Surgical Technique

Three-point flanged optic piercing intrascleral fixation of multifocal intraocular lenses

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Purpose: To evaluate the feasibility of a three-point flanged optic piercing intrascleral fixation technique for replacing a dislocated multifocal intraocular lens (IOL). **Design:** Retrospective cross-sectional study. **Methods:** In total, 13 eyes from 13 patients with a dislocated single-piece C-loop or double C-loop diffractive multifocal IOL were enrolled to undergo dislocated multifocal IOL replacement through three-point flanged optic piercing 120 degrees apart intrascleral fixation using 7-0 polypropylene sutures at 2.5 mm posterior to the limbus. Preoperative and postoperative uncorrected distance visual acuity (UDVA), postoperative uncorrected intermediate visual acuity (UIVA) at 66 cm, uncorrected near visual acuity (UNVA) at 40 cm, residual refractive errors, and the amount of IOL decentration were evaluated. **Results:** There were six multifocal IOLs and seven multifocal toric IOLs. There was a notable improvement in visual acuity, with the mean UDVA improving from 0.79 ± 0.72 logMAR preoperatively to 0.06 ± 0.08 logMAR postoperatively ($P = 0.004$). The mean postoperative UIVA and UNVA were 0.04 ± 0.05 and 0.10 ± 0.12 logMAR, respectively. The mean residual refractive sphere, cylinder, and spherical equivalent were −0.04 ± 0.48 D, −0.29 ± 0.25 CD, and −0.18 ± 0.47 D, respectively. The mean residual cylinder was −0.25 ± 0.25 CD in eyes with multifocal toric IOL fixation. The mean amount of IOL decentration was 0.22 ± 0.05 mm. **Conclusion:** The three-point flanged optic piercing intrascleral fixation technique for dislocated multifocal IOLs could provide good distance, intermediate, and near vision alongside excellent IOL centration.

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The number of cataract surgeries is increasing annually worldwide; meanwhile, the use of multifocal intraocular lenses (IOLs) has also steadily increased.[1-3] The frequency of late in-the-bag IOL dislocation following cataract surgery ranges between 0.2% and 3%.[4,5] These dislocations most commonly occur approximately 6–12 years postoperatively. The risk factors for IOL dislocation include high myopia, pseudoexfoliation syndrome, and previous vitreoretinal surgery.[4,5] Given the growing prevalence of multifocal IOL implantations, it is reasonable to anticipate an increase in multifocal IOL dislocation cases in the near future.

Numerous ophthalmologists have made efforts to reposition dislocated multifocal IOLs through scleral fixation, aiming to restore distance vision and improve intermediate and near visual acuity.[6-10] Multifocal IOLs are available in various optic and haptic designs. Consequently, selecting an appropriate scleral fixation technique based on the configuration of the IOL design can result in satisfactory visual outcomes and positional stability.[9]

For multifocal IOLs with closed-loop haptics, the Canabrava technique can be easily employed for four-flanged fixation.[6,11] Similarly, for plate haptic multifocal IOLs, sutures can be threaded through existing holes in the haptics; where holes are absent, a needle can be used to create them, allowing for a similar four-flanged fixation approach.[8] In our previous case series, we introduced the four-flanged optic piercing technique. This surgical method involved passing two 6-0 polypropylene sutures around the optic periphery twice each to secure a dislocated single piece of multifocal IOL to the sclera.[10] Following the publication of this technique, feedback suggested a need for simplification. Consequently, we started a procedure utilizing three 7-0 polypropylene sutures, each piercing the optic periphery once at 120-degree intervals. This study aimed to delineate the surgical technique and evaluate the clinical outcomes of repositioning dislocated single-piece multifocal IOLs with C-loop or double C-loop through three-point flanged optic piercing intrascleral fixation in patients referred for the management of IOL dislocation.

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Subjects and Methods

This retrospective cross-sectional study received approval from the ethics committee. Owing to the retrospective nature of the study, focusing on the review of existing medical records, an exemption was provided by the ethics committee for the requirement for informed consent. The study strictly followed the principles in the Declaration of Helsinki for all its research and data collection efforts.

Study population

This study was a retrospective analysis of the medical records of patients who presented to our institution between September 1, 2023, and February 29, 2024, were diagnosed with dislocation of multifocal IOLs, and underwent three-point flanged optic piercing intrascleral fixation.

Preoperative examination

For each patient, thorough systemic and ocular histories were recorded, followed by preoperative eye assessments, including slit-lamp biomicroscopy, autorefraction/keratometry (KR-8100; Topcon), noncontact specular microscopy (SP-1P; Topcon), ultra-widefield fundus camera (California; Optos PLC), and optical biometry (IOLMaster 700; Carl Zeiss Meditec). Preoperative uncorrected distance visual acuity (UDVA) was evaluated at a distance of 4 m.

Surgical technique

Every surgical procedure was conducted by a single experienced surgeon (Y.E.), utilizing topical anesthesia with 0.5% proparacaine hydrochloride and pinpoint anesthesia with 2% lidocaine.[12,13] Initially, paracenteses were created at the 3 and 9 o'clock positions, followed by injecting an ophthalmic viscoelastic device into the anterior chamber. Using a toric marker, three points were noted on the limbus at 120-degree intervals [Fig. 1a]. In all cases, the limbus reference points were adjusted to ensure an equal fixation distance from the corneal apex, using the rings of the toric marker as a guide. If anterior access was possible, a Sinskey hook was used to elevate the IOL to the anterior chamber. After positioning a 7-0 polypropylene suture through the paracentesis at the 9 o'clock position, a 30-gauge needle was inserted through the sclera 2.5 mm from the limbal marking at the 1 o'clock position. While supporting the opposite optic with end-gripping forceps, a needle that penetrated the sclera at the 1 o'clock position perforated the periphery of the IOL from front to back. The lumen of the needle that pierced through the IOL optic was then docked using the 7-0 polypropylene suture [Fig. 1b]. Subsequently, the needle was withdrawn from the IOL optic and passed out of the eye through the sclera, allowing the 7-0 polypropylene suture to traverse the periphery optic of the IOL and emerge outside the sclera [Fig. 1c]. Next, a flange was created at the end of the 7-0 polypropylene suture coming out through the paracentesis at the 9 o'clock position by using high-temperature cautery. The suture just in front of the flange was flattened with forceps and bent at a 90-degree angle [Fig. 1d]. While the IOL was held in place with a Sinskey hook, the polypropylene suture emerging outside the sclera was pulled so that the flange portion was positioned at the IOL optic part [Fig. 1e]. Using the same technique, a 7-0 polypropylene suture was positioned at the 3 o'clock paracentesis. Then, penetrating the sclera with a 30-gauge needle 2.5 mm from the 9 o'clock limbus, the polypropylene suture was pierced to the optic at the 9 o'clock position and pulled out of the eye [Fig. 1f]. After positioning the 7-0 polypropylene suture at the 9 o'clock paracentesis, a 30-gauge needle was passed through the 3 o'clock paracentesis, and the 30-gauge needle was pierced through the IOL optic from back to front, while the opposite side was supported with end-gripping forceps. The lumen of the needle that had been pierced through the IOL optic was then docked alongside the 7-0 polypropylene suture. Subsequently, the needle was withdrawn from the IOL optic and passed out of the eye through the paracentesis, allowing the 7-0 polypropylene suture to traverse the periphery optic of the IOL. The end of the polypropylene suture emerging from the 3 o'clock paracentesis was turned into a flange by using high-temperature cautery, and the side next to the flange was bent with forceps. Subsequently, while the IOL was stabilized using a Sinskey hook, the suture toward the 9 o'clock paracentesis was pulled so that the flange was positioned at the optic. After positioning the end of the suture coming out from the 9 o'clock paracentesis into the anterior chamber, the sclera was penetrated with a 30-gauge needle 2.5 mm posterior to the limbus at the 5 o'clock position. Then, the suture that had entered the anterior chamber was docked into the needle's lumen and extracted from the eye through the sclera. The centration of the IOL was adjusted by sequentially creating flanges at the ends of the three polypropylene sutures that emerged outside the eye [Fig. 1f and Supplementary Video 1].

For intravitreal IOL dislocations that could not be addressed through an anterior approach, pars plana vitrectomy was performed using the Stellaris Elite® system (Bausch and Lomb). Conversely, an anterior vitrectomy was executed using the same system when the dislocation was accessible via an anterior route. In all cases, DisCoVisc (hyaluronic acid 1.65%–chondroitin sulfate 4.0%; Alcon) was used as the ophthalmic viscosurgical device, while fortified balanced salt solution (BSS PLUS, Alcon) served as the intraocular irrigating solution.

To reposition a multifocal toric IOL, marks were made on the corneal limbus preoperatively at the 3, 6, and 9 o'clock positions by using a toric reference marker with the patient sitting up and under topical anesthesia. During the surgery, the correct alignment axis for the IOL was delineated using a degree gauge and an axis marker. After making markings on the limbus at locations 60 degrees apart from the one-axis marker, scleral fixation surgery following the same technique was performed at the opposite-axis marker, with the two locations 60 degrees distant on either side [Supplementary Video 2].

Preoperative and postoperative medications

On the day of the operation, instructions were given to patients to administer 1.5% levofloxacin hydrate (Cravit®; Santen) and 1% prednisolone acetate (Pred-forte; Allergan Pharmaceutical) at 2-hour intervals, along with 0.1% bromfenac sodium hydrate (Bronuck; Taejoon Pharm.) twice daily. From the following day onward, the application schedule for 1.5% levofloxacin hydrate and 1% prednisolone acetate was altered to every 6 hours for 1 month, whereas 0.1% bromfenac sodium hydrate was applied twice daily.

Main outcomes

Measurements were conducted for the postoperative UDVA at 4 m, uncorrected intermediate visual acuity (UIVA) at 66 cm, uncorrected near visual acuity (UNVA) at 40 cm, and residual

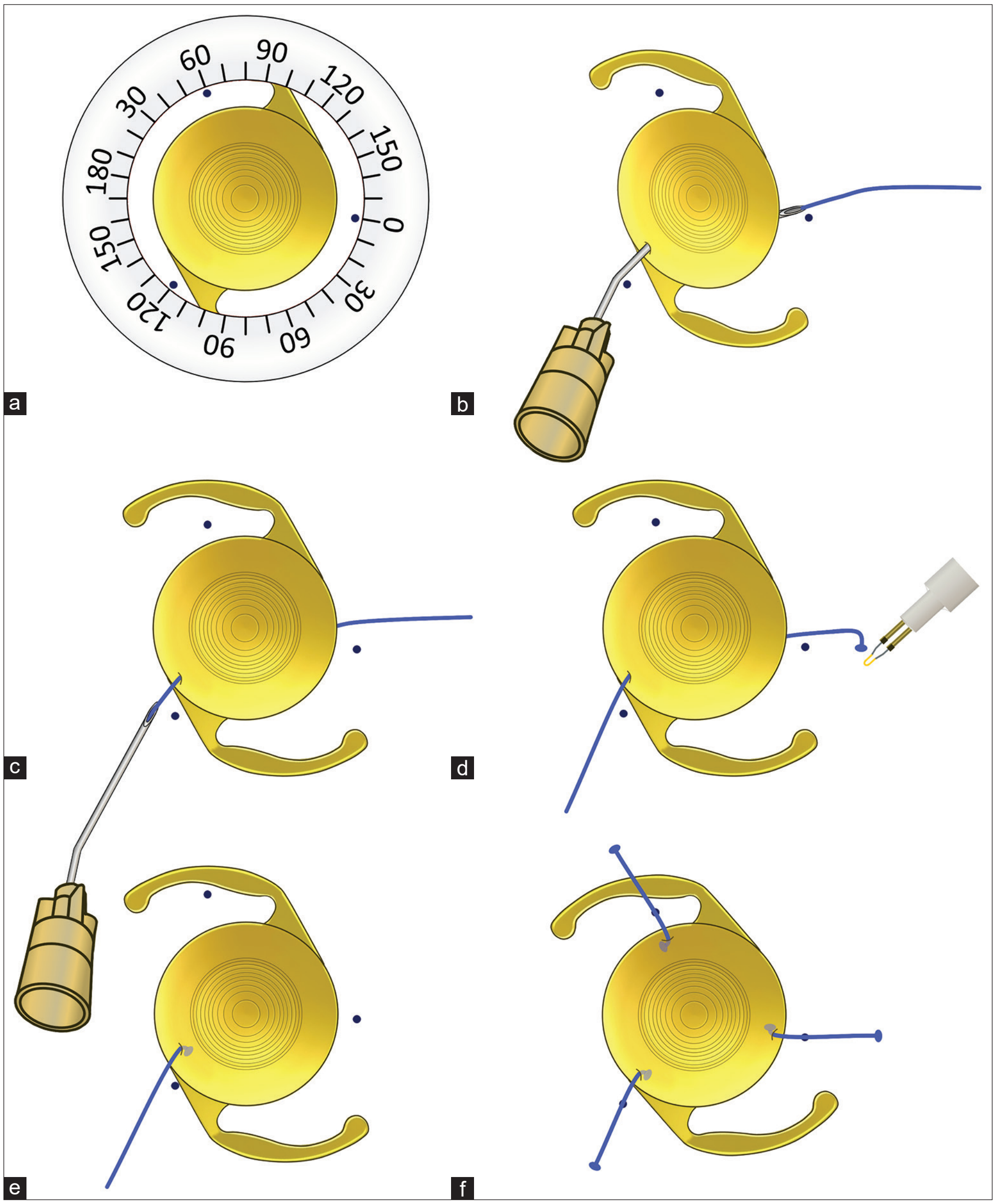

Figure 1: Three-point flanged optic piercing intrascleral fixation technique for dislocated multifocal intraocular lenses (IOLs). Three points were marked on the limbus at 120-degree intervals by using a toric marker (a). After positioning a 7-0 polypropylene suture at the 9 o'clock paracentesis, a 30-gauge needle was inserted through the sclera 2.5 mm from the limbal marking at the 1 o'clock position and pierced the periphery of the IOL optic from front to back (b). The lumen of the needle was docked with a 7-0 polypropylene suture, and the needle was withdrawn from the IOL optic and passed out of the eye (c). High-temperature cautery created a flange at the end of the 7-0 polypropylene suture at the 9 o'clock paracentesis. The suture before the flange was flattened with forceps and bent at a 90-degree angle (d). The polypropylene suture emerging outside the sclera was pulled to position the flange portion at the IOL optic (e). Using the same technique, two further 7-0 polypropylene sutures were fixed at the 9 and 5 o'clock positions. The IOL centration was adjusted by sequentially creating flanges at the ends of the three polypropylene sutures that emerge outside the eye (f)

refractive errors. If the UDVA was 20/20, no further visual acuity measurements were collected. The residual refractive errors were determined by manifest refraction, and the residual sphere, cylinder, and spherical equivalent were recorded.

The IOL centration was evaluated using anterior segment photographs [Fig. 2]. The unit of measurement in the anterior segment photographs was converted from the distance in pixels to millimeters by using the set scale tool in ImageJ software (1.53e, http://imagej.nih.gov/ij; National Institutes of Health, USA), which is based on the measurement of the IOL optic diameter.[14] Next, the distance from the optical center (geometric center of the cornea) to the center of the IOL was measured using the straight line selection tool, and this measurement was recorded as the amount of decentration.

Complications occurring during and after surgery were assessed. Additionally, postoperative endothelial cell density (ECD), coefficient of cell area variation (CV), and hexagonality were compared with preoperative measurements to evaluate the safety of the three-point flanged optic-piercing intrascleral fixation technique.

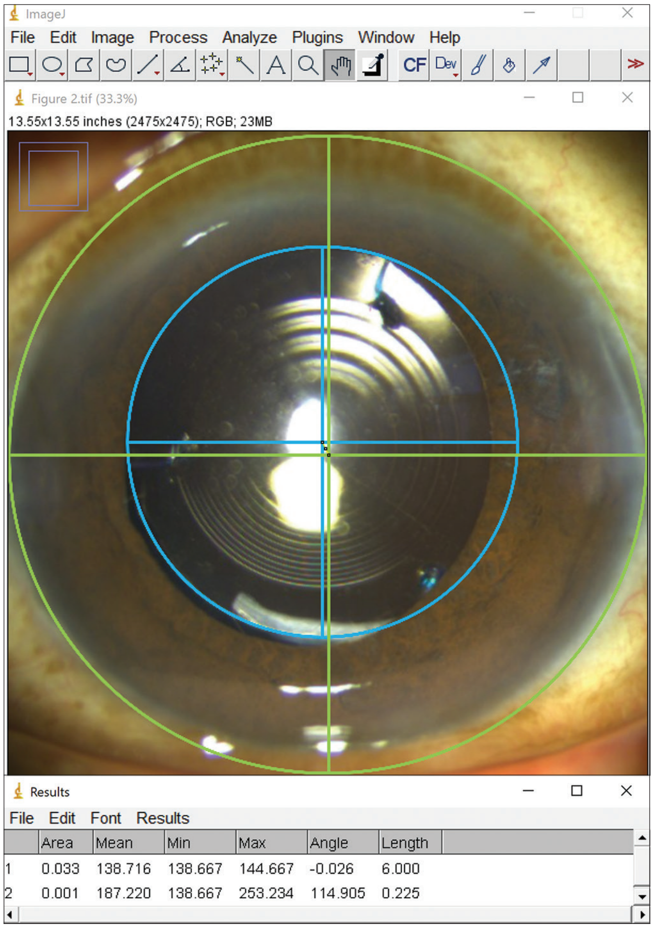

Figure 2: Measurement of the amount of decentration of intraocular lens (IOL) by using the straight line selection tool of ImageJ software (yellow line) from the optical center (green) to the center of the IOL (sky blue)

Statistical analyses

Statistical analyses were conducted using the IBM SPSS Statistics Standard version 20 software (IBM Corp.). To assess the differences between preoperative and postoperative UDVA at 4 m, ECD, CV, and hexagonality, paired *t*-tests were conducted. A *P* - value of less than 0.05 was deemed to indicate statistical significance.

Results

In total, 13 eyes from 13 consecutive patients who underwent three-point flanged optic piercing intrascleral fixation of dislocated multifocal or multifocal toric IOLs were included in this study. Of these 13 patients, 12 (92.3%) were male, and the mean ± standard deviation age was 59.5 ± 5.8 years (range: 52–68 years). This study included nine left eyes (69.2%) and four types of hydrophobic multifocal IOLs: Three cases with extended depth of focus (EDoF) IOLs (Tecnis Symfony, ZXR00; Johnson and Johnson Vision Surgical), two cases with bifocal IOLs (AcrySof IQ ReSTOR; Alcon Laboratories), and eight cases with trifocal IOLs (AcrySof IQ PanOptix; Alcon Laboratories, and FineVision; PhysIOL). The Symfony, PanOptix, and FineVision IOLs also included toric IOLs (n = 7). One patient was referred after experiencing IOL subluxation following total vitrectomy surgery for epiretinal membrane (ERM) removal, and macular edema remained after ERM surgery.

The mean time of occurrence of IOL dislocation following phacoemulsification and IOL implantation was 52.2 ± 39.8 months. The initial preoperative UDVA was 0.79 ± 0.72 logMAR. The mean post-surgery monitoring duration was 1.6 ± 0.8 months, ranging from 1 to 3 months. At the final visit, there was a significant improvement in the mean postoperative UDVA, 0.06 ± 0.08 logMAR, compared to the preoperative UDVA (*P* = 0.004). The mean UIVA at 66 cm was 0.04 ± 0.05 logMAR, and the mean UNVA at 40 cm was 0.10 ± 0.12 logMAR. Additionally, 92.3%, 100%, and 76.9% of patients achieved monocular UDVA, UIVA at 66 cm, and UNVA at 40 cm of 0.1 logMAR (equivalent to Snellen 20/25) or superior, respectively [Fig. 3]. One eye with persistent macular edema after ERM surgery had a UDVA of 0.30 logMAR. Three eyes with Symfony IOL implantation had a UNVA of 0.30 logMAR or greater.

The mean values for postoperative residual sphere, cylinder, and spherical equivalent were −0.04 ± 0.48 D, −0.29 ± 0.25 CD, and −0.18 ± 0.47 D, respectively. The mean residual cylinder was −0.25 ± 0.25 CD in eyes that underwent multifocal toric IOL scleral fixation. The mean amount of decentration was 0.22 ± 0.05 mm.

During the postoperative follow-up period, two patients experienced an increase in intraocular pressure (IOP) exceeding 25 mmHg, necessitating the use of antiglaucoma medications. The elevated IOP was successfully managed, allowing for the discontinuation of all medications within 2 weeks. There were no reported other complications, such as IOL optic capture by the pupil, cystoid macular edema, hypotony, endophthalmitis, or complaints of dysphotopsia after the IOL repositioning surgery.

The mean endothelial cell loss was 9.0%. The preoperative mean ECD measured 2476.7 ± 424.3 cells/mm², which significantly decreased postoperatively to 2253.0 ± 455.7 cells/mm² (*P* < 0.001). However, no significant differences were observed in CV or hexagonality between the preoperative (32.7 ± 4.9 and 61.1 ± 6.0%) and postoperative measurements (31.8 ± 3.3 and 57.1 ± 11.3%; *P* = 0.421 and *P* = 0.206, respectively).

Discussion

This study aimed to investigate the clinical outcomes of the three-point flanged optic piercing intrascleral fixation technique performed on dislocated multifocal IOLs or multifocal toric IOLs. The results of this study indicate that applying three-point flanged optic piercing intrascleral fixation to dislocated multifocal or multifocal toric IOLs yields excellent clinical outcomes. In this study, after surgery, the mean UDVA, UIVA, and UNVA were 0.06, 0.04, and 0.10 logMAR, respectively, even though there was one case of persistent macular edema following ERM surgery and three eyes with extended-depth-of-focus IOLs implanted. Therefore, three-point flanged optic piercing intrascleral fixation of dislocated multifocal IOLs significantly improves both distance and near vision, effectively leveraging the inherent characteristics of multifocal IOLs. Previous studies have also reported that various surgical methods for scleral fixation of dislocated multifocal IOLs provide excellent outcomes for both distance and near visual acuity.[6-10,15]

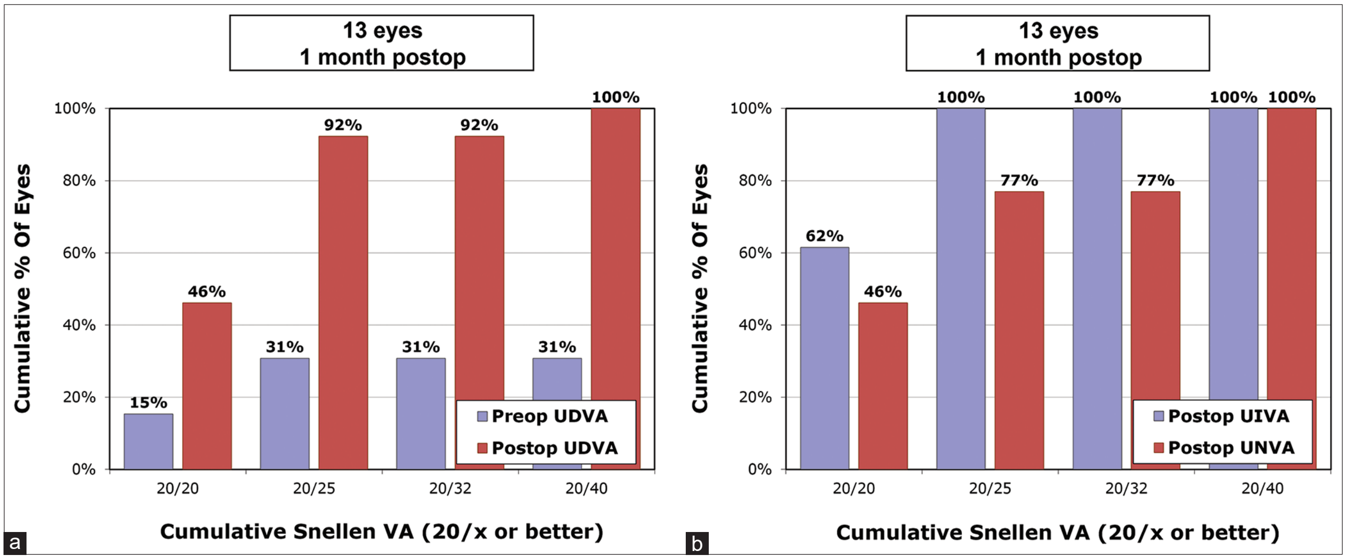

Figure 3: Distribution of preoperative and postoperative monocular uncorrected distance visual acuity (UDVA) (a), and postoperative uncorrected intermediate visual acuity (UIVA) at 66 cm and uncorrected near visual acuity (UNVA) at 40 cm (b) after three-point flanged optic piercing intrascleral fixation of dislocated multifocal or multifocal toric IOLs

Although the impact of IOL decentration can differ based on the specific design of the multifocal IOL, it has been reported that IOL scleral fixation exhibits greater postoperative tilt and decentration compared to those positioned in the bag.[16-19] In this study, the surgical technique applied involved scleral fixation of the IOL at three points spaced 120 degrees apart, located 2.5 mm posterior to the surgical limbus. The limbus reference points were adjusted using the rings of the toric marker as a guide to ensure an equal distance from the corneal apex. Similar to how a tripod provides a very stable structure, the method of fixation at three evenly spaced points used in this technique might also be sturdy and stable. Moreover, fixing the IOL at three points equidistant from the limbus, based on the corrected limbal reference positions, appears to reduce the possibility of IOL tilt significantly. Although this study did not evaluate IOL tilt by using imaging techniques such as anterior-segment optical coherence tomography, no noticeable IOL tilt was observed during slit-lamp microscope examination.

Zonular weakness during cataract surgery presents significant challenges, and the choices between using a capsular tension ring (CTR), suture of scleral fixated capsular tension segments, or performing intracapsular cataract extraction with scleral fixation of an IOL depends largely on the extent of zonular dehiscence.[20-22] CTR implantation is generally recommended for cases with mild-to-moderate zonular weakness involving less than 3 to 4 clock hours. The presence of pseudoexfoliation syndrome and phacodonesis can be relative contraindications for premium IOLs.[23] However, implanting a CTR helps maintain the stability and centration of the capsular bag and the IOL, especially in preventing tilt and subluxation of the premium IOL in cases with specific ocular comorbidities, such as pseudoexfoliation syndrome.[20,24-26]

For toric IOLs, positioning the IOL at the correct axis is crucial. While placing a toric IOL in the bag can easily achieve the targeted axis, postoperative IOL rotation can diminish the effectiveness of correcting astigmatism in toric IOLs.[27,28] Conversely, while scleral fixation of a toric IOL might eliminate postoperative IOL rotation, positioning the IOL accurately at the precise axis can be challenging. Therefore, scleral fixation was performed in this study at one toric axis mark, with two additional fixations symmetrically made, each 60 degrees apart from the opposite toric axis mark, to fix a multifocal toric IOL accurately at the targeted axis [Supplementary Video 2]. The average postoperative residual astigmatism for all patients in this study was −0.29 CD, and specifically for the seven eyes that underwent scleral fixation of multifocal toric IOLs, the residual astigmatism was also −0.25 CD. This demonstrates that the surgical method in this study is an effective approach for the scleral fixation of multifocal toric IOLs.

Piercing the peripheral optic may disrupt the optical radius of curvature and refractive index of the IOL. However, no differences were observed in our previous study for the modulation transfer function between IOLs with and without peripheral optic piercing four times via optical bench testing. The three-point piercing technique used in this study pierces fewer times than the previous technique, where the IOL was pierced four times. The mean postoperative spherical equivalent was −0.18 ± 0.47 D, which is nearly ideal for postoperative refraction. Thus, the effect of peripheral optic piercing on the optical radius of curvature and refractive index of the IOL might be minimal.

In this case series, no patients complained of dysphotopsia after the IOL repositioning surgery. One of the reasons for the absence of dysphotopsia complaints is that most patients may have experienced severe dysphotopsia due to IOL dislocation before the IOL repositioning. Thus, after the repositioning, all patients achieved good centration of the IOL (mean amount of decentration: 0.22 ± 0.05 mm), likely resulting in a dramatic decrease in dysphotopsia. Therefore, it appears that no patients complained of dysphotopsia.

In this study, although ECD significantly decreased following IOL repositioning surgery using the three-point flanged optic-piercing intrascleral fixation technique, the mean endothelial cell loss was 9.0% at an average of 1.6 months post-surgery. This rate is comparable to the observed mean endothelial cell loss of 6%–14% three months after phacoemulsification.[29-32] Moreover, no significant changes in CV and hexagonality were observed after surgery compared to the preoperative values.

In the surgical technique utilized in this study, 7-0 polypropylene sutures were applied such that one end was passed through the IOL optic and subsequently fashioned into a flange to prevent it from slipping out of the IOL optic. The other end of the 7-0 polypropylene suture was passed through the sclera to emerge outside the eye, where a flange was created at the end to ensure fixation to the eye. Notably, the flange attached to the IOL optic was positioned behind the IOL to avert the risk of pigment dispersion syndrome, which could result from the flange being located in front of the IOL and causing iris chafing. Additionally, the suture was bent at a 90-degree angle adjacent to the end flange to align the horizontal orientation of the 7-0 polypropylene suture as closely as possible with the IOL plane, thereby aiming to improve IOL stability. Conversely, a long-term safety evaluation is imperative because the external flange was covered solely by the conjunctiva and/or Tenon's capsule. Although the majority of cases involving flanged scleral fixation did not exhibit any significant postoperative complications,[6,7,10,33] there have been reports of infections attributed to flange exposure.[34] A previous study with a 5-year follow-up on flanged scleral fixation showed flange-related complications, particularly in eyes with short scleral tunnels and cases where the flange was not embedded within the sclera.[11] In the surgical method used in this study, the surgeon gently presses each flange head with the cannula tip and observes the IOL moving away from the flange to verify that sufficient tension is applied and to prevent the flange head from extruding. This indicates that the tension is sufficient to keep the flange head slightly buried in the sclera without causing extrusion. Moreover, no conjunctival erosion or endophthalmitis cases were encountered throughout the practice of this flange technique.

Surgeons already familiar with the Canabrava flanged fixation technique will likely adapt quickly to the three-point flanged optic piercing fixation method presented in this study without requiring a significant learning curve. The only additional necessary skill involves becoming accustomed to using a needle to pierce the peripheral optic at a perpendicular angle, which should be manageable for anterior-segment surgeons. Indeed, the author who developed this technique could successfully pierce the peripheral IOL on the first attempt without difficulty. Furthermore, it is crucial to maintain equal tension across the three Prolene sutures to ensure proper centration of the IOL. Surgeons experienced in centering the IOL using the Canabrava flanged fixation technique should also find this step manageable. Therefore, it may be beneficial to become proficient in the Canabrava flanged fixation technique first to minimize potential complications when initially adopting the three-point fixation method.

A previous study that conducted biomechanical testing to ascertain the safety of scleral fixation concerning the thickness of polypropylene sutures showed that an increase in the thickness of the polypropylene suture correlates with a proportional increase in breaking force.[35] Additionally, it was reported that the diameter of the flange created by flange melting increases with a larger gauge and greater amount of melting. Notably, in that study, the disinsertion force of the flange created by melting the last 1 mm of a 7-0 polypropylene suture was found to be comparable to the breaking force of a 9-0 polypropylene suture, suggesting its safe clinical use. In contrast, the disinsertion force of an 8-0 polypropylene suture was weaker than the breaking force of a 9-0 polypropylene suture, raising concerns about its long-term stability.[35] Therefore, this study utilized the 7-0 polypropylene suture, which is as thin as possible while ensuring long-term stability, to maintain safe postoperative outcomes with minimal impact from the optic piercing.

Several limitations are noted in this study. First, the number of eyes included in this study was small, and the study was retrospective. Therefore, the small sample size limits the generalizability of the findings. Although there are currently few cases of multifocal IOL dislocation, follow-up studies are expected to validate the surgical method proposed in this paper further, as such cases are anticipated to increase in the near future. Second, due to the short postoperative follow-up duration in this study, an evaluation of the long-term safety of the flange covered by the conjunctiva and/or Tenon's capsule and the flange affixed to the IOL optic was not conducted. Therefore, larger prospective comparative studies using the Canabrava technique and applying a longer follow-up period are needed to corroborate the enduring safety and clinical efficacy of the three-point flanged optic piercing intrascleral fixation technique for dislocated multifocal IOLs in a larger patient population.

In conclusion, the three-point flanged optic piercing intrascleral fixation technique utilized in this study for the scleral fixation of dislocated multifocal and multifocal toric IOL not only provides good distance, intermediate, and near vision but also delivers excellent IOL centration postoperatively through securing the IOL at three scleral points. With the increasing use of multifocal IOLs, the incidence of multifocal IOL dislocations is expected to increase; thus, this three-point flanged optic piercing intrascleral fixation technique could serve as a valuable method for salvaging dislocated multifocal IOLs.

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Conflicts of interest: There are no conflicts of interest.

References

1. Erie EA, Hodge DO, Mahr MA. Prevalence of pseudophakia: U.S. population-based study. J Cataract Refract Surg 2022;48:717-22.
2. Gollogly HE, Hodge DO, St Sauver JL, Erie JC. Increasing incidence

of cataract surgery: Population-based study. J Cataract Refract Surg 2013;39:1383-9.

3. Rho CR, Kim JH, Chung IK, Kim EC, Han YK, Han SY, *et al*. Cataract surgery practice in the Republic of Korea: A Survey of the Korean Society of Cataract and Refractive Surgery 2020. Korean J Ophthalmol 2021;35:272-9.
4. Kristianslund O, Dalby M, Drolsum L. Late in-the-bag intraocular lens dislocation. J Cataract Refract Surg 2021;47:942-54.
5. Gimbel HV, Condon GP, Kohnen T, Olson RJ, Halkiadakis I. Late in-the-bag intraocular lens dislocation: Incidence, prevention, and management. J Cataract Refract Surg 2005;31:2193-204.
6. Whang WJ, Kwon H, Jeon S. Application of a four-flanged intrascleral fixation technique for toric and multifocal intraocular lenses. Am J Ophthalmol Case Rep 2020;20:100933.
7. Eom Y, Lee YJ, Park SY, Choi Y, Kim JW, Kim SJ, *et al*. Cable tie technique for securing scleral fixation suture to intraocular lens. Am J Ophthalmol Case Rep 2022;27:101646.
8. Wang Y, Zhou L, Bao X, Peng T, Lei R, Ortega-Usobiaga J. Four-point flange intrascleral fixation with double suture through the dislocated plate-haptic trifocal intraocular lens. Am J Ophthalmol 2023;255:68-73.
9. Park SY, Eom Y, Lee YJ, Choi Y, Kim SJ, Song JS, *et al*. Scleral fixation of subluxated or dislocated multifocal and multifocal toric intraocular lenses. Graefes Arch Clin Exp Ophthalmol 2022;260:1195-203.
10. Eom Y, Koh E, Yang SK, Kim S, Yi S, Jeon HS, *et al*. Four-flanged polypropylene optic piercing technique for scleral fixation of multifocal intraocular lens. BMC Ophthalmol 2023;23:392.
11. Canabrava S, Carvalho MS. Double-flanged polypropylene technique: 5-year results. J Cataract Refract Surg 2023;49:565-70.
12. Fukasaku H, Macron JA. Pinpoint anesthesia: A new approach to local ocular anesthesia. J Cataract Refract Surg 1994;20:468-71.
13. Fukasaku H, Marron JA. Sub-Tenon's pinpoint anesthesia. J Cataract Refract Surg 1994;20:673.
14. Eom Y, Lee JS, Rhim JW, Kang SY, Song JS, Kim HM. A simple method to shorten the unfolding time of prehydrated hydrophobic intraocular lens. Can J Ophthalmol 2014;49:382-7.
15. Ton Y, Naftali M, Lapid-Gortzak R, Assia EI. Management of subluxated capsular bag-fixated intraocular lenses using a capsular anchor. J Cataract Refract Surg 2016;42:653-8.
16. Soda M, Yaguchi S. Effect of decentration on the optical performance in multifocal intraocular lenses. Ophthalmologica 2012;227:197-204.
17. Ortiz C, Esteve-Taboada JJ, Belda-Salmerón L, Monsálvez-Romín D, Domínguez-Vicent A. Effect of decentration on the optical quality of two intraocular lenses. Optom Vis Sci 2016;93:1552-9.
18. Hayashi K, Hayashi H, Nakao F, Hayashi F. Intraocular lens tilt and decentration, anterior chamber depth, and refractive error after trans-scleral suture fixation surgery. Ophthalmology 1999;106:878-82.
19. Liu X, Xie L, Huang Y. Effects of decentration and tilt at different orientations on the optical performance of a rotationally asymmetric multifocal intraocular lens. J Cataract Refract Surg 2019;45:507-14.
20. Paritekar P, Haldipurkar S, Shetty V. Nothing is impossible if you have the right tools and techniques to support. Indian J Ophthalmol 2023;71:3270-1.
21. Venkateswaran N, Henderson BA. Loose zonules in cataract surgery. Curr Opin Ophthalmol 2022;33:53-7.
22. Cionni RJ, Osher RH. Management of profound zonular dialysis or weakness with a new endocapsular ring designed for scleral fixation. J Cataract Refract Surg 1998;24:1299-306.
23. Braga-Mele R, Chang D, Dewey S, Foster G, Henderson BA, Hill W, *et al*. Multifocal intraocular lenses: Relative indications and contraindications for implantation. J Cataract Refract Surg 2014;40:313-22.
24. Fontana L, Coassin M, Iovieno A, Moramarco A, Cimino L. Cataract surgery in patients with pseudoex-foliation syndrome: Current updates. Clin Ophthalmol 2017;11:1377-83.
25. Bayraktar S, Altan T, Küçüksümer Y, Yilmaz OF. Capsular tension ring implantation after capsulorhexis in phacoemulsification of cataracts associated with pseudoexfoliation syndrome. Intraoperative complications and early postoperative findings. J Cataract Refract Surg 2001;27:1620-8.
26. Miyoshi T, Fujie S, Yoshida H, Iwamoto H, Tsukamoto H, Oshika T. Effects of capsular tension ring on surgical outcomes of premium intraocular lens in patients with suspected zonular weakness. PLoS One 2020;15:e0228999.
27. Raucau M, El Chehab H, Agard E, Lagenaite C, Dot C. Toric lens implantation in cataract surgery: Automated versus manual horizontal axis marking, analysis of 50 cases. J Fr Ophtalmol 2018;41:e1-9.
28. Wang Y, Lou X, Qian S, Li Y, Wu X, Li S, *et al*. Comparison of the effect of capsular bend on the rotational stability between 2 toric intraocular lenses. J Cataract Refract Surg 2024;50:283-8.
29. Baradaran-Rafii A, Rahmati-Kamel M, Eslani M, Kiavash V, Karimian F. Effect of hydrodynamic parameters on corneal endothelial cell loss after phacoemulsification. J Cataract Refract Surg 2009;35:732-7.
30. Bourne RR, Minassian DC, Dart JK, Rosen P, Kaushal S, Wingate N. Effect of cataract surgery on the corneal endothelium: Modern phacoemulsification compared with extracapsular cataract surgery. Ophthalmology 2004;111:679-85.
31. Faramarzi A, Javadi MA, Karimian F, Jafarinasab MR, Baradaran-Rafii A, Jafari F, *et al*. Corneal endothelial cell loss during phacoemulsification: Bevel-up versus bevel-down phaco tip. J Cataract Refract Surg 2011;37:1971-6.
32. Eom Y, Kim SW, Ahn J, Kim JT, Huh K. Comparison of cornea endothelial cell counts after combined phacovitrectomy versus pars plana vitrectomy with fragmentation. Graefes Arch Clin Exp Ophthalmol 2013;251:2187-93.
33. Assia EI, Wong JXH. Adjustable 6-0 polypropylene flanged technique for scleral fixation, part 1: Primary fixation IOLs in aphakia, capsular stabilizing devices, and aniridia implants. J Cataract Refract Surg 2020;46:1387-91.
34. Roditi E, Brosh K, Assayag E, Weill Y, Zadok D. Endophtalmitis associated with flange exposure after a 4-flanged canabrava fixation techique. JCRS Online Case Reports 2021;9:e00042.
35. Yuan A, Ma K, Sharifi S, Pineda R. Biomechanical Testing of Flanged Polypropylene Sutures in Scleral Fixation. Am J Ophthalmol 2021;230:134-42.