SURGICAL OUTCOME OF SIMULTANEOUS INTRAOCULAR LENS RESCUE AND SUTURELESS INTRASCLERAL TUNNEL FIXATION OF DISLOCATED INTRAOCULAR LENSES

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Purpose: To report short-term surgical outcomes of single-stage simultaneous rescue and sutureless intrascleral fixation of dislocated intraocular lens (IOLs).

Methods: Sixteen eyes of 16 patients who underwent simultaneous rescue and intrascleral fixation of dislocated 3-piece IOLs were retrospectively evaluated. Partial thickness limbal-based scleral flaps (2.0 × 2.0 mm) were created, and a 22-gauge round needle was used to create a sclerotomy at 1.5 mm from the limbus under the previously created scleral flap, and a 23-gauge trans pars plana vitrectomy was performed. Bimanual maneuvers using two 23-gauge end-grasping forceps under chandelier illumination and a wide-angle viewing system enabled 1 step rescue of IOLs from the posterior vitreous cavity with 1 hand and simultaneous haptic externalization through sclerotomy with the other hand. An externalized haptic was placed into the 3-mm intrascleral tunnel created using a bent 26-gauge needle. Fibrin glue was used to fixate haptics and close the scleral flaps.

Results: Intraocular lenses were successfully rescued and sclera-fixated through intrascleral tunnels in all 16 eyes (mean age, 56.56 ± 19.89 years). The mean preoperative logarithm of the minimum angle of resolution best-corrected visual acuity was 0.92 ± 0.68, and this significantly improved at 6 months to 0.289 ± 0.36 ($P = 0.003$). During the follow-up period (10.1 ± 3.21 months), no significant change of endothelial cell count or central foveal thickness was noted postoperatively ($P = 0.203$ and $P = 0.979$, respectively). There were no significant postoperative complications such as IOL dislocation, IOL decentration, retinal detachment, endophthalmitis, or postoperative hypotony.

Conclusion: Simultaneous rescue and sutureless intrascleral haptic fixation of dislocated 3-piece IOLs using bimanual maneuvers is an effective, safe, and minimally invasive surgical method to rescue and fixate the dislocated IOL without further explant.

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Intraocular lens (IOL) dislocation is uncommon yet one of the more serious complications of cataract surgery with seemingly increasing frequency in recent years.[1] It can present in the form of either extracapsular out-of-the-bag IOL dislocation or IOL capsular bag complex dislocation in the posterior segment.[2–5] Traditionally, dislocated IOL in the posterior segment requires pars plana vitrectomy, IOL rescue, and removal of the IOL through either a large corneal or scleral incision, followed by implantation of a secondary IOL using various methods for scleral fixation of a new IOL in the absence of capsular support.[1,6,7] This can usually be accomplished by transscleral fixation of posterior chamber IOLs, iris fixation of IOLs, or by implanting anterior chamber IOLs.[8–13] However, the conventional method can be invasive, time consuming, technically challenging, and it may require manipulation of the IOLs in the anterior chamber, potentially causing corneal endothelial damage. As a result, it can be associated with a higher rate of surgical complications such as corneal endothelial damage and risk for redislocation of the IOL after a period because of suture degradation.[1,5,7] Despite these complications, there is no single standard of safe and effective surgical treatment for the management of dislocated IOLs. Thus, an effective surgical technique for simultaneous IOL rescue and refixation of the dislocated IOL, without a need for explanting the IOL and using sutures, could be less invasive, leading to fewer occurrences of postoperative complications and better postoperative surgical outcomes.

As the early work by Maggi and Maggi[14] first described the sutureless scleral fixation technique, intrascleral fixation of IOLs without sutures has become more common,[14,15] and several variations of the technique have been introduced.[15–18] This method enables intrascleral fixation of a three-piece IOL in the absence of capsular support without the use of any sutures. Also, 20-gauge pars plicata vitrectomy for repositioning of dislocated IOL was reported in small case series of 5 eyes,[19] and similar techniques involving small-gauge vitrectomy and bimanual manipulation of the IOL were introduced.[20–25] By modifying these various surgical techniques, using chandelier illumination, a wide-angle visualization system, and small-gauge sutureless vitrectomy, we have performed single-stage simultaneous IOL rescue and fixation in patients with IOL dislocation, thus simultaneously accomplishing two surgical goals. Using chandelier illumination, bimanual manipulation of dislocated IOLs in the posterior segment allows for simultaneous one-step IOL rescue from the posterior vitreous cavity with one hand and externalization of the dislocated IOL haptic through sclerotomy with the other hand, without further manipulation of the rescued IOL in the anterior chamber. Here, we report the surgical outcome of single-stage simultaneous IOL rescue and sutureless intrascleral tunnel refixation of a dislocated IOL.

Methods

Patients

We retrospectively reviewed all patients who had undergone simultaneous IOL rescue and sutureless fixation of a dislocated IOL between March 2012 and September 2013. All surgeries were performed by a single surgeon (M.K.) at Yonsei University Gangnam Severance Hospital, Seoul, Korea. The study was approved by the Institutional Review Board of Yonsei University Gangnam Severance Hospital and was conducted in accordance with the tenets of the Declaration of Helsinki. Informed consent was obtained from all patients. All patients underwent a standard ophthalmic examination, including measurement of best-corrected visual acuity (BCVA) with autorefraction with a Snellen chart, intraocular pressure measurement with a noncontact tonometer, slit-lamp examination, and dilated fundus examination at all preoperative and postoperative visits. The corneal endothelial cell density was measured by specular microscopy (CellChek CC-7000; Konan Medical Inc, Nishinomiya, Japan) preoperatively and postoperatively at 6 months. Central foveal thickness was measured with spectral domain optical coherence tomography (Cirrus OCT; Carl Zeiss Meditec, Dublin, CA) preoperatively and postoperatively at 3 months.

Surgical Technique

Conjunctival peritomy was performed first, and a 2.0 mm × 2.0 mm partial thickness limbal-based scleral flap was created at either the inferior and superior limbus (if horizontal white-to-white [WTW] was ≥11 mm) or temporal and nasal limbus (if horizontal WTW was <11 mm) at approximately 180° apart, based on the preoperative measurement of horizontal WTW distance. Three-port 23-gauge trans pars plana vitrectomy was prepared by creating a sclerotomy at 3 mm from the limbus, and a 25-gauge chandelier illumination was placed inferonasally (see **Video, Supplemental Digital Content 1**, http://links.lww.com/IAE/A326, which demonstrates the key steps of the procedure). A 22-gauge round needle was used to create a sclerotomy at 1.5 mm from the limbus through the ciliary sulcus under the previously created scleral flap. A constellation vitrectomy system (Alcon Laboratories, Inc, Fort Worth, TX) was used for vitrectomy, and a wide-angle viewing system with a noncontact lens (BIOM 4; OCULUS Surgical Inc, Port St. Lucie, FL) was used for visualization of the posterior segment throughout the surgery. Posterior vitreous detachment was induced with suction of the 23-gauge vitrectomy probe, if posterior vitreous detachment was not present. While holding the IOL with the forceps, vitrectomy was performed to free the dislocated IOL from the vitreous. In case of in-the-bag IOL dislocation with capsular bag IOL adhesion (Figure 1, top left), a vitrectomy probe was used to free the IOL from the posterior capsular bag complex while holding the IOL with the intraocular forceps (Figure 1, top right). A thorough peripheral vitreous shaving was performed using a scleral indentator. Using two 23-gauge intraocular end-grasping forceps (Grieshaber; Alcon Laboratories, Inc) in both

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hands, 1 hand was used to carefully grasp the haptic to lift up the dislocated IOL to the level of the sclerotomy site and the other forceps was used to gently grasp the haptic and externalize the haptic through the previously created sclerotomy at 1.5 mm from the limbus (Figure 1, middle left). Then, the other haptic was pulled through the other sclerotomy site and externalized in a similar manner (Figure 1, middle right). Bimanual maneuvers using 23-gauge end-grasping forceps under chandelier illumination enabled 1-step rescue of the dislocated IOL from the posterior vitreous cavity with 1 hand and simultaneous haptic externalization through sclerotomy with the other hand. After externalizing the haptics, a 3-mm long intrascleral tunnel was created using a bent 26-gauge needle, and the externalized haptic was tucked into the intrascleral tunnel as described previously[15] (Figure 1, bottom left). Fibrin glue (Tisseel; Baxter, Deerfield, IL) was used to fixate the haptics and close the scleral flaps. The conjunctiva was also closed with the fibrin glue. The 23-gauge sclerotomy sites were sutured with 7-0 Vicryl (Ethicon, Somerville, NJ) if leakage was noted. Topical antibiotics and steroids were used in all patients postoperatively.

Statistical Analysis

SPSS 18.0 software was used for statistical analysis (SPSS Inc, Chicago, IL). The BCVA was converted to

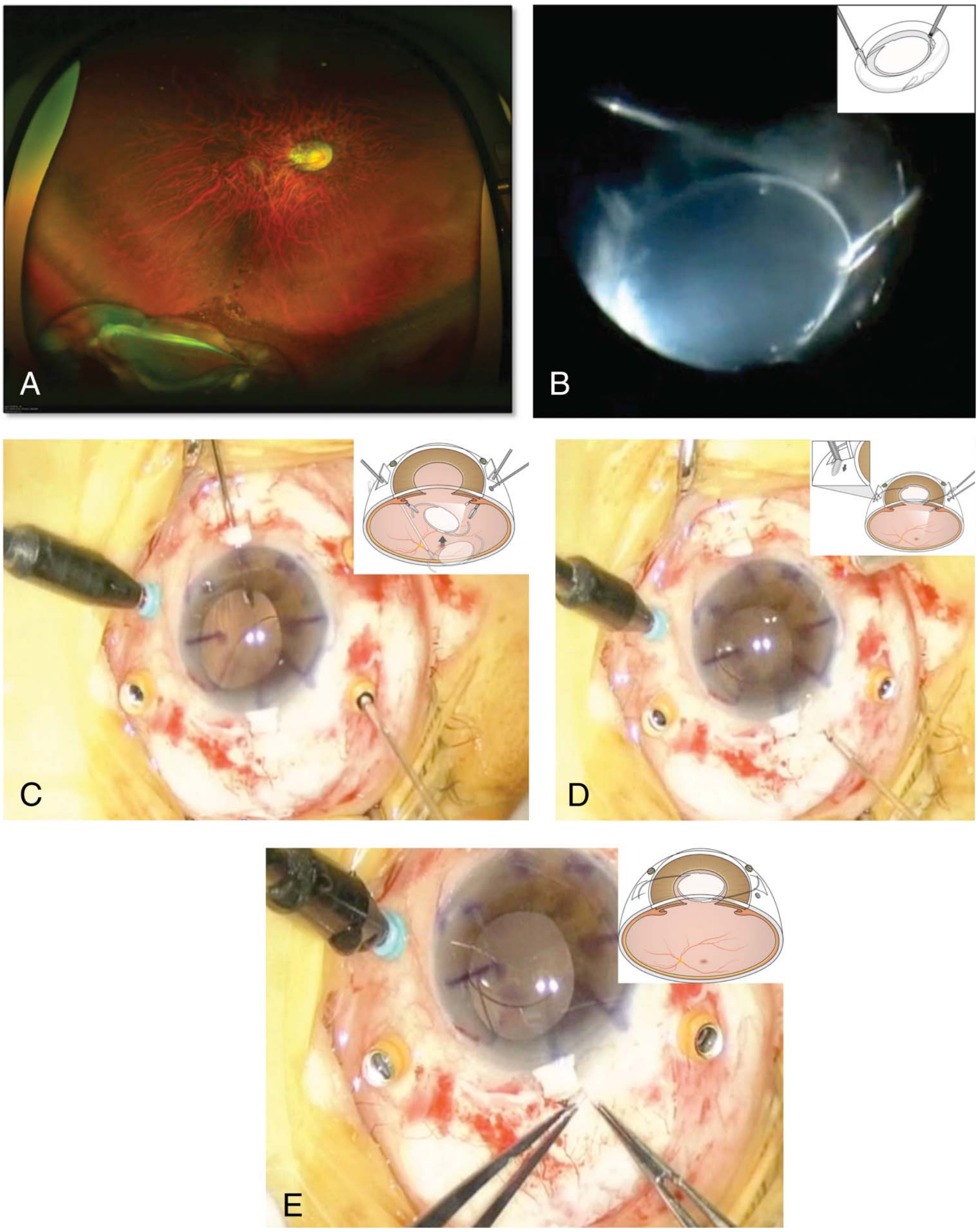

Fig. 1. Patient (Case 14) with in-the-bag IOL dislocation. **A.** Preoperative wide-angle photograph of in-the-bag IOL dislocation into the vitreous cavity. **B.** A vitrectomy probe was used to free the IOL from the posterior capsular bag IOL adhesion while holding the IOL with the intraocular forceps. **C.** Using two 23-gauge intraocular end-grasping forceps in both hands, rescue of IOL under chandelier illumination was performed by carefully grasping the haptic to lift up the dislocated IOL to the level of the sclerotomy site and the other forceps was used to gently grasp the haptic and externalize the haptic through the previously created sclerotomy at 1.5 mm from the limbus. **D.** Externalization of the other haptic of rescued IOL through the opposite sclerotomy site in a similar manner. **E.** The externalized haptic was tucked into the 3-mm long intrascleral tunnel created previously with a bent 26-gauge needle.

the logarithm of the minimum angle of resolution (logMAR), and the Wilcoxon signed-rank test was performed to analyze the significance of change in BCVA, endothelial cell count, and central foveal thickness preoperatively versus postoperatively. A $P < 0.05$ was considered significant.

Results

The IOLs were successfully rescued and sclera-fixated through intrascleral tunnels without sutures in all 16 eyes of 16 patients (11 males, 5 females; mean age, 56.56 ± 19.89 years; Table 1). The mean duration of time to IOL dislocation from previous cataract surgery was 5.19 ± 3.1 years, and the mean follow-up period was 10.1 ± 3.21 months. The detailed clinical features and postoperative outcome of patients are presented in Table 2. All patients, except Patient 14, had associated ocular conditions such as complicated cataract surgery, ocular trauma, nystagmus, or pseudoexfoliation syndrome. There were two cases with IOL capsular bag complex dislocation, both of which were successfully rescued, and the IOLs were safely freed from the capsular bag complex by vitrectomy.

Table 1. Baseline Characteristics of Patients and Surgical Outcome

Characteristics	Value
Number of eyes (patients)	16
Age (mean ± SD), years	56.56 ± 19.89
Gender (male:female)	11:5
Time to IOL dislocation from previous surgery, years	5.19 ± 3.1
Follow-up (mean ± SD), months	10.1 ± 3.21
Preoperative parameters	
Baseline logMAR UCVA (mean ± SD)	1.16 ± 0.65
Baseline logMAR BCVA (mean ± SD)	0.92 ± 0.68
Baseline endothelial cell count	2515.69 ± 479.89
Baseline CFT, μm	249.13 ± 31.25
Baseline IOP, mmHg	16 ± 7.03
Postoperative parameters	
LogMAR BCVA at 3 months (mean ± SD)	0.38 ± 0.42 (P = 0.001)*
LogMAR BCVA at 6 months (mean ± SD)	0.289 ± 0.36 (P = 0.003)*
Endothelial cell count at 6 months	2501.7 ± 487.6 (P = 0.203)*
CFT at 3 months, μm	248.25 ± 25.32 (P = 0.979)*
IOP at 6 months, mmHg	12.62 ± 3.99 (P = 0.32)*

*Compared with baseline values.

CFT, central foveal thickness; IOP, intraocular pressure; logMAR, logarithm of the minimum angle of resolution; SD, standard deviation; UCVA, uncorrected visual acuity.

The mean preoperative logMAR BCVA was 0.92 ± 0.68, and the mean postoperative logMAR BCVA at 3 months and at 6 months were 0.38 ± 0.42 and 0.289 ± 0.36, respectively. All eyes attained statistically significant improvement in BCVA at postoperative 3 and 6 months (P = 0.001 and P = 0.003, respectively). There was no significant reduction of endothelial cell count postoperatively at 6 months (P = 0.203), and no significant change of central foveal thickness as measured by spectral domain optical coherence tomography or intraocular pressure was noted at postoperative 3 months (P = 0.979 and P = 0.32, respectively; Table 1). The IOLs remained well fixated and stable postoperatively in all eyes (Figure 2). The mean preoperative cylinder was −2.39 ± 2.08, and the mean postoperative cylinder was −2.42 ± 1.28. There was no significant change in cylinder, postoperatively (P = 0.755).

Transient vitreous hemorrhage developed in 1 patient during the immediate postoperative follow-up period, which resolved within 1 week without further significant complication. Other postoperative complications included iris capture by the IOL in 1 eye (6.3%) and transient ocular hypertension in 1 eye (6.3%). No other significant postoperative complications, such as postoperative hypotony, endophthalmitis, retinal detachment, IOL dislocation, IOL decentration, cystoid macular edema, or choroidal detachment were found during the follow-up period.

Discussion

The management of IOL dislocation presents two unique challenges to surgeons. One must decide whether to remove the dislocated IOL and perform a new IOL implant or reposition and refixate the dislocated IOL using various surgical techniques. The former procedure necessitates the creation of a large corneal/scleral incision for IOL explant, which may cause unwanted postoperative astigmatism. Even if the dislocated IOL is rescued and used again for refixation to perform either iris fixation or transscleral suture fixation, conventional methods involve manipulation of the IOL in the anterior chamber and placement of additional sutures for fixation of the haptics, which can be technically challenging and time consuming. Moreover, additional risks associated with sutured IOLs include increased risk of bleeding and suture erosion with subsequent IOL malposition or dislocation.

Recently, sutureless techniques for the scleral fixation of a posterior chamber IOL[15–19] and similar techniques using small-gauge vitrectomy and bimanual manipulation of the IOL have been introduced.[15,18–25] With some modification of this technique, using a small-gauge

Table 2. Clinical Features and Postoperative Surgical Outcome of Each Patients

Cases	Sex/Age	Associated Ocular Conditions From Previous Surgery	Time to Dislocation From Previous Surgery, Years	Type of Dislocation at Presentation	WTW Distance, mm	Preoperative logMAR BCVA	Postoperative logMAR BCVA at 6 Months	Direction of IOL Fixation	Postoperative Complications
1	M/52	PCR and sulcus-fixated IOL	14	Out-of-the-bag	12.5	0.15	0.04	Vertical	Transient ocular hypertension
2	M/72	PCR and sulcus-fixated IOL	5	Out-of-the-bag	12.1	1.69	1.39	Vertical	None
3	M/44	PCR and sulcus-fixated IOL	3	Out-of-the-bag	13.2	0.30	0	Vertical	None
4	M/38	Nystagmus	6	In-the-bag	12.3	0.69	0.52	Vertical	IOL iris capture
5	M/70	Pseudoexfoliation syndrome, glaucoma	2	Out-of-the-bag	10.9	0.22	0.09	Horizontal	None
6	F/76	PCR and sulcus-fixated IOL	3	Out-of-the-bag	11.7	1.69	0.09	Vertical	None
7	F/67	PCR and sulcus-fixated IOL	2	Out-of-the-bag	12.4	1	0.30	Vertical	None
8	F/47	Trauma	5	Out-of-the-bag	10.8	0.52	0	Horizontal	None
9	M/73	PCR and sulcus-fixated IOL	3	Out-of-the-bag	11.9	2	0.52	Vertical	None
10	M/82	Pseudoexfoliation	4	Out-of-the-bag	11.2	2	0.52	Vertical	None
11	M/50	PCR and sulcus-fixated IOL	7	Out-of-the-bag	13	1	0.22	Vertical	Transient vitreous hemorrhage
12	F/63	PCR and sulcus-fixated IOL	6	Out-of-the-bag	13.3	0.30	0	Vertical	None
13	M/49	Trauma	4	Out-of-the-bag	11.9	0.22	0	Vertical	None
14	M/66	None	7	In-the-bag	12.4	0.52	0.39	Vertical	None
15	M/59	Trauma	9	Out-of-the-bag	11.6	1.69	0.39	Vertical	None
16	F/44	PCR and sulcus-fixated IOL	3	Out-of-the-bag	11	0.69	0.09	Horizontal	None

logMAR, logarithm of the minimum angle of resolution; PCR, posterior capsule rupture.

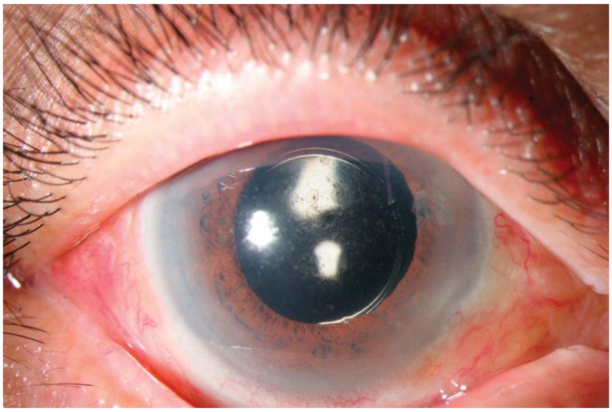

Fig. 2. Postoperative slit-lamp photograph of a patient with vertical IOL fixation shows a well-centered fixated IOL at postoperative Day 7.

vitrectomy system, a wide-angle viewing system, chandelier illumination, and simultaneous use of two intraocular forceps bimanually, we were able to successfully perform a single-stage simultaneous IOL rescue and refixation of dislocated IOL without using any sutures. Use of a wide-angle viewing system under chandelier illumination allowed bimanual surgery by freeing one hand, thereby enabling simultaneous manipulation of both haptics and good visualization of the posterior segment, including the vitreous base, while lifting up the dislocated IOL into the sclerotomy plane.

There are several advantages of this technique. First of all, as no IOL explantation was required with this technique, we could avoid the construction of a large corneal or scleral wound for the removal of dislocated IOL and thus prevent creation of visually significant astigmatism. Avoiding the creation of large corneal/scleral wounds allows surgery to be performed in a closed system, reducing intraocular pressure fluctuations. Utilization of dislocated IOLs without explantation can reduce surgical time and potential phototoxicity to the retina, which is associated with longer surgical times. Second, this technique enabled direct IOL rescue and subsequent externalization of the IOL haptics without any further manipulation of the IOL in the anterior segment for IOL explantation, thereby minimizing any potential complications associated with the cornea, as IOL manipulations in the anterior chamber may increase the risk for developing intraocular inflammation and corneal endothelial damage. Third, compared with other previously known methods for scleral fixation of IOLs, this technique does not require the use of any sutures for IOL fixation, thereby avoiding suture-related complications such as suture-associated inflammation/infection, suture degradation, and resultant IOL redislocation.[26–29] Furthermore, this could contribute to less postoperative pain and inflammation, as no scleral sutures would be required, and no large corneal/scleral incision for IOL removal would be needed. Fourth, because complete wound healing in scleral tissue can take up to 3 months,[30] placement of the haptic inside the intrascleral tunnel and fixation with fibrin glue can stabilize the IOL immediately in the early postoperative period, thus may lessen the chance of redislocation. Furthermore, the use of fibrin glue helps stabilize the haptic to the sclera and seals the flap, potentially reducing the risk for infection and postoperative hypotony. It may also prevent transverse movement of haptics within the scleral tunnel, and this technique can thus be used successfully even in a patient with recurrent IOL dislocation because of nystagmus (as in Case 4). Because the haptic was placed in its normal configuration into the intrascleral tunnel without any traction, stabilizing the axial positioning of the IOL, there was no apparent IOL tilt or decentration during the follow-up. Furthermore, the procedure does not require the use of any specifically designed instruments, such as special IOL forceps for IOL handling. In our study, the 23-gauge end-grasping forceps for internal limiting membrane peeling were used for handling of the IOL without any difficulty.

Kumar et al[19] previously reported using 20-gauge pars plicata vitrectomy for repositioning of the dislocated IOLs in 5 eyes. Although their technique was successfully performed in five eyes, performing vitrectomy and IOL haptic externalization through pars plicata presents potential risk for intraoperative bleeding. Our technique uses pars plana approach for performing vitrectomy and rescuing dislocated IOLs, thereby providing a better safety profile.

There are some caveats in performing this surgical procedure. It is important to maintain the reverse S configuration of the dislocated IOL while lifting it up to the sclerotomy plane, as sudden tilting or movement of the forceps could result in IOL rotation, making it difficult to externalize its haptic. In cases of flipped IOLs, because both hands are available for IOL manipulations, the IOL can be safely rotated upside down before externalizing the haptic, and this also can be safely performed without having to position the IOL in the anterior chamber. It is also important to perform a complete vitrectomy with shaving of the vitreous base to ensure no vitreous traction, as lifting up the dislocated IOL can cause undue vitreoretinal traction, resulting in postoperative retinal break or detachment. Although we were able to successfully remove the thick Soemmering's rings from the IOL in two cases with dislocation of the capsular bag–IOL complex, vitrectomy in those cases can be somewhat challenging, as it can fall back into the vitreous cavity. Regarding the optimal location of scleral flap, a limbal-based scleral flap was created at the inferior and superior limbus for vertical fixation of IOLs, if WTW was ≥11 mm, because authors initially believed that there would be less haptics to place within the intrascleral tunnel if placed horizontally. However, contrary to our belief, studies have demonstrated the inaccuracy of WTW measurement at predicting the horizontal diameter of the ciliary sulcus, as there was a poor correlation between external WTW measurements and sulcus-to-sulcus measurements using ultrasound biomicroscopy. In fact, vertical sulcus-to-sulcus diameter was found to be longer than the horizontal sulcus-to-sulcus diameter.[31] Thus, one could argue in favor of horizontal placement of haptics for maximum intrascleral haptic length instead of vertical placement, and this is one of the limitations of the study.

There are several limitations to our study. Our follow-up period was limited, but there were no cases of any significant postoperative complications such as retinal detachment or IOL redislocation, except for one case of transient vitreous hemorrhage. Another disadvantage of this technique was that it could only be performed with 3-piece IOLs and could not be used in cases with dislocation of single-piece foldable IOLs, as the haptics were not firm enough to externalize and bury into the scleral tunnels. Also, there is a potential of breakage of haptics due to an undue stress on haptic–optic junctions of the IOL while externalizing the haptics through the sclerotomy, but this can be prevented by careful and gentle manipulation of the IOL with forceps. Although no significant IOL tilt or decentration was noted by slit-lamp examination during the postoperative follow-up period, the degree of tilt was not exactly quantified using advanced imaging modalities such as anterior segment optical coherence tomography.

In conclusion, our technique of single-stage simultaneous rescue and sutureless intrascleral haptic fixation of a dislocated IOL, using bimanual maneuver under chandelier illumination, seems to be an effective, safe, and minimally invasive surgical method to rescue and fixate the dislocated IOL without having to explant it. Further studies with more patients and longer follow-up are warranted in the near future.

Key words: dislocated IOL, IOL rescue, scleral fixation, sutureless fixation.

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