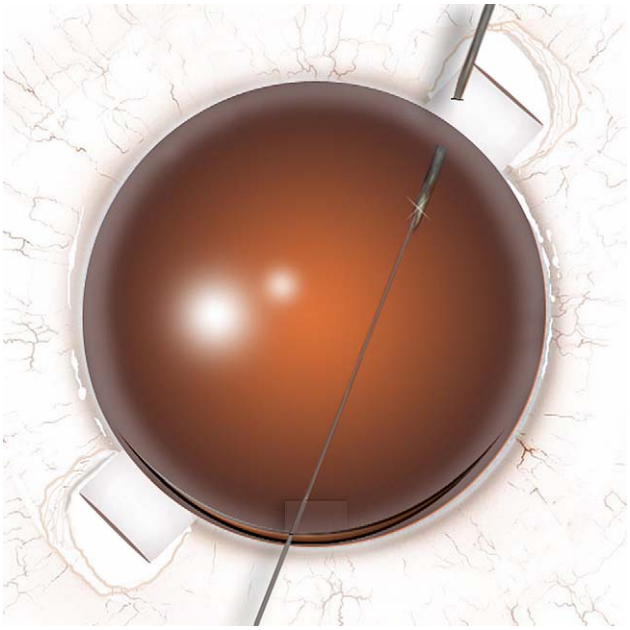

Figure 2. Docking a Prolene suture needle into a 27-gauge hollow needle. The suture needle is initially passed through the 2.5 mm clear corneal tunnel. The 27-gauge needle is passed into the eye through the scleral tunnel roof 1.0 mm posterior to the limbus.

opened into the anterior chamber with a 2.5 mm keratome (#05-5086 3D, Rhein Medical).

A 27-gauge needle is passed through the roof of the nasal scleral tunnel 1.0 mm posterior to the surgical limbus and inserted into the eye far enough to allow visualization of the beveled tip. A double-armed 10-0 (preferably 9-0) polypropylene suture (Prolene) on a long straight needle (STC-6, Ethicon) is passed through the temporal incision opening into the anterior chamber and docked in the 27-gauge needle; suture and needle are removed nasally (Figure 2). The other end of the double-armed suture is passed through the IOL haptic eyelet. The 27-gauge needle is again passed through the roof of the nasal scleral tunnel 1.0 mm posterior to the surgical limbus and 1.0 to 2.0 mm adjacent to the first pass of the needle. The second arm of the double-armed Prolene suture is passed through the clear corneal incision and docked in the 27-gauge needle; suture and needle are again removed nasally (Figure 3).

The clear corneal incision is then widened to its full extent using a diamond keratome (Fine Triamond, Mastel Precision), being careful not to cut the Prolene sutures. A double-armed 9-0 Prolene suture on a curved needle (#1795G/TG 140-8, Ethicon) is passed through the enlarged incision and back through the sclera approximately 1.0 mm posterior to the surgical limbus, through the dissected region of the temporal scleral tunnel (Figure 4). The second arm of the suture is passed through the trailing IOL haptic eyelet and similarly passed ab interno through the sclera 1.0 to 2.0 mm adjacent to the first pass.

The IOL is placed in the eye with the haptics in the sulcus, and the clear corneal incision is closed with interrupted 10-0 nylon sutures. At this point, all IOL suture passes are through the full thickness of the sclera at the ciliary sulcus. By removing the needles from all suture passes, each suture end can be retrieved through the scleral tunnel opening by passing a Lester or Sinskey hook into the scleral tunnel and pulling the trailing suture end through the external excision so the sutures pass through the scleral incision, through the floor of the tunnel (1.0 mm posterior to the surgical limbus), and into the eye through the ciliary sulcus. Holding the other suture of the double-armed pass with a forceps will prevent inadvertently pulling the suture end out of the eye when retrieving the suture (Figure 5).

Cinching and tying the double-armed suture ends results in 4-point scleral fixation of the IOL haptic and concealment of the knot under the roof of the scleral tunnel (Figure 6). Suturing the scleral tunnels is not necessary, and the conjunctival peritomies can be closed with a single 7-0 or 8-0 polyglactin 910 suture (Vicryl).

DISCUSSION

The techniques for transscleral fixation of secondary IOLs have undergone many modifications and improvements

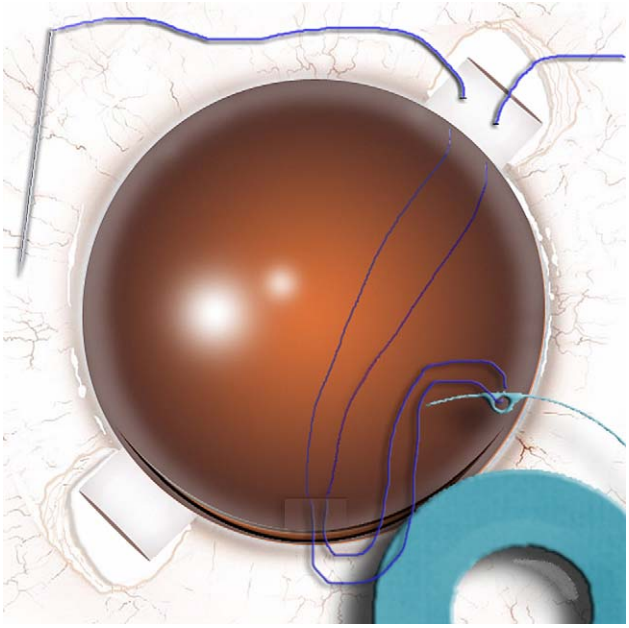

Figure 3. The second arm of the double-armed Prolene suture (off to the right) was passed through the IOL eyelet, through the corneal incision, and out through the nasal scleral tunnel roof assisted by placement of a 27-gauge needle 2.0 mm adjacent to the first pass.

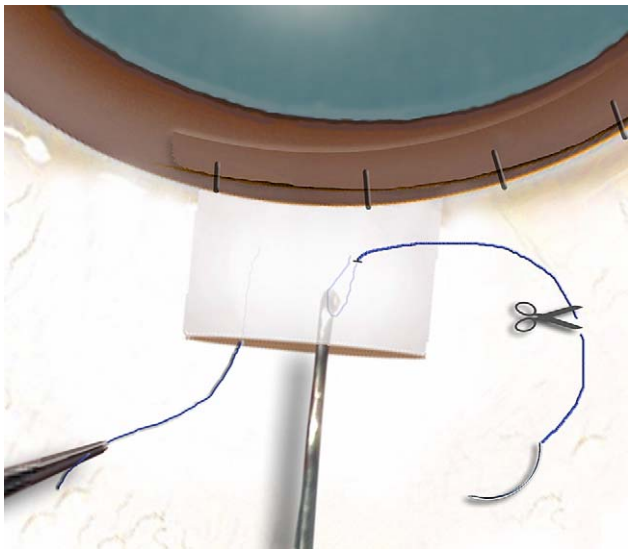

Figure 5. Following the second pass of the double-armed suture and IOL insertion, the suture ends are retrieved through the scleral tunnel incision using a Lester hook after removal of the needles. The left suture is retrieved and held with forceps to avoid inadvertent suture loss during retrieval of the right suture.

over the past 2 decades.[18] Areas for continued improvement include simplifying the technique while minimizing the incidence of IOL tilt, late IOL dislocation, and suture erosion through the conjunctiva.

Intraocular lens tilt can be improved using a technique that creates 4-point fixation rather than the 2-point variety that results from a single pass through the sclera.[19] Late IOL dislocation, resulting from a mechanism of 10-0 Prolene suture degradation, may be reduced by ensuring more accurate placement of the haptics within the ciliary sulcus and, perhaps, by using a thicker gauge suture such as 9-0 Prolene or 8-0 Gore-Tex.[20,21] Attempts to prevent suture erosion through the conjunctiva with subsequent endophthalmitis have included suture knot rotation into the eye[22–24]; suturing within a scleral groove[25–27]; and covering the knot with a patch graft,[28] fascia lata,[29] or scleral flap.[8,12,30–33]

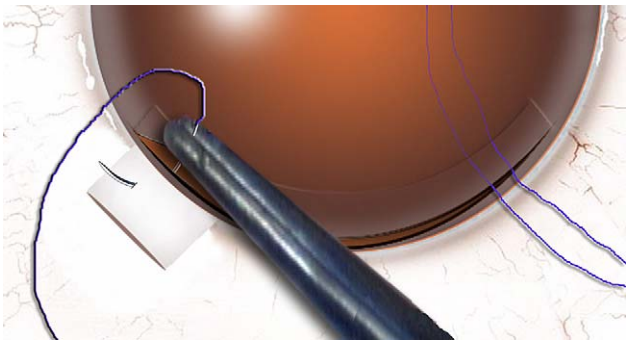

Figure 4. The Prolene 9-0 suture for the IOL trailing haptic is passed ab interno through the clear corneal incision and ciliary sulcus and out through the roof of the scleral tunnel.

Rotation of full-thickness scleral suture knots into the eye has the advantage of eliminating the potential for conjunctival erosion; however, suture breakage during the rotation maneuver may lead to undesired consequences when it develops at the end of a scleral fixation procedure. In addition, rotation of surgical knots into the eye can be impeded by short suture passes; with the current recommendation of thicker suture gauges to lower the incidence of late IOL dislocation, it may be more difficult to bury the larger knots formed by the thicker sutures. Furthermore, current opinions regarding the nature of late IOL dislocation point to a mechanism of suture degradation rather than internal cheese-wiring through partial-thickness sclera.[20] Thus, from the standpoint of decreasing the incidence of late IOL dislocation, there is no added benefit to a full-thickness scleral suture pass that results from rotating a knot into the eye. It is with these points in mind that a scleral covering, which avoids the need for knot rotation, is our preferred method for scleral fixation despite the

Figure 6. The Prolene sutures for each haptic are tied, allowing the knot to slide under the roof of the scleral tunnel.

possibility that knot erosion may occasionally develop through a scleral flap[34,35] or the roof of a scleral tunnel.

There are several other advantages of transscleral fixation through a scleral tunnel. Dissection of a scleral tunnel appears to be a simpler means of generating a scleral covering for the suture knot than the traditional triangular scleral flap. In addition, a larger surface area can be created, which will facilitate passing the needles. Although a triangular flap can facilitate single-armed suture passes that require tying the suture to itself, these small flaps necessitate extremely accurate suture placement when using an ab interno technique to ensure that the suture passes through the floor of the dissection. Similarly, the scleral groove technique can be used for ab externo suture passes but by nature of the limited groove area, it cannot be used effectively with an ab interno method. With the scleral tunnel technique, suture passes can exit anywhere inside the larger dissected tunnel as long as they are at the appropriate distance from the surgical limbus (0.5 to 1.0 mm for ciliary sulcus fixation[36]).

The ability to retrieve the suture ends through the external incision of the tunnel facilitates the initial suture pass of an ab interno technique since the roof of the tunnel does not have to be elevated or reflected for the needle pass. An ab externo approach is aided in a similar manner by the ability to accurately pass the docking needle through the external sclera at the desired distance from the limbus without lifting the roof or estimating the correct distance under the roof, which are necessary if the docking needle is passed through the external incision opening. Once each suture end is retrieved through the external opening, tying the 2 ends with a surgeon's knot will fixate the haptic in the sulcus and the knot will slide under the protection of the tunnel roof. Suturing the tunnel is not required, further simplifying and expediting the procedure.

Use of a scleral tunnel with hook retrieval of the suture ends can be performed in any procedure requiring transscleral fixation including implantation of secondary IOLs, repair of dislocated IOLs,[37–41] employment of adjunctive surgical devices such as Ahmed capsular tension segments and Cionni capsular tension rings,[42] and repair of iridodialyses.[43–46] This modification of the traditional scleral flap simplifies the creation of a scleral covering, eliminating the need to rotate suture knots while facilitating needle placement for an ab interno or ab externo technique.

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