Simplified *ab externo* fixation technique to treat late dislocation of scleral-sutured polymethyl methacrylate intraocular lenses

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This article has been corrected since Advance Online Publication and a corrigendum is also printed in this issue

Abstract

Purpose We report a simplified *ab externo* scleral fixation technique to manage the late dislocation of scleral-sutured polymethyl methacrylate (PMMA) intraocular lenses (IOLs) in the absence of capsule support. **Materials and methods** The technique was performed on five eyes of five patients. Symmetrical scleral pocket tunnels without conjunctival peritomy were created. An anterior vitrectomy via a limbal approach with an anterior chamber infusion or a 3-port pars plana vitrectomy was performed to rescue the dislocated IOL. A long straight suture needle and 23-gauge vitreoretinal forceps were used to conveniently reposition the IOL and loop sutures through the IOL positioning eyelets without externalizing IOL haptics. The outside suture knots were buried under the roof of the scleral tunnels. **Results** The patients were followed for 5–14 months after surgery. All the operated eyes quickly recovered with negligible corneal endothelial cell loss and mild inflammation. Visual acuity improvement and IOL centration were achieved in all eyes with no major complications.

Conclusion The simplified *ab externo* scleral fixation technique offers an effective and minimally invasive surgical alternative to salvage dislocated previously scleral-sutured PMMA IOLs.

Eye (2016) 30, 668–672; doi:10.1038/eye.2015.286; published online 22 January 2016

Introduction

Scleral-sutured intraocular lenses (IOLs) have been widely used for aphakic correction in eyes

with insufficient capsule support. These rigid polymethyl methacrylate (PMMA) IOLs have a special design of incorporating symmetrically positioned eyelets for suture fixation, and a large optic that allows for mild decentration with less chance for the IOL edge to be exposed in the pupil. Although infrequently reported, scleral-sutured IOLs may dislocate many years after initial implantation due to polypropylene suture breakage or erosion, and necessitates surgical repair.¹

Methods to reposition dislocated scleral-sutured IOLs^{2–6} evolved primarily from the *ab interno* scleral fixation technique of Smiddy *et al.*⁷ and the *ab externo* technique of Lewis.⁸ *Ab interno* methods are relatively straightforward. However, this method involves the blind penetration of a suture needle into a decompressed eye, which can result in IOL decentration and unwanted ocular tissue injury. *Ab externo* methods provide better surgical control via a relatively closed-eye system. Nevertheless, many of these require externalizing IOL haptics through corneal or scleral incisions for suture knot formation, which risks damaging the corneal endothelium, iris, or peripheral retina; particularly in eyes with a rigid PMMA IOL. A modified *ab externo* scleral suture loop fixation technique was previously developed in a closed-eye system, providing advantages such as smaller incisions, fewer intraocular manipulations, and excellent IOL positioning.⁹ However, this technique⁹ requires a continuous intraocular needle dock to loop a suture around each IOL haptic, and it is challenging to simultaneously immobilize a severely dislocated IOL while looping the

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Received: 7 June 2015
Accepted in revised form:
17 December 2015
Published online:
22 January 2016

suture around the IOL haptic in a two-handed approach. Recently reported closed-eye methods require less suturing maneuvers, but necessitate certain specially devised materials for introducing loops into the globe before rescuing a dislocated IOL.^{10,11}

We describe a simplified *ab externo* scleral fixation technique to manage late dislocation of scleral-sutured PMMA IOLs. By taking full advantage of the positioning eyelets on IOL haptics, our closed-eye technique avoids externalization of IOL haptics, minimizes surgical trauma, and enhances efficiency and control in repositioning procedures.

Materials and methods

The technique was performed in five patients (five eyes) after appropriate informed consent was obtained. A 5 ml retrobulbar block of lidocaine 2.0% was administered under monitored anesthesia care. The corneal center and the intended meridian for two symmetrical limbal incisions were marked with a corneal-marking ring. Using a crescent blade, a 3-mm-wide limbal incision was made with a depth one-third of the limbal thickness, followed by posterior lamellar dissection at the same intrascleral plane to create a scleral pocket tunnel without conjunctival dissection (Hoffman *et al*¹² first described the scleral tunnel technique). The scleral tunnel was extended 3.0 mm posterior to the limbus underlying the conjunctiva, Tenon capsule, and scleral tunnel roof. This was followed by the establishment of a conjunctival mark

overlying the scleral pocket tunnel 2.0 mm behind the limbus in the marked limbal meridian.

An anterior vitrectomy via a limbal approach with an anterior chamber infusion or a 3-port pars plana vitrectomy was performed as needed to free the IOL from its surrounding vitreous. Afterwards, the IOL was retrieved and elevated behind the pupillary area by 23-gauge vitreoretinal forceps inserted in a convenient corneal paracentesis. Old sutures attached to the haptics were removed and the non-dislocated haptic was refixedated to the scleral as a prophylactic measure.

A single-armed 10-0 polypropylene suture on a long straight needle (cut from 8065304901; Alcon, Fort Worth, TX, USA) was inserted through the conjunctival mark and the full thickness of the scleral pocket, entering the posterior chamber horizontally; and was threaded upward through the eyelet from below to a position above the IOL optic (Figure 1a). Once the long straight needle supports the IOL, the needle tip was gripped by vitreoretinal forceps that were no longer required for holding the IOL. The suture needle was brought out of the eyelet and exits the globe through the corneal paracentesis (Figure 1b). The suture needle was then passed back through the same paracentesis and guided out of the eye by a 27-gauge hollow needle inserted through the same scleral bed 0.5 mm above the previous 10-0 suture entry and 2 mm behind the limbus. A suture loop was formed around the haptic through the positioning eyelet (Figure 1c; Supplementary Video 1).

Figure 1 Simplified *ab externo* scleral fixation technique. (a) The suture needle enters the posterior chamber horizontally and passes through the eyelet, whereas the IOL haptic is held by 23-gauge vitreoretinal forceps through corneal paracentesis. (b) The needle tip is gripped and guided out through the same paracentesis by the vitreoretinal forceps, which are no longer required for holding the IOL. (c) The suture needle is passed back through the same paracentesis and guided out of the globe by a 27-gauge hollow needle inserted through the same scleral bed 0.5 mm above the previous 10-0 suture entry, which is 2 mm behind the limbus. The suture is looped around one haptic. (d) An identical procedure is performed to secure the second IOL haptic. (e) Outside suture ends are retrieved out of the external incision of the scleral tunnel opening by a chopper. (f) After achieving centration of the IOL, sutures are tied and knots are buried under the roof of the scleral tunnels. Then, all wounds are closed and inspected for wound leakage.

The second IOL haptic was sutured. The other limbal incision followed by a scleral pocket tunnel was created 180° from the existing one using the same method. An identical procedure was repeated for the second haptic fixation at the opposite scleral tunnel, in which the needle entered the globe in the conjunctival mark and finally exited the globe from the site 0.5 mm below the previous 10-0 suture entry (Figure 1d). Outside suture ends were retrieved out of the external incision of the scleral tunnel opening by a chopper (Figure 1e). After achieving centration of the IOL, sutures were tied and the knots were buried under the roof of the scleral tunnels. All wounds were then closed and inspected for wound leakage (Figure 1f).

Results

This procedure was successfully completed in five eyes of two female and three male patients with late dislocation of a scleral-sutured IOL (CZ70BD; Alcon, Fort Worth, TX, USA), which had been previously secured by a single 10-0 polypropylene suture on each haptic. Table 1 lists the clinical characteristics of each patient. In three of the eyes, an IOL was found to be subluxated in the vitreous cavity with one haptic anchored to the sclera in the inferior position. The inferior suture broke free during surgery and the dislocated inferior haptic was also refixedated. In the remaining two eyes, an IOL was found to be sitting on the retinal surface. Five eyes had a history of two or more ocular surgeries. Four eyes had an ocular contusion before the dislocated IOL was detected, and corneas were opaque from previous corneal injuries in three eyes. Judging from the poor clinical states of our cases, IOL repositioning by scleral suture loop fixation technique was performed cautiously to reduce any unwanted contact between the rigid IOL and the intraocular tissue. The average time of follow-up after IOL repositioning was 9 months.

Reasonable visual improvement was achieved in all eyes except for patient 2 who developed an epiretinal membrane after multiple surgical interventions for retinal detachment. Three eyes achieved a best-corrected visual acuity above 0.50. Patient 1 had a corneal scar near the superior limbus, and an IOL decentration of <1.0 mm was detected on the first postoperative day. The patient's IOL remained stable throughout the follow-up, and the patient's uncorrected visual acuity of 0.50 and best-corrected visual acuity of 0.60 was maintained. IOLs were well centered throughout the follow-up period for the other four patients (Figure 2; Table 2).

Minor corneal edema with mild anterior chamber reaction was noted in all eyes at the first week postoperatively, which were mostly resolved after the

Table 1 Patient characteristics

Pt	Eye	Age (year)/sex	Preexisting condition	Type of IOL/ dislocated haptics	Cause for dislocation	Surgical history and initial implantation (M/D/Y)	IOL repositioning (date)	FU (months)	BCVA pre Op/post Op
1	Left	45/M	IOL dislocation, corneal scar	Alcon CZ70BD/ both	Ocular contusion	Corneal laceration repair (7/13/2007); Pha+PPV+scleral-sutured IOL (7/27/2007)	Scleral suture fixation +23G PPV (1/23/2014)	12	0.25/0.60
2	Left	48/M	IOL dislocation, epiretinal membrane	Alcon CZ70BD/ superior	Ocular contusion	PPVs for RRD (6/11/2008, 8/22/2008, 10/21/2008); Pha (12/23/2008); Scleral sutured IOL (2/17/2009)	Scleral suture fixation (12/8/2013)	14	0.08/0.10
3	Left	52/M	IOL dislocation, corneal scar	Alcon CZ70BD/ superior	Ocular contusion	Lensectomy+PPV for IFB (7/7/2006); Scleral sutured IOL (3/4/2009)	Scleral suture fixation (11/18/2014)	5	0.50/0.60
4	Right	38/F	IOL dislocation, corneal scar	Alcon CZ70BD/ both	Ocular contusion	Corneal laceration repair (6/2006); PPV+lensectomy (6/2006); Scleral sutured IOL (1/16/2007)	Scleral suture fixation+ 23G PPV (6/5/2014)	9	0.15/0.30
5	Right	63/F	IOL dislocation, diabetic retinopathy	Alcon CZ70BD/ superior	Spontaneous	PPV+Phaco for diabetic retinopathy (2002); Scleral sutured IOL (2003)	Scleral suture fixation (11/29/2014)	5	0.40/0.50

Abbreviations: BCVA, best-corrected visual acuity; G, gauge; IFB, intraocular foreign body; IOL, intraocular lens; FU, follow-up; Op, operation; PPV, pars plana vitrectomy; Pt, patient; RRD, rhegmatogenous retinal detachment; V, vitrectomy.

second week with the use of topical corticosteroids. Corneal endothelial cell loss was negligible (Table 2). Conjunctival hemorrhage or congestion was nearly undetectable by the third postoperative week. No eye exhibited any sign of suture slippage or suture knot exposure. No eye experienced chronic corneal edema or posterior segment complications including vitreous hemorrhage, retinal detachment, or macular edema (Table 2).

Discussion

Our simplified technique for repositioning scleral-sutured PMMA IOLs enhances existing scleral fixation methods in a closed-eye system. This technique maintains the advantages reported in previous closed-eye techniques including smaller incisions, maintenance of intraocular pressure throughout the surgery, and the absence of manipulations for haptic externalization and internalization.^{8,9,11} Moreover, this technique simplifies suturing maneuvers and expedites surgery. By making good use of a straight long needle and 23-gauge vitreoretinal forceps, this technique allows convenient

immobilization of the IOL and introduction of the suture through the IOL eyelet in a bimanual approach, even in the context of complete IOL dislocation. Once the IOL was suspended with one thread, subsequent manipulations for creating a suture loop around the IOL haptic can be conveniently accomplished. In addition, this technique minimizes surgical trauma to the intraocular tissue caused by undesirable contact with rigid IOL. All repositioning procedures were performed with the IOL in the posterior chamber, which is a relatively safe place for various surgical maneuvers. This technique also prevents any blind penetration of the suturing needle. By centrally placing suture loops symmetrically through the positioning eyelets, this technique allows a stable IOL fixation with minimal risk of tilting and decentration.

Favorable outcomes in our cases have demonstrated the effectiveness and safety of this technique in rescuing scleral-sutured PMMA IOLs. CZ70BD is a commonly used scleral-sutured PMMA IOL that has an optic diameter of 7.0 mm and an overall tip-to-tip size of 12.5 mm. Any rotation or movement of such a sizable rigid IOL in the anterior chamber would result in damage to the iris and corneal endothelium, which may give rise to postoperative complications including chronic corneal edema, posterior synechia, and cystoid macular edema. Our cases had pre-existing poor clinical status and our repositioning technique appears to be superior to other techniques, because it avoids excessive manipulation to expose the haptics or IOL. To date, all eyes quickly recovered with negligible corneal endothelial cell loss and mild inflammation. IOL centration was achieved in all of our cases after surgery with no major complications. The closed-eye fixation technique that we used can work well with either pars plana vitrectomy or limbal vitrectomy. Such a combined approach is efficient in both posterior and anterior segment management.

However, this technique has limitations. Although a 10-0 polypropylene suture loop in this technique appears more durable than a single delicate suture to anchor each IOL haptic, more tensile sutures such as 9-0 polypropylene¹ and Gore-Tex¹¹ may be better options for

Figure 2 Anterior segment photography of patient 2 at 12 months after surgical repositioning, showing a well-centered IOL and good wound healing.

Table 2 Surgical outcomes in five patients

Pt	Eye	BCVA pre Op/post Op	Postoperative IOL tilt	Postoperative IOL decentration	ECC Pre/post (cells/mm ³)	IOP pre/post	Complication
1	Left	0.25/0.60	None	<1.0 mm	2394/2476	17/23	None
2	Left	0.08/0.10	None	None	1951/1942	19/18	None
3	Left	0.50/0.60	None	None	1845/1810	16/21	None
4	Right	0.15/0.30	None	None	1737/1678	18/20	None
5	Right	0.40/0.50	None	None	1989/1978	11/15	None

Abbreviations: BCVA, best-corrected visual acuity; ECC, endothelial cell count; IOP, intraocular pressure; Op, operation; Pt, patient.

scleral fixation of the IOL in the prolonged postoperative period if these sutures are available.

In summary, our results confirm that the simplified *ab externo* fixation technique that we developed offers an effective and minimally invasive surgical alternative to secure dislocated previously scleral-sutured PMMA IOLs. Long-term observation is required to further ascertain the effectiveness of this technique, and to determine any associated complications.

Summary

What was known before

- Late dislocation of scleral-sutured PMMA IOLs can be managed by *ab interno* or *ab externo* scleral fixation techniques.
- Current techniques usually require haptic externalization or involve intricate suturing maneuvers. Excessive manipulations may lead to increased surgical injuries and complications.

What this study adds

- The simplified *ab externo* scleral fixation technique we developed does not need haptic externalization, simplifies suturing maneuvers, and greatly minimizes surgical trauma.
- This closed-eye technique achieves both favorable anatomical and visual outcomes.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

The authors thank the participating patients and the medical staff at Xinhua Hospital Affiliated to Shanghai Jiao Tong University School of Medicine.

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Supplementary Information accompanies this paper on Eye website (<http://www.nature.com/eye>)