Trans-optic Suture Fixation of Subluxated Intraocular Lenses

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Abstract

Purpose

To report a technique for fixating posterior chamber intraocular lenses (PCIOLs) to the sclera by passing sutures through the lens material

Methods

Cases in which PCIOLs were fixated to the sclera using trans-optic sutures were included in this series. Intra and post-operative complications were recorded, and lens position was assessed using slit lamp examination.

Results

Fourteen cases were included in this series. In 9 cases the procedure was performed using 9-0 polypropylene in pseudophakic eyes to correct subluxation, centration, tilt or to replace a broken haptic. In 5 cases this technique was used for primary PCIOL fixation using a flanged 6-0 polypropylene suture in aphakic eyes. In all cases the lenses remained centered and stable at the end of follow up, and no post-operative complications occurred.

Conclusion

Trans-optic suturing is a safe and effective alternative method for fixation of IOLs in a variety of pseudophakic and aphakic clinical scenarios.

Introduction

Scleral fixation of posterior chamber intraocular lenses (IOLs) is a practical surgical strategy for IOL implantation in the absence of adequate zonular or capsular support. Various methods for scleral fixation have been described over the past 30 years [1-3] though it has seen a recent surge in popularity with the introduction of the sutureless techniques of Scharioth [4], Agarwal [5] and Yamane [6]. In some cases, however, standard scleral fixation techniques may not provide a satisfactory solution. For example, in cases where one haptic is broken or detached and cannot be used for fixation. Another example is cases in which the haptics of the IOL are made of a soft pliable material as in hydrophilic acrylic IOLs, and with a tapered haptic design; these are often not suitable for suture fixation due to the risk of slippage. A third example is a case of decentered or tilted IOL [7], which needs to be positioned in a direction different from the axis of the haptics. Domingues et al. described a technique for scleral fixation using a 10-0 nylon suture which is passed through the optic and termed it "Cupid fixation" [8]. To the best of our understanding, the cases in their series were of in-the-bag subluxated IOLs. We present the use of trans-optic suturing in various other clinical scenarios, as well as modifications to this technique including a technique for optic-based scleral fixation to correct aphakia. Importantly we present techniques using

either 9-0 polypropylene with scleral knots or a flanged 6-0 polypropylene. Both these techniques can be applied to any material of foldable IOLs (Figure 1).

Surgical technique - flanged polypropylene

Trans-optic IOL fixation can be performed using 6-0 polypropylene, a suture recently popularized for trans-scleral fixation [9-11]. This can be done in two ways by either using the original curved needle of the 6-0 prolene suture in aphakia, or by threading the naked suture through the lumen of a 30G needle in pseudophakia with subluxation.

Primary fixation - aphakia

The IOL is prepared while still outside of the eye. The curved 3/8 needle is inserted through the lens material of the IOL haptic, IOL optic or at the optic-haptic junction. Using diathermy, a flange is created preferably on the posterior surface of the IOL to eliminate chaffing of the iris tissue. The sutures are then inserted through the main corneal incision to exit at the predetermined location at 1-2 mm posterior to the limbus using a 30G needle as a guide. The IOL is inserted only after the prolene sutures are in place thus no suture manipulations are required after implantation and lens positioning is safe and comfortable. The sutures are then shortened in a stepwise fashion, and external flanges are formed facilitating final adjustments in IOL position. Steps of this technique are presented in figure 2.

Secondary fixation – pseudophakia

The following is performed in cases of subluxated IOLs (figure 3). A 30G docking needle is inserted through a paracentesis (PA), and then passed through the optic material using a second instrument for counter traction as described above. Intraocular forceps can also be used to stabilize the IOL. The 6-0 polypropylene suture is inserted through a paracentesis 180 degrees away (PB) and docked into the needle. The needle and suture are removed from the eye, and a flange is created using diathermy. The flanged edge of the suture is re-entered into the eye (PA) with the flange positioned posterior to the IOL. A docking needle is passed 2mm from the limbus (on the side of the flange), and the un-flanged edge of the suture is re-entered into the eye (PB), docked into the needle, and externalized. The suture is shortened to facilitate good IOL centration, and a flange is created.

Surgical technique – 9-0 polypropylene

A 10-0 Polypropylene suture can also be used for this technique, though 9-0 is preferred by the authors for its superior strength. A conjunctival peritomy is performed at the site of planned suture passage. A 9-0 polypropylene suture on a straight needle (MANI, Utsunomiya, Japan) is passed 2 mm posterior to the limbus and advanced until visualized through the pupil. The suture is then passed through the peripheral portion of the optic material or at the optic-haptic junction. A second instrument, typically a lens hook or manipulator, is needed at this point to tilt the IOL at an angle to facilitate suture passage, as well as for providing counterforce against the movement of the needle. The suture needle is then docked inside a 27G or 30G needle inserted through a paracentesis 180 degrees away, externalized from the anterior

chamber and then re-inserted through the same paracentesis taking care to avoid creating a false passage through corneal tissue. The suture is then docked into a 27G or 30G needle placed approximately 2 mm away, on a horizontal plane, from the primary suture entry point. Alternatively, the suture can be passed again through the optic material near the original passage (double passage through the optic), thus creating a wider area of contact. Once outside of the eye, the suture is tied, buried in the sclera, and the peritomy is closed. The main steps of the procedure are shown in figure 4 and the video.

Results

Nine pseudophakic eyes of 9 patients underwent trans-optic scleral fixation using a 9-0 polypropylene suture (Table 1) and 5 aphakic eyes of 5 patients underwent trans-optic scleral fixation using a flanged 6-0 polypropylene suture (Table 2). In one case both techniques were used in a single eye – primary fixation using a 6-0 polypropylene suture and correction of IOL tilt by a 9-0 polypropylene suture (case number 5 in table 2).

Pseudophakic cases

Four of the lenses were hydrophobic acrylic, 4 were hydrophilic acrylic and 1 was a silicone plate haptic (Figure 2). The function of the trans-optic suture was to replace a detached haptic in 4 of the cases, to re-fixate an unstable subluxated IOL in four cases, to re-center a stable but decentered IOL in 1 case and to correct severe IOL tilt in 1 case. In the 4 cases in which the subluxated IOL was re-fixedated to the sclera using trans-optic sutures the IOLs were hydrophilic and had a tapered haptic (B-Lens, Hanita, Israel). These 4 cases required entry at 2 different locations on the haptic – 180 degrees from each other in 3 cases, and 90 degrees from each other in one case. In the 4 cases in which a trans-optic suture was used to replace a detached haptic, entry at 1 site on the optic sufficed. In one of these, a double pass through the optic was used. In the case of the significantly decentered plate haptic silicone lens, a single trans-optic suture placed perpendicular to the axis of the lens adequately centered the lens. In one case significant IOL tilt was evident after implantation of a 1-piece acrylic using 6-0 polypropylene flanged scleral fixation following intracapsular cataract extraction (ICCE). A single trans-optic suture was inserted perpendicular to the axis of fixation to resolve the tilt.

Aphakic cases

Primary scleral fixation of posterior chamber IOLs was performed in 5 cases. Four of these cases were following ICCE, and the fifth case was after removal of an opacified IOL that dislocated into the vitreous. The IOLs in all cases remained stable and centered until their last follow up examinations. The fixated lens was a 1-piece hydrophobic acrylic in 4 of the 5 cases, and a 1-piece hydrophilic acrylic in one case. In the 5th case the two-point fixation by 6-0 polypropylene suture resulted in significant IOL tilt, which was corrected by a single 9-0 polypropylene suture perpendicular to the axis of the haptics (figure 5).

Discussion

Scleral fixation of IOLs is a popular and well-established strategy used in cases of inadequate capsular support. Trans-optic suture fixation can be used to replace standard scleral fixation techniques in certain cases, and to augment them in others. At the time we performed the presented cases we were not aware of the previous publication by Domingues et al, however he was apparently the first to report the "Cupid fixation" and should be credited for pioneering this technique.

In the original description by Domingues et al.⁸, the reported subluxated IOLs were apparently in-the-bag. In our experience in such cases, looping a suture around the bag-haptic complex is less challenging and far less traumatic than creating a trans-optic suture. Passing a needle through the lens optic requires tilting of the lens, often turning a limited zonular dehiscence or weakness into a complete loss of zonular support. In contrast, three scenarios seem to benefit specifically from the trans-optic approach. The first is in the case of a subluxated 1-piece acrylic IOL with tapered haptics which are located outside of the capsular bag. In these cases, the approach of looping a suture around the haptic may not suffice as the haptic may slip out of the loop. This risk seems to be related to the soft and pliable hydrophilic material of the haptics. The second scenario is the missing haptic, mostly seen with haptic detachment in 3-piece lenses, or a torn haptic of a 1-piece lens. Two of our cases occurred after performing Yamane's fixation of 3-piece hydrophobic IOLs. The haptics detached from the optics, likely during IOL maneuvers, causing IOL subluxation. In these cases, a single trans-optic suture can be used to replace the missing haptic and stabilize the IOL. The polypropylene suture functions as a "pseudo-haptic". The final scenario is adjustment of lens position in cases of residual decentration or tilt. In one case in this series a trans-optic suture was used to center an IOL which was severely decentered, though not tilted, whereas in another case a trans-optic suture was used to resolve significant IOL tilt in an otherwise well centered lens. In cases of aphakia with no capsule support, trans-optic suturing is a valuable option as well. This is done by fashioning pseudo-haptics using 5-0 or 6-0 polypropylene sutures and the creation of flanges to avoid scleral flaps and knots.

In addition to demonstrating the utility of this technique in a variety of different clinical settings and with different IOL materials, this series also shows the variety of ways to use trans-optic suturing. In 5 of the 9 pseudophakic cases the suture was used to anchor the IOL to the sclera at one location, and in the remaining 4 cases 2 sutures were used to anchor the IOL in 2 different locations. In 3 cases a double pass of the suture was performed through the optic. This provides a wider area of contact for the suture and can potentially aid in the stability of the lens.

Special care should be practiced not to stretch the suture after passing through the soft lens material and to avoid excessive IOL manipulations. In a case not included in this series, manipulations on the lens and excessive stretch caused the suture to "cheese wire" through the optic. It is advised to carefully observe the location of the suture passage through the lens at the end of surgery to confirm stability.

In conclusion, trans-optic IOL suturing is a useful technique which can be utilized in all commonly used foldable IOLs and in a variety of different clinical situations.

Declarations

Ethics approval: This is case series, no approval required.

Consent for Publication: A consent to publish these cases, findings and images were gathered from the patients. All the patients were adults.

Availability of data and material: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declares that they have no competing interests.

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Tables

Table 1. Trans-optic suturing in pseudophakia – case descriptions

Single vs double pass of 9-0 suture at each fixation point on the optic	# of scleral fixation points	Material of IOL optic	Function of trans-optic suture	Clinical summary	
Double/Double	2	Hydrophilic	IOL fixation	Traumatic IOL subluxation and total aniridia in a 92-year-old female, after primary corneal laceration repair. Haptics outside the capsule. In a secondary surgery, 2 sided trans-optic sutures were used to fixate the lens.	1
Single/0	1	Hydrophobic	Replace detached haptic	Subluxation after scleral fixation of a 3-piece IOL using the Yamane technique. One haptic detached from the optic. A single trans-optic suture was used to recenter and re-fixate the lens.	2
Single/Single	2	Hydrophilic	IOL fixation	Spontaneous subluxation of a 1-piece IOL. After one trans-optic suture was passed the IOL was decentered, a second suture was placed perpendicular to original fixation plane.	3
Double/Single	2	Hydrophilic	IOL fixation	Spontaneous posterior capsule rupture 20 years after in the bag placement of a 1-piece IOL, with dislocation of the IOL behind the posterior capsule. IOL was fixated to the sclera with 2 trans-optic sutures .	4
Double/0	1	Hydrophobic	Replace detached haptic	Congenital subluxated cataract treated with 4-point fixation of a 3-piece IOL to sclera and iris. When 1 haptic detached from the optic, severe tilt ensued which was repaired with a single trans-optic suture .	5
Single/0	1	Silicone	Recenter IOL	Subluxation of a plate haptic IOL. After scleral fixation through the islet, IOL remained decentered. A single trans-optic suture perpendicular to fixation plane recentered the lens.	6
Single/Single	2	Hydrophilic	IOL fixation	Spontaneous subluxation of a 1-piece IOL. Two trans-optic sutures 180 degrees from one another were used to center and fixate the lens.	7
Single/0	1	Hydrophobic	Replace detached haptic	Subluxation after scleral fixation of a 3-piece IOL using the Yamane technique. One haptic detached from the optic. A single trans-optic suture	8

was used to recenter and re-fixate the lens.

Single/0	1	Hydro phobic	Replace detached haptic	Subluxation after detachment of 3-piece IOL haptic. A single trans-optic suture was used to recenter and re-fixate the lens.	9
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Table 2. Trans-optic suturing in aphakia – case descriptions

	Clinical summary	Material of IOL optic	# of scleral fixation points	Single vs double pass of 6-0 suture at each fixation point on the optic
1	Aphakia following ICCE for mature cataract with severe phacodonesis. Two 6-0 polypropylene sutures were passed through both OHJs and fixated to the sclera 180 degrees apart.	Hydro phobic	2	Single/Single
2	Aphakia following ICCE for mature cataract with severe phacodonesis. Two 6-0 polypropylene sutures were passed through mid-shafts of both haptics and fixated to the sclera 180 degrees apart.	Hydro philic	2	Single/Single
3	Dislocated opacified IOL was removed from the posterior segment using PPV. Two 6-0 polypropylene sutures were passed through both OHJs and fixated to the sclera 180 degrees apart.	Hydro phobic	2	Single/Single
4	Mature cataract dislocated to the posterior segment was removed using PPV & ICCE. Two 6-0 polypropylene sutures were passed through both OHJs and fixated to the sclera 180 degrees apart.	Hydro phobic	2	Single/Single
5	Brunescent subluxated cataract in an eye with severe Megalocornea. After ICCE, two 6-0 polypropylene sutures were passed through both OHJs and fixated to the sclera 180 degrees apart, leaving the IOL significantly tilted. A single 9-0 polypropylene trans-optic suture perpendicular to fixation plane resolved the tilt.	Hydro phobic	3	Single/Single

ICCE – Intra capsular cataract extraction, OHJ – Optic-haptic junction, IOL - intraocular lens, PPV – Pars plana vitrectomy

Figures

Figure 1

Trans-optic fixation of foldable posterior chamber IOLs a. Hydrophilic 1-piece IOL b. Hydrophobic 3-piece IOL (1 haptic detached) c. Silicone plate haptic IOL

Figure 2

Trans-optic fixation of a PC-IOL using 6-0 polypropylene flange technique a. Subluxated hyper-mature rock-hard cataract was removed through a scleral tunnel (ICCE). b. The 6-0 polypropylene suture is passed at the optic-haptic junction and a flange is created to create a pseudo-haptic. c. The polypropylene sutures are externalized using 27G needles on opposite sides. IOL implantation is very safe as the lens is inserted only after the sutures are externalized. d. One-month post operatively the IOL is stable and central. The flanges are well covered by the conjunctiva.

Figure 3

Flange fixation using 6-0 polypropylene. a. Subluxated extracapsular acrylic intraocular lens. b. A 30G needle is inserted through a paracentesis and passed through the peripheral optic. The 6-0 prolene is threaded through it, and the needle externalized. c. A flange is created so that it will be positioned on the posterior aspect of the optic. d. Good lens centration with the flange visible at its final position.

Figure 4

Subluxated hydrophilic IOL and total aniridia in a 92-year-old following penetrating trauma. a. Two months after primary closure of corneo-scleral wound the IOL is tilted, hanging on a fibrotic adhesion between the IOL haptic and the cornea. b. A 9-0 polypropylene suture is passed through the lens material to fixate the IOL to the scleral wall. Adhesions were released and the contracted capsule was removed using a vitrectome. c. Trans-optic scleral fixation of the opposite haptic d. The IOL is stable and central. The patient refused surgical correction of the aniridia.

Figure 5

Trans-optic fixation to correct IOL tilt a. Toric PC-IOL fixated by two trans-optic 6-0 prolene sutures. The IOL is significantly tilted relative to the iris plain. b. A third trans-optic polypropylene 9-0 suture is inserted perpendicular to the IOL axis to compensate for the lens tilt. c. Three-point fixation of the IOL. The lens is central, stable, parallel to the iris plain and at the correct toric axis.