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Original Article

Long-term outcome of combined vitrectomy and transscleral suture fixation of posterior chamber intraocular lenses in the management of posteriorly dislocated lenses

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Abstract

Background: There is no general consensus on the optimal choice of intraocular lenses (IOLs) or fixation methods in eyes with inadequate capsular support. The purpose of this study was to determine the long-term safety, efficacy and refractive status of combined vitrectomy and transscleral suture fixation of posterior chamber (PC) IOLs in the management of posteriorly dislocated lenses in Taiwan.
Methods: We conducted a retrospective interventional study at our medical facility. The posteriorly dislocated crystalline lenses (or dislocated IOL) were removed with pars plana vitrectomy followed by transscleral suture fixation of PC IOLs at the same setting. Additionally, preexisting ocular condition, postoperative visual acuity (VA) and refraction were recorded.
Results: Fifteen patients were enrolled for analysis, including traumatic posteriorly dislocated IOLs in seven cases, and traumatic posteriorly dislocated crystalline lenses or retained lens nuclei after cataract surgery in eight cases. The end result of our study showed that best-corrected VA of 6/12 or better was achieved in 13 patients (87%) after a mean 45 months follow-up. The mean VA significantly improved from 0.98 logarithm of the minimum angle of resolution (logMAR) at baseline to 0.14 logMAR at last follow-up ($p < 0.01$). The refractive status after suture fixation of PC IOL revealed a mean myopic shift of -1.18 ± 1.47 D from the predicted spherical equivalent. Overall, most complications were minor. Ciliary body hemorrhage occurred during operation in one case and was cleared without visual compromise. Erosion of prolene suture through conjunctiva was noted in three patients. Elevated intraocular pressure was well controlled by topical antiglaucoma medications in three cases. No suture breakage or IOL dislocation was noted in any of the patients. There were no serious adverse events of retinal detachment, corneal compromise, or endophthalmitis in any of the patients.
Conclusion: Our data showed that use of combined vitrectomy and transscleral suture fixation of PC IOLs is a safe and efficient technique to correct aphakia in eyes without adequate capsular support. Our study demonstrated good long-term visual outcome with only minor complications. Furthermore, we recommend that the IOL power should be adjusted 1.00 D less for transscleral suture fixation.

Keywords: intraocular lenses; lens dislocation; pars plana vitrectomy; scleral fixation

1. Introduction

Posterior dislocation of crystalline lenses or intraocular lenses (IOLs) is a serious, sight-threatening complication. Significant intraocular inflammation, elevated intraocular pressure (IOP), cystoid macular edema (CME) and retinal detachment have led to the development of a variety of

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vitreoretinal techniques for its management.[1–4] Following pars plana vitrectomy surgery, patients have numerous available options for secondary visual rehabilitation arising from aphakia. The lens may be repositioned in the ciliary sulcus if there is adequate capsular support. If capsular support is insufficient, IOLs may be sutured to the sclera (transscleral suture fixation) or iris, exchanged for an anterior chamber (AC) IOL, or aphakic spectacle or contact lens correction may be utilized. A review of the literature conducted by the American Academy of Ophthalmology supports the effective use of sclera-sutured posterior chamber (PC) IOL, open-loop AC IOL and iris-sutured PC IOL in the correction of aphakia in eyes without adequate capsular support.[5] However, there is insufficient evidence to demonstrate the superiority of one lens type or fixation technique.[5] Modern open-loop AC IOL may still result in some complications, such as endothelial cells loss, glaucoma, uveitis, hyphema and CME.[5–7]

Theoretically, sclera-suture fixation of IOL in the posterior segment will result in less corneal decompensation, glaucoma and CME than with use of open-loop AC IOL. Most reports involved secondary implantation of PC IOL with transscleral fixation in aphakic patients, and short follow-up periods.[8,9] Furthermore, the procedure of sclera-sutured PC IOL has some potential risks, such as vitreous hemorrhage, retinal break and retinal detachment.[5,8,9] There is little information in the literature regarding the long-term safety and outcome of combined pars plana vitrectomy and transscleral suture fixation of PC IOLs at the same setting after removal of posteriorly dislocated lenses.[10,11] The aim of the current study was to evaluate the long-term safety, efficacy and refractive outcome of this combined therapeutic option in our institute over a 10-year period. Special emphasis is placed on the investigation of the functional outcome, spherical equivalent and any postoperative adverse events, including suture breakage, IOL subluxation or dislocation, corneal edema, elevated IOP, or retinal detachment.

2. Methods

This study followed the guidelines of the Helsinki Declaration, and informed consent was obtained from each patient. The chart records of all patients of posteriorly dislocated crystalline lenses or dislocated IOLs who were referred and managed at our institute (Taipei Veterans General Hospital) over a 10-year period from February 2005 to February 2015 were reviewed. The general characteristics of patients were recorded, including age and sex, preexisting ocular diagnosis, onset duration of lens dislocation, preoperative visual acuity (VA), IOP, operations performed, postoperative best-corrected VA (BCVA) and IOP, and duration of follow-up. The calculation of IOL power was based on the SRK-T formula preoperatively. Thereafter, the predicted refraction was chosen for each individual patient. The postoperative final refractive status, spherical equivalent and any complications after combined vitrectomy and transscleral suture fixation of PC IOLs were also recorded.

The general surgical approach of conventional standard three-port pars plana vitrectomy was performed to remove the dislocated lenses in all patients. A 6-mm infusion cannula was sewn into the sclera at 3.5 mm posterior to the limbus in the inferotemporal quadrant with a 6-0 silk suture. Superotemporal and nasal sclerotomies were also placed 3.5 mm posterior to the limbus. The vitrectomy probe and a fiberoptic light pipe were used to remove all vitreous surrounding the dislocated crystalline lenses or IOLs until it was freely mobile. The vitrectomy probe was frequently used to remove dislocated softer lens material. Intravitreal fragmatome lensectomy was necessary to manage hard nucleus fragments. The dislocated IOL was grasped with an intraocular forceps and brought into the AC. In three cases, perfluorocarbon (PFC) liquid was used to float the dislocated crystalline lens up to the pupillary plane, or to elevate the dislocated IOL off the retinal surface prior to grasping it with intraocular forceps. A limbal incision was prepared and opened to remove the dislocated lens or IOL via limbus.

After vitrectomy, the visual rehabilitation procedure for aphakia was then performed using the technique of transscleral suture fixation of the PC IOLs at the same setting. Two scleral grooves, 3.0–4.0 mm in length, were created 1.5 mm to the limbus at the 3 and 9 o'clock positions. A double-armed 10-0 polypropylene (prolene) suture on an Ethicon CIF-4 needle and a bent 25-gauge needle were inserted through opposite scleral grooves. The CIF-4 needle was pushed as far as possible into the barrel of the 25-gauge needle. The 25-gauge needle was first withdrawn slightly to examine whether it was able to carry the suture needle safely without slipping out before being completely withdrawn from the globe. A 10-0 prolene suture was extended from the 3 to 9 o'clock positions behind the iris. The thread was retrieved with a hook or forceps and cut in half. The preferred IOL type was the single piece PMMA with haptic suture eyelets. Two IOL brands, Alcon CZ70BD and Bausch & Lomb P366UV, have been used in this study, consistent with the general hospital supply. The free ends of the sutures were tied to the eyelets of the haptic of the poly(methyl methacrylate) (PMMA) posterior chamber IOL. The alternative IOL type was single piece PMMA IOL (Alcon MC50BD or MZ60BD) when the above particular type of IOL was not available in our hospital at the time of surgery. The IOL was slowly inserted into the ciliary sulcus. The suture was pulled as necessary during implantation until the IOL was secured in a central position. The corneoscleral wound was closed using a 10-0 nylon suture. The needles of the prolene were passed through the bottom of the sclera grooves, and sutures were tied to each other at both sides. The first suture was tied in a releasable knot on one side. After the tension of the sutures and the IOL position were carefully adjusted, both sutures were tied permanently using 3-1-1-1 surgeon's knots. The threads were trimmed exactly above the knots, and the knots were buried into the sclera grooves. The infusion cannula was withdrawn and the sclerotomy was closed. The other two sclerotomies and conjunctival wound were closed in a conventional manner. In addition, subconjunctival antibiotics and corticosteroids were injected.

Statistical analysis of the data was performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA). Preoperative and

postoperative BCVA was recorded. BCVA was reported as (logarithm of the minimum angle of resolution) VA for statistical analysis. The Wilcoxon *t* test was used to assess differences between baseline and final follow-up mean logMAR BCVA. A p value < 0.05 was considered to be statistically significant.

3. Results

A total of 15 cases were identified for analysis (Table 1), comprising 12 men and three women with a mean age of 61 years (range: 34–85 years). The ocular presentation of enrolled patients included traumatic posteriorly dislocated IOL in seven cases, traumatic posteriorly dislocated crystalline lenses in four cases, and retained lens nucleus posteriorly after cataract surgery in four cases. None of the 15 patients had adequate capsular remnant for inserting a PC IOL in the ciliary sulcus without suture.

The final postoperative BCVA was 6/12 or better in 13 (87%) patients (Table 1). Mean VA significantly improved from 0.98 logMAR at baseline to 0.14 logMAR at last follow-up ($p < 0.01$). The average length of follow-up was 45 ± 36 months (range: 6–109 months). Case 11 presented with mild vitreous hemorrhage during the operation when the bent 25-gauge needle was inserted through the scleral groove. For that patient, hemorrhage was cleared completely using a vitrectomy cutter. In two cases of traumatic dislocated crystalline lenses, PFC liquid was used to elevate the lens up to the pupillary plane, then the lens was removed through limbal incision. In one of the cases of IOL dislocation, PFC liquid was used to elevate the IOL off the retinal surface prior to safely grasp it with intraocular forceps. Residual PFC droplets were found in one patient (Case 4) postoperatively, which was removed by further AC irrigation. Post-traumatic mydriasis was noted due to a tear in the iris sphincter in Cases 2 and 4. Elevated IOP was well controlled by topical antiglaucoma medications in Cases 1, 3, and 12; otherwise, no elevated postoperative IOP was noted in the other cases. Exposed prolene suture occurred postoperatively in Cases 4, 5, and 13, and these patients required conjunctival suture coverage or trimming of prolene suture. No other severe intraoperative or postoperative complications, including suture breakage, lens tilting or dislocation, retinal tear, retinal detachment, corneal compromise, or late endophthalmitis, were found in any of the patients in this study.

The postoperative final refractive status after transscleral suture fixation of PC IOLs was also recorded (Table 1). The associated refractive data included the brand and type of implanted IOL, the predicted spherical equivalent (SE) and

Table 1
Patient demographics, operation data, refractive status and magnitude of myopic shift in eyes after combined pars plana vitrectomy and sulcus sutured fixation of PC IOL.

No.	Age/sex/Eye	Pre-op VA	Ocular presentation	Post-op VA	Operation procedure notes	IOL Brand, type	Predict SE (D)	Manifested SE (D)	Myopic shift (D)
1	59/M/OS	CF/30cm	Traumatic IOL dislocation to retina	6/6	PFC used to elevate IOL	Alcon CZ70BD	−0.03	−1.25	−1.22
2	77/M/OD	6/30	Traumatic crystalline lens dislocation	6/12		Alcon CZ70BD	0.0	−3.38	−3.38
3	55/M/OS	6/10	Traumatic IOL dislocation	6/12		Bausch & Lomb P366UV	−0.90	1.50	+2.40
4	56/M/OD	6/10	Traumatic crystalline lens dislocation to retina	6/6	PFC used to elevate lens	Alcon CZ70BD	−0.27	−2.75	−2.49
5	34/M/OS	6/60	IOL dislocation, atopic dermatitis,	6/10		Alcon CZ70BD	−2.75	−3.75	−1.00
6	47/F/OD	1/60	Traumatic crystalline lens dislocation to macula	6/6	PFC used to elevate lens	Bausch & Lomb P366UV	−2.5	−4.0	−1.50
7	81/M/OD	1/60	Retained lens nucleus after CE	6/6	Fragmatome lensectomy	Alcon MC50BD	0.01	−2.0	−2.01
8	66/F/OD	6/60	Retained lens nucleus after CE	6/7.5		Alcon MC50BD	0.30	−1.0	−1.30
9	84/M/OS	3/60	Retained lens nucleus after CE	6/8.6	Fragmatome lensectomy	Alcon MC50BD	0.19	−3.38	−3.57
10	82/M/OD	6/15	Traumatic IOL dislocation	6/6		Alcon CZ70BD	−0.12	0.0	+0.12
11	52/F/OD	6/15	In the bag IOL dislocation, zonule disruption	6/7.5	Vitreous hemorrhage after scleral suture	Alcon MZ60BD	−2.5	−1.75	+0.75
12	53/M/OS	6/15	IOL dislocation	6/6		Alcon CZ70BD	−2.0	−2.50	−0.50
13	48/M/OD	CF/20cm	Traumatic crystalline lens dislocation	6/6.7		Alcon CZ70BD	−0.29	−1.25	−0.96
14	63/M/OS	6/20	IOL dislocation	6/20		Alcon CZ70BD	−0.23	−2.25	−2.02
15	85/M/OS	CF/10cm	Retained lens nucleus after CE	6/15		Alcon CZ70BD	−0.10	−1.25	−1.15

CE = cataract extraction; CF = counting finger; D = diopter; IOL = intraocular lenses; OD = right eye; Op = operation; OS = left eye; PC = posterior chamber; PFC = perfluorocarbon liquid; SE = spherical equivalent; VA = visual acuity.

postoperative manifested SE (Table 1). The mean axial length was 24.47 ± 2.06 mm. The difference between the actual postoperative refraction and predicted refraction after sulcus fixation of IOL was calculated for each patient. The mean preoperative predicted refraction was −0.87 ± 1.17 D. The mean postoperative manifested refraction was −2.05 ± 1.50 D. A mean magnitude of myopic shift of −1.18 ± 1.47 D from the predicted refraction was noted (Table 1).

4. Discussion

The present study described the technique of combined pars plana vitrectomy and transscleral suture fixation of PC IOLs after removal of posteriorly dislocated lenses. Our study demonstrated good long-term visual outcome; final postoperative VA was 6/12 or better in 13 (87%) patients after a mean 45-month follow-up period, and the complication rate was low. No patient presented with suture breakage, lens tilting or IOL dislocation. No other severe intraoperative or postoperative adverse events were found during the study period, including retinal tear, retinal detachment, corneal compromise, or late endophthalmitis.

There is no consensus on the optimal choice of IOLs or fixation methods in eyes with inadequate capsular support. When adequate capsular support is absent, there are a variety of lens options that can be undertaken for visual rehabilitation. Most surgeons consider flexible open-loop AC IOLs, or the transscleral sutured posterior chamber IOL technique, as the most acceptable alternatives.[9,12,13] However, there is some controversy surrounding which of these two methods is most appropriate for this clinical situation.[5] A retrospective comparative case study reported that there is no significant difference in visual outcome and complications between these two methods.[13] Conversely, Omulecki et al[10] reported that visual outcome after transscleral sutured PC IOL improved to a greater degree than after AC IOL. Previous clinical studies have also reported the functional outcome of sclera-fixated PC IOL implantation and acceptable safety profiles of this technique.[10,11] Although the technique of suture fixation of PC IOLs in the ciliary sulcus is time-consuming and more difficult than AC IOL implantation, this technique appears to avoid many of potential complications of AC IOLs.[6,7,9] Late sequelae related to AC IOL may be a gradual decrease of corneal endothelial counts, CME and glaucoma. Our long-term study demonstrates that transscleral suture fixation of PC IOL is a safe and efficacious alternative to AC IOL implantation when patients present with keratopathy, shallow AC, or glaucoma. Our study showed good long-term visual outcome without any complications of corneal compromise or CME compared to reported complications in a prior AC IOL study, including corneal edema (6%) and CME (15%).[13]

Traumatic posteriorly dislocated crystalline lenses or retained lens nucleus after cataract surgery may result in potentially devastating complications. Retained intravitreal lens fragments may produce several complications including significant intraocular inflammation, elevated IOP, corneal edema, vitreous opacities, CME, and retinal detachment.[14,15] In one of our prior studies, pars plana vitrectomy with removal of retained intravitreal lens fragments was found to be beneficial for patients with persistent uveitis and glaucoma after phacoemulsification.[16] In the majority of patients, visual improvement was achieved after vitrectomy.[16] The technique of vitrectomy is dependent on the amount and hardness of retained lens fragments. A vitrectomy instrument is usually used to remove softer lens material. However, intravitreal fragmatome lensectomy is necessary in the management of hard nucleus fragments. In cases of dislocated whole crystalline lenses or very hard nucleus posterior dislocation, using PFC liquid represents the safest and most efficient means of removing an entire lens or hard nucleus through limbus incision.[17]

Posterior dislocation of the IOL into the vitreous cavity is a sight-threatening complication. Without treatment, CME, chronic anterior inflammation, retinal break from vitreous traction with IOL movement, or retinal detachment may occur.[1–3,12] The modern vitreoretinal technique has been developed to remove the posteriorly dislocated IOL. The dislocated IOL was grasped with an intraocular forceps and brought into the AC. A limbal incision was prepared and subsequently opened to remove the dislocated IOL via the limbus. In one case of the current study, PFC liquid was used to elevate the IOL off the retinal surface before safely grasping it with intraocular forceps.

The combined vitrectomy surgery with scleral suture fixation of posterior chamber IOL implantation has several advantages. The surgical goal of vitrectomy and rapid visual rehabilitation with IOL implantation can be achieved simultaneously. IOP can be kept stable by infusion pressure during the operation. In addition, a formed and stable AC provides the surgeon with optimal visualization to perform scleral suture fixation of the PC IOL safely and accurately. Althaus et al[18] also demonstrated by endoscopy that chances of the needle passing through the ciliary sulcus accurately are greater when the eye maintains a normal IOP. Furthermore, there is no vitreous in the retropupillary plane after vitrectomy. Vitrectomy surgery significantly decreases the risk of vitreous traction and retinal events when surgeons perform transscleral suture manipulation of the IOL. Bading et al[11] recently reported that combined vitrectomy and scleral-sutured fixation of IOLs is a safe procedure with minor complications. The authors suggested that even in younger patients, this procedure is still adequate to correct aphakia.[11] However, this combined operation is complex and requires experience, elaborate skill, and the cooperation of anterior and posterior segment surgery surgeons.

We observed few minor complications after this procedure in our long-term study. Ciliary body hemorrhage occurred during the operation in one case when the bent 25-gauge needle was inserted through the scleral groove. Passing a suture into the ciliary sulcus may cause vitreous hemorrhage if the major arterial circle is inadvertently penetrated.[10] Fortunately, hemorrhage can always be stopped by raising the infusion bottle, and subsequently cleared completely using a vitrectomy cutter during the operation. Erosion of prolene suture through the conjunctiva was noted in three patients in the current series. This event has been reported both with and without partial thickness of the sclera flap.[19,20] When we compared the overall

complication rates of the current series with the literature data,[13,21] in one retrospective study of 51 eyes with secondary implantation of scleral-fixated PC IOL, the postoperative complications spectrum included suture erosion noted in four eyes (7.8%), tilt or decentered IOL noted in three eyes (5.9%), late secondary glaucoma in one eye (2%) and vitreous hemorrhage in one eye (2%).[21] Donaldson et al[13] also reported the outcome and complications after implantation of scleral-fixated PC IOLs in a case series study, included suture erosion (3%), implant malposition (4%), elevated IOP (42%), and retinal detachment (4%). However, the follow-up period in that study was only 14 months. Elevated IOP was well controlled by topical antiglaucoma medications in three cases in the current series. The underlying ocular pathologies were traumatic IOL dislocation in two of these three cases. We chose the particular type of IOL with haptic suture eyelets (Alcon CZ70BD) to avoid the complications of lens tilt or malposition. No suture breakage, lens tilting, or IOL dislocation were noted in any of the patients in the current longer follow-up study. Suture breakage or degradation with spontaneous IOL dislocation has been rarely reported in patients with long-term follow-up.[8,11] Retinal break and retinal detachment are potential risks and complications that may arise from improper suture and manipulation of vitreous base.[8] In one report, the factors contributing to retinal detachment after transscleral fixation of PC IOL were vitreous hemorrhage and myopia.[22]

The postoperative refractive status after transscleral suture fixation of PC IOLs revealed a mean myopic shift of −1.18 D from the predicted SE in our study. The suture entry site cannot be determined exactly when performing transscleral suture fixation of the IOL. In our outside-in suture method, two scleral grooves prepared for sclera suture entry were created about 1.5 mm to the limbus at the 3 and 9 o'clock positions. Donaldson et al[13] also reported that SEs tended to be more myopic (−1.32 D) in the sutured PC IOL group. Because sulcus-fixated IOL is more anteriorly located than the intended in-the-bag fixation, resultant postoperative refraction resulted in a myopic shift from the predicted value. Suto et al[23] previously reported that a significant myopic shift (−0.78 D) from the predicted refraction occurred after sulcus fixation of the same acrylic IOL. The effective lens position (ELP) of the IOLs was 0.75 mm shorter using A-mode measurement with sulcus fixation than with in-the-bag fixation.[23] As an AC depth change of 0.1 mm was calculated to correspond to 0.14 D, 0.75 mm represents a difference of 1.05 D.[24,25] Therefore, we recommend that the IOL power should be adjusted 1.0 D less for sulcus fixation than for in-the-bag fixation in eyes with a normal axial length. Moreover, Ma et al[26] also postulate that over-tightening a transscleral fixation suture may result in a greater anterior shift of the IOL optic than when the suture is tightened properly. In our technique, before fixation sutures were tied permanently, the tension of the sutures and the IOL position were carefully adjusted in all patients.

There were limitations to this study, including the fact that a small number of patients were enrolled. Additionally, there was no control comparison group of AC IOL implantation. Therefore, a long-term prospective study is essential to confirm the maintenance of the therapeutic benefits demonstrated in this study. Evaluation of any long-term ocular adverse effects is also mandatory.

In conclusion, the present study shows that combined pars plana vitrectomy and transscleral suture fixation of PC IOLs after removal of posteriorly dislocated lenses is a safe and efficient technique to correct aphakia in eyes without adequate capsular support. This combined operation offers good IOL centration, stability, and good long-term visual outcome, with only minor complications. Transscleral suture fixation of PC IOLs provides a suitable alternative to avoid the potential complications of AC IOL. Further studies with larger patient cohorts are warranted to confirm long-term outcome and safety.

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