A Novel Scleral Fixation Technique Via the 23-Gauge Trocar System with “Z” Suturation

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Abstract

Purpose: To present a novel scleral fixation technique where a 23-gauge (23-G) transconjunctival sutureless vitrectomy trocar system and forceps are used to implant a posterior chamber intraocular lens (IOL) in eyes with insufficient capsular support.

Methods: A 10/0 polypropylene suture is passed through the 23-G trocar and the free ends are tied to the IOL haptic holes. The IOL is then placed through the corneal incision and into the ciliary sulcus. A “zig zag” or “Z” suture is placed, tied twice and left in the subtenon region by trimming the ends long.

Results: We performed 6 cases by using this technique, no major complications including suture protrusion/erosion, retinal detachment, cystoid macular edema, and endophthalmitis related to erosion were encountered except one case with tilted IOL.

Conclusions: The technique seems to be effective, practical, reliable, and reproducible with shorter operation time for the correction of aphakia, if the posterior vitrectomy has been planned in cases with aphakia or a case has been complicated during phacoemulsification surgery prior to posterior vitrectomy.

Keywords: Absence of Capsular Support; Lens Implantation; Scleral Fixation; Technique; Trocar

Introduction

Optical rehabilitation of eye with aphakia continues to present a unique surgical challenge. Various surgical approaches including unilateral aphakic spectacle, contact lens, epikeratophakia, angle-fixated anterior chamber (AC) intraocular lens (IOL) implant, AC IOL implant with iris enclavation, iris-sutured posterior chamber (PC) IOL implant, or a scleral-sutured or -glued PC IOL implant have been reported in recent years [1,2].

Intra-scleral fixation of an IOL with and without a scleral flap has been reported. In the techniques without a scleral flap, it is possible to use sutures or fibrin glue [3]. Moreover, techniques that use forceps [3,4] or are guided by a needle provide externalization of the IOL haptic [5]. We define a novel modified technique in which a scleral-fixated IOL (SF-IOL) is implanted via a 23-gauge (23-G) trocar system with “zig zag or Z” saturation technique [6] as an alternative to the previously mentioned techniques.

Technique

The conjunctival peritomies were made at 4 and 10 o’clock and light scleral cautery was used to provide sufficient hemostasis. The 23-G trocars (MANI, Inc., Utsunomiya, Tochigi, Japan) were placed into the sclera, approximately 1.5 mm from the limbus, at 10, 2 and 4 o’clock (Figure 1 A). A maintainer was sometimes used instead of the 23G trocar at the limbal 2 o’clock position depending on the case.
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The 23-G sclerotomy at 2 o'clock was used as the infusion port. A 4.0-mm clear corneal incision (CCI) was created with a phaco keratome and an ophthalmic viscosurgical device (OVD) was used to fill the anterior chamber and retropupillary space following anterior vitrectomy with a 23-G vitrectomy cutter from the sclerotomy site in order to protect the corneal endothelium and to push the vitreous backwards and the iris forwards while expanding the posterior chamber. We then divided a double-armed, 10/0 polypropylene suture on a spatula needle (2xGLZ-16,0-150, 16 mm, 20 cm; FSSB, Jestetten, Germany) into two. The IOL used (MED-C, Inc., Bursa, Turkey) was single-piece polymethylmethacrylate (PMMA) with an A constant of 118.2, overall diameter of 13.50 mm, a 6.50 mm optic and a single hole on each haptic. We used a 23-G vitrectomy forceps to grasp the free-end of the 10/0 polypropylene suture and passed it through the scleral port into the eye (Figure 1B). The forceps was used to guide the suture exiting the eye through the CCI (Figure 1C). The same procedure was performed at the other scleral port. The sutures were then attached to the haptic hole of the IOL (Figure 1D).

The 23-G trocars were removed from the eye. The IOL was then slowly inserted through the CCI and into the sulcus by gently pulling the prolene suture while simultaneously pulling the threads out of the globe in order to prevent the suture from wrapping around the IOL (Figure 1E). Suture tension and IOL position were adjusted. The “zig zag or Z” suture technique was used for the burial procedure [6] (Figure 1F): the needle was shortly passed through the sclera (Figure 2A), then again in the opposite direction (Figure 2B) and then once again in the original direction for the third time (Figure 2C). The free-end with the needle was tied on itself twice to form a loop. The suture was cut long and left in the subtenon area (Figure 2D). The CCI and the conjunctiva were closed with a 10/0 monofilament nylon (SMI, Steinerberg B, Belgium) and 8/0 polyglactin sutures (Sutures Ltd, Wrexham Wales, UK), respectively.

Using this technique, we have been able to perform a reliable and reproducible surgical procedure with improvement in visual acuity and no complications during the follow-up such as suture protrusion/erosion, retinal detachment, cystoid macular edema (CME), and endophthalmitis related to erosion. We encountered with a case with minimally tilted IOL since one of the 23-G trocars were placed into the sclera, approximately 2.5 mm from the limbus, at 10 o’clock.

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**Figure 2:** "Z" Suturation: A: We passed a 10/0 polypropylene needle through the sclera with a short bite and B: then again in the opposite direction. C: This was followed by a third pass in the original direction. D: The free-end with the needle was used to form a loop by knotting it twice on itself. The suture that was cut long was left in the subtenon area.

**Video**

**Discussion**

Scleral fixation of PC IOLs is one of the surgical management options to correct aphakia in cases with capsular support deficiency. The pros and cons of this technique have already been reported. Its advantages are a good position of the IOL that is as close as possible to the original lens with good optical correction and an anatomical site away from the corneal endothelium and trabecular meshwork; reduced risk for corneal edema, endothelial cell loss, secondary glaucoma, peripheral anterior synechia, and chronic uveal irritation; and reduced potential suture movement or instability thanks to the haptic holes that allow a suture to pass through [7]. On the other hand, improvements in technique have been made to shorten the operation time, reduce complications such as IOL tilt, decentration, and displacement into the vitreous cavity; and reduce the risk of choroidal hemorrhage, retinal detachment, CME and conjunctival erosion secondary to the use of transscleral sutures [8-10].

Girard was the first to report suturing the IOL through the pars plana [11]. Subsequently, Teichmann improved the technique [12], but the ciliary sulcus fixation technique became more popular than Teichmann's technique. Fixation of the sutured IOL's into the ciliary sulcus was performed by the ab interno technique [13,14]. In this technique, a long needle with suture attached was passed into the eye from the superior corneoscleral incision and then through the ciliary sulcus from the inside to the outside. However, the iris prevented observation of the needle tip and it could be difficult to control the penetration site and direction.

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Scleral fixation methods are divided into two groups as ab interno and ab externo [15]. The ab interno approaches require complex intraocular maneuvers to place the suture accurately and the disadvantage of these approaches is the possibility of the haptic slipping free of the suture during or after surgery [16]. However, they also offer the possibility of creating suture loops, which can stabilize the IOL haptics with knotless cow-hitch knots. Ab externo approaches have the advantage of better controlled and safer placement of fixing sutures [17,18] but it is not possible to introduce suture loops into the eye using the original ab externo method [17]. The disadvantages of these approaches are the possibility of IOL dislocation into the vitreous cavity and damage to intraocular tissues [16].

Partial-thickness triangular scleral flaps [19], radial scleral slits [20], or scleral pockets [21] created around the scleral fixation sites have been reported to prevent suture knot erosion. Lewis reported in 1991 an ab externo technique to provide controlled placement of scleral fixation sutures [17]. An additional advantage was that the knots could be buried under the triangular flap. This procedure is preferred by many surgeons, despite the extra time necessary to prevent flaps under vascularized conjunctiva. Lewis then reported a technique for sulcus fixation without the need for flaps in 1993 [22]. Seki, et al. defined a modified ab externo method and applied two polypropylene suture loops as leading and trailing strands for scleral fixation of the PC IOL by a single ab externo procedure where the IOL haptics could be held with stable knotless cow-hitches [23]. Our technique is different as suture loops were introduced into the eye via 23-G trocars and fixated to the sclera with three “Z” saturation, and then the free end of suture was tied on itself over twice to form a loop and left at a length of approximately 10 mm under the subtenon region of the six cases.

Sutureless scleral fixation of a special IOL was previously described by Maggi and Maggi [24]. Gabor and Pavilidis were the first to define opening a parallel scleral tunnel with a 24-gauge (24-G) needle to perform straight sclerotomy with intrascleral haptic fixation of a PC IOL [3]. Jacob, et al. identified a technique using a glued-IOL forceps to grab the intrascleral haptic of a foldable PC IOL [25]. They also introduced the glued-IOL forceps through the sclerotomy to grasp the IOL during vitrectomy. One of the advantages of this technique was reported as being able to use a rigid PMMA IOL, a 3-piece PC IOL, or an IOL with modified PMMA haptics and not require special sutured scleral-fixated IOLs with holes [26]. Wilgucki, et al. placed a 3-piece PC IOL using the sutureless scleral fixation technique in 24 eyes of 24 patients undergoing PC IOL implantation or rescue [27]. The postoperative short-term complications included vitreous hemorrhage, conjunctival hemorrhage, elevated IOP, and hypotony while the long-term complications were IOL dislocation, CME and iris capture [27]. Almashad, et al. suggested four-point scleral fixation of the PC IOL without scleral flaps [28]. They used a scleral groove instead of a scleral flap and IOLs with two holes at each haptic. The operation time was reduced, good IOL centration and stability were achieved, and postoperative suture-related complications were minimized [28]. In our technique, scleral regions are remarked on conjunctiva via caliper, 23G trocars are inserted transclerally, and then 10/0 prolene suture is fixed to loops of IOL haptics. It requires minimal manipulation in the vitreous cavity with a needle and we therefore consider our method to be safer.

Trocar-assisted intrascleral PC IOL implantation is another novel technique for patients with insufficient posterior capsule support [29].Totan and Karadag described this technique using 25-gauge (25-G) transconjunctival sutureless vitrectomy trocars and a three-piece foldable IOL [30].IOL haptics were incarcerated into previously prepared scleral tunnels. The scleral tunnel was then sutured with a 10/0 monofilament transconjunctival suture. The clear corneal incision was closed with hydration. The authors did not observe any complication with this technique during follow-up. The authors also compared two different sutureless scleral-fixated PC IOL techniques (25-G trocar vs. 24-G needle) [30]. This time the authors used a standard three-piece IOL with propylene haptic and observed that it did not become deformed during surgery [30].Totan and Karadag reported similar postoperative results and complications with both techniques [30]. In the presented technique, the sutures were exited from the sclerotomy through the trocar system instead of the IOL haptics in the techniques by Totan and Karadag [30]. Furthermore, we used a single-piece PMMA IOL with holes however a foldable IOL and a 25-G trocar system would be alternative options.

The advantages of our technique are the lack of a scleral flap, cleft, or patch to bury the suture or knot and the need for only one suture with a double-armed regular needle without a needle guide. The patients with insufficient capsular support also often require PPV.
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surgery to remove a dislocated crystalline lens, nucleus or IOL and our technique could also allow vitreoretinal surgeons to fixate intraocular lenses to the sclera after 23-G or 25-G vitrectomies. Eye surgeons would also find it easier to perform anterior and/or posterior vitrectomies when necessary or planned. We would now suggest placing 23-G (or 25-G) trocars at the 4 and 10 o’clock positions with reusable forceps instead of disposable trocars and forceps to make the surgery more cost-effective and placing the trocar at the 3 and 9 o’clock positions as in our previous technique. This technique also reduces the surgery time by eliminating the need for scleral flaps. The conjunctiva and tenon covering long left buried “Z” suture using the technique above would prevent any suture-related complications. The method is therefore effective, practical and reliable and we expect surgeons to find that it is reproducible and developable in future.

Conflict of Interest

The authors state that the manuscript has not been published previously, and they have no conflict of interest.

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Bibliography


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