

CASE REPORT

Intraocular Lens (IOL) Exchange Procedure in Refractive Surprise After Ten Years of Cataract Surgery

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**Abstract**

Introduction: Postoperative refractive surprises may manifest following cataract surgery. A residual refraction difference of > 2.0 D after cataract surgery was considered a refractive surprise. Treating refractive error after cataract surgery includes non-surgical and surgical options. The objective is to report clinical outcomes of intraocular lens (IOL) exchange with ciliary sulcus placement technique to manage refractive surprise. **Case Presentation:** A female patient aged 70 years reported experiencing blurred vision in her right eye (RE) for the past two years. History of RE cataract surgery ten years ago, however, she only had control 1-2 times after surgery. After that, the patient underwent cataract surgery on the left eye (LE), and then she complained that her RE was getting blurry. Her RE's visual acuity (VA) was 1/60 with best corrected visual acuity (BCVA) S-8.00 C-1.00 X100° to 6/10, and her LE was 7/10 with BCVA C-0.75 X60° to 10/10. The anterior segment examination of the RE was a 3-piece sulcus intraocular lens with complete continuous curvilinear capsulorhexis (CCC) intact anterior capsule, posterior capsule rupture, and the LE was in the bag IOL. Ultrasound examination of the RE revealed posterior staphyloma. She was diagnosed with OD refractive surprise, pseudophakia, posterior staphyloma, and OS pseudophakia. She underwent IOL exchange surgery on her RE. Post-operatively, the visual acuity of the RE was 7/45 using the Snellen chart. Three months post-op, the BCVA of RE was 10/10. **Conclusions:** In well-prepared cataract surgery, unexpected refractive outcomes such as a refractive surprise can be prevented. IOL exchange with ciliary sulcus placement technique is a treatment option for refractive surprise associated with posterior capsule rupture, and it has a good outcome.

Keywords: refractive surprise, intraocular lens (IOL) exchange, cataract surgery, posterior staphyloma

Introduction

Intraocular lens (IOL) implantation in cataract surgery has become the preferred way to treat cataracts in ophthalmology. The IOL implantation in cataract extraction is a surgical procedure that improves visual acuity with a high success rate. The refractive cataract surgeon seeks to maximize uncorrected visual acuity, aiming to reduce the need for glasses and enhance patients' quality of life and productivity.^[1]

The ability to achieve reliable refractive results indicates the effectiveness of cataract surgery and the IOL. In some cases, the final result of the refractive error may be different from the preoperative target, which is called a refractive surprise. The prevalence of refractive surprise in the European registry of quality outcome for cataract and refractive surgery (EUREQUO) 2014 is 2.501 or 1.8% of the 142.572 cases.^[2] Approximately 20% of these errors were significantly large, with 433 cases (0.4%) of 4.0 D or more and 40 cases (0.03%) of 10.0 D or more.^[2] Refractive surprise following cataract surgery can be caused by biometric measurement errors, which are the most common, incorrect selection of IOL formula and IOL power, and inaccurate estimation of IOL position due to implantation.^[3]

Options for treating refractive error after cataract surgery include eyeglasses or contact lenses. However, a refractive surprise with a high refractive error is

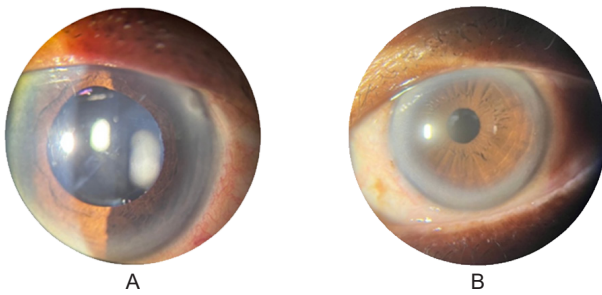


Figure 1. The examination of the anterior segment; (A) The examination revealed a mid-dilated pupil in the right eye, 3-pieces sulcus intraocular lens with complete CCC intact anterior capsule, posterior capsule rupture; and (B) The left eye showed in the bag intraocular lens.

uncomfortable for the surgeon and patient, so surgical treatment is preferred. Surgical options to correct refractive surprise includes piggyback IOL, IOL exchange, and laser in situ keratomileusis (LASIK).^[4] This case report discusses selecting IOL exchange as an alternative treatment for refractive surprise.

Case Presentation

A female patient aged 70 years came to the Undaan Eye Hospital with blurred vision in her right eye (RE) as the chief complaint. The blurred vision has persisted over the last two years. Blurred vision is felt when the patient looks far away and tends to squint her eyes. Complaints are not accompanied by red eye, watery, itchy, or pain. The patient underwent cataract surgery on their RE a decade ago at the Undaan Eye Hospital, Surabaya, Indonesia; however, the patient only had control 1-2 times after surgery because she felt her vision was clear and there were no more complaints. After cataract surgery on the left eye (LE), the patient complained that her RE was getting blurry. The patient had a history of hypertension and was treated with amlodipine 10 mg. History of type 2 diabetes mellitus (DM), asthma, and heart disease was denied. The patient has no previous history of wearing glasses.

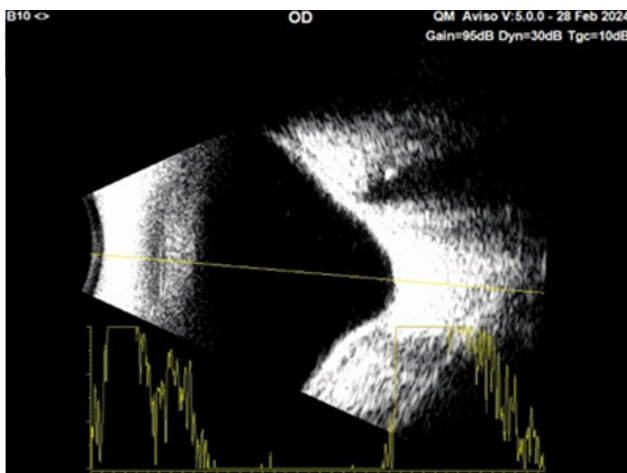


Figure 2. Ultrasonography (USG) of the RE showed posterior staphyloma.

An ophthalmic examination unveiled that her RE's uncorrected visual acuity (UCVA) was measured as 1/60. Best corrected visual acuity (BCVA) with S-8.00 C-1.00 X100° to 6/10. Her LE's UCVA was measured at 7/10. BCVA with C-0.75 X60° to 10/10. Intraocular pressure (IOP) assessed via noncontact tonometry (NCT) was 20 mmHg in her RE and 18 mmHg in her LE. The anterior segment evaluation of both eyes was clear cornea, deep anterior chamber, negative flare or cell, round pupil, 3-piece sulcus intraocular lens with complete continuous curvilinear capsulorhexis (CCC) intact anterior capsule, posterior capsule rupture in her RE, and IOL in her LE (Figure 1). The examination of both eyes at the posterior segment was a round optic disc, and the RE's cup and disc ratio (CDR) was 0.3 without glaucomatous optic neuropathy (GON).

The patient was diagnosed with OD refractive surprise, pseudophakia, posterior staphyloma, and OS pseudophakia (Figure 2). Specular microscope examination obtained the RE's cell density was 2.602 cells/mm², and the LE's density was 2.556 cells/mm². In the preoperative assessment, optical biometry was performed with IOL master 700, and the RE's axial length (AL) measured 27.69 mm, while the LE measured 24.35 mm. There was a 3.34 mm difference in the AL of both eyes, a repeat biometric examination was performed for confirmation. The second biometric examination using immersion biometry with Quantel Medical-Axis Nano V.2.00 shows that the RE's AL measured 27.38 mm, while the LE measured 24.06 mm. The third biometric examination using optical biometry with IOL master 700 shows that the RE's AL is 27.70 mm, while the LE is 24.24 mm. Lens measurement using the third biometry, the SRK/T formula, with a target emmetropia of +10.0 diopters, A constant of 118.40. The patient will be managed with IOL exchange OD implantation with polymethyl methacrylate (PMMA) IOL in the ciliary sulcus.

The surgery was successful, and no complications were encountered (Figure 3). A day after the surgery, the visual acuity of the RE was 6/45 using the Snellen chart, and the IOP was 23.1 mmHg using NCT. On examination of the RE's anterior segment (Figure 4A), there is a ciliary injection in the bulbar conjunctiva, clear cornea with three impermeable sutures, deep anterior chamber, and positive air bubble, IOL fix in the sulcus. One week post-surgery (Figure 4B), BCVA was 5/10, and the IOP was 17 mmHg on the RE. Three weeks post-surgery (Figure 4C), The BCVA was 8/10, and the IOP was 19.6 mmHg on the RE. One-half months post-surgery, the BCVA was 7/10, and the IOP increased to 23.1 using a Schiottz tonometer; then, the patient was treated with timol eye drops 2 x 1 OD and evaluation after one month. After three months post-surgery, the BCVA was 10/10, and the IOP had normalized to 17 mmHg using NCT.

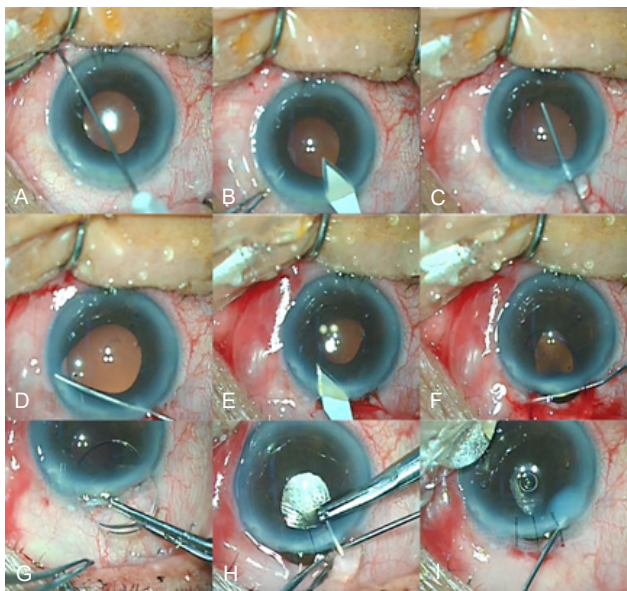


Figure 3. The IOL exchange procedure with ciliary sulcus placement technique; (A) IOL exchange was performed under sub tenon anesthesia; (B) Use a keratome to make a 2.75mm incision in the cornea; (C) Anterior chamber is filled with ophthalmic viscosurgical device (OVD); (D) Using an iris spatula, trace the iris; (E) The corneal incision is widened to remove the old IOL; (F) Explantation of three pieces IOL; (G) The PPMA 6 mm optic IOL with overall length 13 mm were implanted using the ciliary sulcus placement technique; (H) Hechting cornea with 10-0 nylon; and (I) Hydration of wound edges.

Discussion and conclusions

Refractive surprise is a refractive error that does not match the target refraction after cataract surgery where the spherical equivalent (SE) value is more than 2D. The goal in most target refractive outcome post cataract surgery is emmetropia. Emmetropia has spherical equivalent -0.5 to $+0.5$ D and <1.0 D astigmatism.^[5] Meanwhile, this patient had residual refraction after cataract surgery of -8.00 D in the RE post-cataract surgery.

Post-cataract surgery refractive surprise can be caused by preoperative, operative, and postoperative causes. Preoperative causes incorrect estimation of preoperative AL measurement, inaccurate estimation of IOL position, inadequate selection of formula and IOL power, and inadequate precision in IOL manufacturing. Surgical factors contributing to this are variations in the size and central position of the capsulorhexis during surgery, which may affect the final position of the IOL inside the eye's bag and are influenced by the technique used by the surgeon. Refractive surprise following cataract surgery may result from surgically induced astigmatism (SIA). After surgery, potential causes may arise during the healing process, such as anterior displacement of the IOL due to fibrosis and contraction of the capsular bag.^{[4],[6]}

In this patient, the biometric measurement error and inappropriate IOL power selection may have been due to a history of cataract surgery ten years ago, however, the medical record data for those ten years could not be found, so the IOL size data and formula used could not be

unknown. The cause of the biometric error in this case occurred due to posterior staphyloma.

Posterior staphyloma refers to the protrusion of the posterior wall of the eye globe. A higher risk of developing posterior staphyloma occurs in patients who have pathologic myopia. Pathologic myopia is an extreme elongation of the eyeball, often linked with myopia, causing structural alterations in the eye's posterior segment.^[7] Approximately 50% of patients affected by pathologic myopia are reported to have a staphyloma, a condition that can affect AL. So, the longer AL increases the prevalence of posterior staphyloma.^[8]

The AL is the most critical IOL calculation factor. AL is the distance between the anterior surface of the cornea and the fovea. A 1 mm error in AL measurement outcome indicates an average eye's refractive error of approximately 2.5 D.^[9] Reassessing the evaluation where there was a significant difference in AL between both eyes (> 0.3 mm), $AL < 22.00$ mm or $AL > 25.00$ mm should be considered by the surgeon. AL measurement should be routinely conducted in both eyes before cataract surgery to validate the accuracy of AL assessment further.^[10] In this case, the biometric examination was repeated three times.

The refractive surprise can be managed conservatively or surgically. If conservative management, use glasses or contact lenses. There are two types of surgery: corneal-based or keratorefractive surgery, i.e., LASIK, and lens-based surgery (piggyback IOLs and IOL exchange).^[11] This patient is not recommended to wear glasses due to the significant difference in spherical equivalent between the two eyes, which may cause the patient to become dizzy. When using glasses, the spherical equivalent correction is < 3.00 D. Contact lenses are also not recommended, considering that the patient is elderly, so the risk of infection and dry eye may increase.

LASIK can be performed with a minimum corneal thickness of 500 μ m, the minimum target remaining stromal layer is 300 μ m. Thus, LASIK can be performed

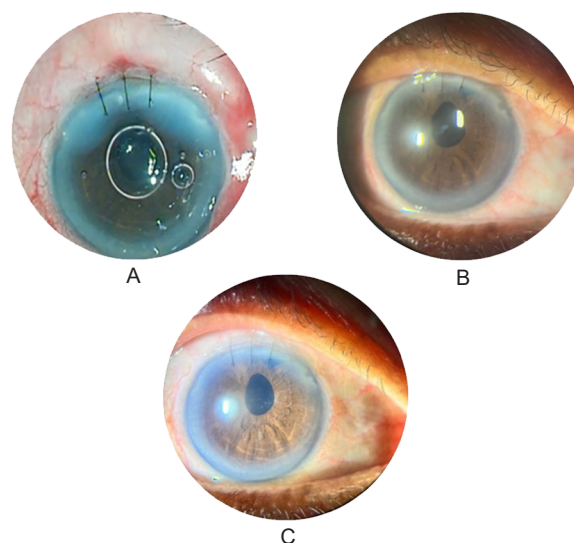


Figure 4. Patient's condition post-surgery RE, (A) Day one; (B) One week; and (C) Three week.

depending on corneal thickness. In addition, the LASIK procedure requires specialized equipment and an experienced surgeon.^[12] LASIK is expensive, and the side effects of dry eye may increase with age, so it is not the right choice for this patient.

Lens-based surgery, including piggyback IOL implantation or IOL exchange, is favored over corneal-based surgery like LASIK due to numerous advantages. Lens-based surgery can effectively address high degrees of spherical error in cases of significant postoperative refractive surprise, as it is a lens-based procedure. Lens-based procedures do not alter the cornea's refractive power, as they do not affect corneal surgery. The previous cataract wound can be reopened and utilized for the implantation of IOL shortly after the initial surgery, which is helpful for surgeons without an excimer laser in their setup.^{[4],[6]}

Piggyback IOL is the placement of an additional IOL in the sulcus of the ciliary body above the first intraocular lens (in the bag). It aims to place two IOLs in posterior chambers. This method does not require previous axial length and IOL power information; secondary IOL implantation is reversible.^[13] However, one of the complications that can occur with this technique is intralenticular opacification (ILO). ILO refers to opacities between two IOLs, primarily caused by the persistence of regenerative cortical material, like posterior capsular opacification. This membrane cannot be removed using the yttrium aluminum garnet (YAG) laser, which requires IOL exchange for treatment. Piggyback IOLs can also make the anterior chamber shallow, injuring the iris and increasing the risk of secondary glaucoma.^[14]

In this patient, piggy bag IOL could not be performed because the posterior capsule ruptured, and the primary IOL was located in the sulcus. In addition, the piggy bag IOL requires a special type of IOL, which is unavailable at this hospital. So, IOL exchange is the right choice for patient.

The IOL exchange procedure is frequently performed in cases of refractive surprise.^[15] A study by Patel et al.^[15] found that IOL exchange due to refractive surprise was 3.9%. Ideally, IOL exchange should be performed in the early postoperative period (within four months) before fibrosis capsular occurs. However, Roeloffs and Rudnisky's^[16] case said that IOL exchange can still be performed 13 years postoperative lens extraction. Several techniques can perform IOL exchange procedures. Although the choice of in-bag IOL techniques is still superior in terms of safety when possible, one of the most common techniques is ciliary sulcus placement.^[15] In this patient, an IOL exchange procedure with a ciliary sulcus placement technique was performed due to posterior capsular rupture with the intact anterior capsule.

IOL exchange is a beneficial therapeutic option when appropriate; IOL exchange demonstrated a significant improvement in uncorrected technique; more than 75% of the eyes that underwent the procedure resulted

in a refractive outcome that was within 1 D of the preoperative target refraction. Several smaller studies have reported comparable refractive outcome rates after IOL exchange. Five weeks after surgery, 67.9% of the 128 eyes that underwent IOL exchange achieved their target refraction. A study with a comparable design, with 22 eyes undergoing IOL exchange, revealed that 86% of the eyes attained postoperative refraction within ± 1.0 D of the target. Additionally, a significant improvement in uncorrected visual acuity (UCVA) of 20/40 or better was noted in 95% of the eyes.^[15]

The limitation of this study is that there is no data on previous operations ten years ago due to the destruction of medical records following the Indonesia Ministry of Health regulations. In conclusion, the refractive surprise is a condition that can be avoided with adequately prepared cataract surgery. Before the preparation of a patient with suspected high myopia, the surgeon should re-evaluate the biometry and perform a USG examination to rule out the presence of staphyloma. Refractive surprise associated with posterior capsule rupture can be treated with IOL exchange with ciliary sulcus placement, which has been shown to have a good outcome.

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