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Insights in managing refractive surprise after cataract surgery: A case series

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Case Report

ABSTRACT

Improvements in cataract surgery techniques and intraocular lens (IOL) calculations have raised patient expectations for precise visual outcomes. Refractive surprise occurs when the post-operative refractive outcome differs from the intended target, leading to unexpected visual outcomes. Secondary piggyback IOL implantation and IOL exchange are techniques to correct the refractive surprise. We presented some case series of refractive surprise after cataract surgery. Case I was A 55-year-old woman presented with the complaint of blurred vision in her left eye after cataract surgery ten months before. The visual acuity was 0.125 in the right eye (RE) and 0.05 in the left eye (LE). The best-corrected visual acuity of the left eye was 0.63 with a refraction of S+6.00 C-0.50 × 20°. She was diagnosed with hyperopic surprise in the left eye and pseudophakia in both eyes. The piggyback intraocular lens implantation procedure was chosen to correct the refractive surprise. Case II was A 72-year-old man presented with the complaint of blurred vision in his right eye after cataract surgery five years before. The visual acuity was 1/60 in his right eye and 0.16 in his left eye. The best-corrected visual acuity of the right eye was 0.4 with a refraction of S-14.00 C-1.50 × 125°. He was diagnosed with myopic surprise in his RE. The IOL exchange to scleral fixation with the Yamane technique implantation procedure was chosen to correct the refractive surprise. Piggyback IOL implantation and IOL exchange are proven, safe, and effective methods for correcting refractive surprises following cataract surgery.

INTRODUCTION

Cataracts are the leading cause of blindness worldwide, but this can be prevented through cataract surgery to optimize visual function and enhance quality of life.[1] Despite advancements in IOL power calculations and surgical techniques, residual refractive errors and refractive surprises may still occur, potentially causing dissatisfaction for both patients and physicians.[2]

Refractive surprise, defined as a deviation of more than ±1.00 dioptre from the expected postoperative refractive target, can result from biometric inaccuracies, incorrect lens power selection, or improper lens positioning.[3] Management options for postoperative refractive errors include glasses, contact lenses, IOL exchange, piggyback IOL implantation, and keratorefractive procedures.[4] The IOL exchange is recommended for significant refractive errors, while piggyback IOL implantation offers a safer and simpler alternative.[5,6]

Pre-, intra-, and post-operative factors can cause refractive surprise. The most common cause of refractive surprise is preoperative measurement error.[7] Accurate preoperative examination is needed to achieve the best visual acuity after cataract surgery.[8] Preoperative factors that can increase the risk of refractive surprise are the condition of the ocular surface with corneal irregularities, biometric measurement errors, IOL power selection errors, and postoperative IOL position estimation errors.[9] Patients with high ametropia have a higher tendency to experience residual refractive errors, due to limitations in calculating the IOL formula and the inaccuracy of making IOL in certain conditions. Intraoperative factors consist of surgical technique, zonular stability, aberrometry, and lens position. Postoperative factors include refraction technique, IOL shift, and healing pattern.[10] This case report highlights a series of cases addressing the management of refractive surprise following cataract surgery.

CASE DESCRIPTIONS

Case I

A 55-year-old woman presented with a chief complaint of blurring in her left eye after cataract surgery 10 months ago. She said that her vision was never cleared after surgery. There was no pain or redness in the eye. After cataract surgery, her glasses prescription was increased to +6.00 on her left eye. This patient had a history of cataract surgery on both eyes 10 and 3 months previously, respectively. The general physical examination and vital signs were normal. Ophthalmologic examination revealed visual acuity of 0.125 on her RE and 0.05 on her LE. Refractometer examination results showed C -2.00 X 172 on her right eye and S+6.25 C-0.50 x 17 on her LE. Distance visual correction on her right eye was 0.125, and on her left eye, with S+6.00 C-0.50 x 20, was 0.63. Intraocular pressure was tested using non-contact tonometry, resulting in 13 mmHg and 14 mmHg on her RE and LE, respectively.

Examination of the anterior segment of her right eye revealed a single-piece intraocular lens inside the capsular bag with good centration. The left anterior segment showed a single-piece intraocular lens inside the capsular bag with posterior capsule opacification. Another anterior segment was normal. The posterior segments of her right and left eyes displayed round, well-defined papillae, flat retinae, pigmented paravenous retinochoroidal atrophy (PPCRA) (+), macular atrophy, and tigroid fundus.

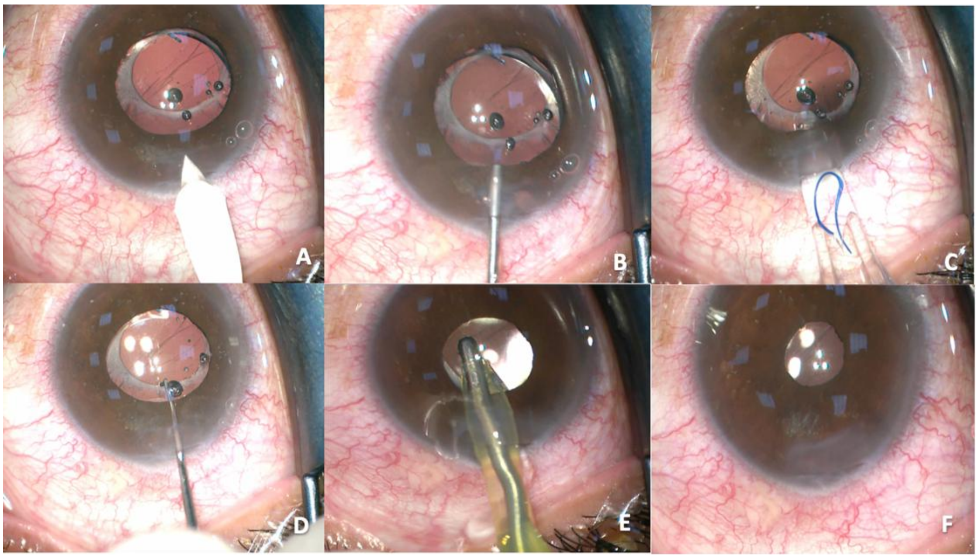

Figure 1. During piggyback IOL implantation surgery. (A) Incision on the cornea penetrating the anterior chamber (AC) using a keratome. (B) Injection of an ophthalmic viscosurgical device (OVD) to deepen the AC. (C) IOL implanted with sulcus fixation, positioned anterior to the primary IOL. (D) IOL positioned centrally in the pupil. (E) Aspiration and irrigation of the remaining OVD. (F) Wound edge hydration is performed, and the procedure is completed.

Biometry showed that the axial length of her RE and LE was 31.44 and 27.57 mm, respectively. The endothelial cell count of her right eye was 2,685 and 2,620 cells/mm^2 on her LE. Keratometry RE examination showed results of K1 42.53 D, K2 44.24 D, Astigmat K -1.71 D, and average K 43.37 D, while for the left eye K1 42.22 D, K2 43.38 D, Astigmat K -0.93 D, and average K 42.91 D were found.

She was diagnosed with Hyperopic Surprise LE + pseudophakia in both eyes + macular atrophy RE. Piggyback IOL implantation in the left eye was planned under sedation anaesthesia. She underwent piggyback intraocular lens implantation with sulcus fixation using a three-piece IOL lens with a power of +9.00 (Figure 1). Postoperative therapy included levofloxacin 0.5% ophthalmic solution, one drop six times daily, and prednisolone acetate 1% ophthalmic suspension, one drop six times daily, instilled in the left eye.

One-week post-surgery, she came back for control. There were no complaints; the vision in her left eye was clearer. The visual acuity on her LE was 0.63. The refractometer of the LE showed S+0.50 C-1.00 x 15, and the best visual acuity with correction of C-1.00 x 20 was 0.63. The intraocular pressure of her LE was 14 mmHg.

The postoperative therapy was continued with tapering off prednisolone acetate drops, and follow-up was scheduled at one-month post-surgery. Bifocal glasses were given to her. On one-month post-surgery control, she had no complaints, and vision in her left eye was much clearer (Figure 2). The visual acuity was 0.125 and 0.63 on her RE and LE, respectively. The refractometer of the left eye showed S+0.50 C-1.00 x 15, and the best visual acuity with correction of C-1.00 x 20 was 0.63. Neodymium-doped Yttrium Aluminum Garnet (Nd:YAG) laser capsulotomy was planned for the right eye. After the procedure, the visual acuity was 0.5. The vision did not improve to 1.0 due to the presence of macular atrophy.

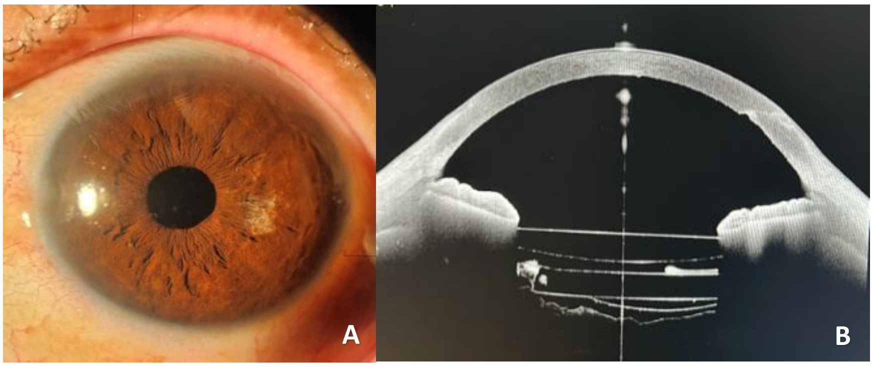

Figure 2. One-month post-surgery examination. (A) Left eye anterior segment examination (B) Anterior® examination

Case II

A 72-year-old male presented with a chief complaint of blurred vision in the right eye, which had undergone cataract surgery five years earlier. He said that his vision was never clear after the surgery. There were no red and painful eyes. He had a history of wearing glasses. After cataract surgery, his glasses strength was increased to -14.00 in the right eye.

General physical examination was within normal limits. Ophthalmological examination revealed visual acuity 1/60 and 0.16 in his RE and LE, respectively. The refractometer examination displayed S-14.00 C-2.00 x 129 on his RE and S-3.75 on his LE. His visual acuity improved to 0.4 with -14.00 C-1.50 x 125 on his RE and to 0.63 with S-3.75 on his LE. Intraocular pressure was tested using non-contact tonometry, resulting in 17 mmHg and 18 mmHg in his right and left eyes, respectively. Examination of the right anterior segment revealed a single-piece intraocular lens in the capsular sac with good centration. The posterior segments of the right and left eyes showed round, well-defined papillae with early optic atrophy, flat retina, and tigroid fundus.

The biometry demonstrated axial lengths of 30.62 mm and 28.60 mm on his RE and LE, respectively. Endothelial cell counts were 2,685 cells/mm2 in his RE and 2,620 cells/mm2 in his LE. Keratometry examination of the right eye showed results of K1 41.10 D, K2 41.29 D, Astigmat K -0.18 D, and average K 41.19 D, while the results for the left eye were K1 40.88 D, K2 42.28 D, Astigmat K -1.40 D, and average K 41.56 D.

He was diagnosed with myopic surprise RLE. The IOL exchange to scleral fixation using the Yamane technique in the right eye was planned under sedation anaesthesia, using an avanse lens size +7.00 (Figure 3).

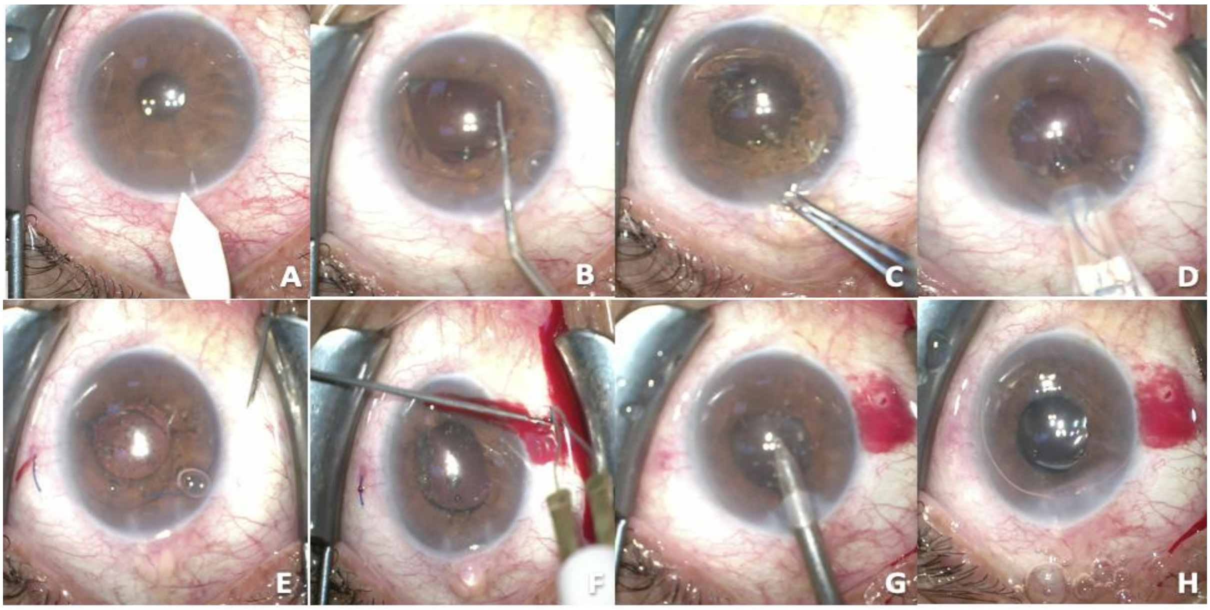

Figure 3. During intraocular lens (IOL) replacement surgery. (A) Corneal incision penetrating the anterior chamber (AC) with a keratome. (B,C) IOL is removed from the posterior chamber to the anterior chamber. (D) Insertion of the IOL. (E) Sclerotomy is made using a 27-gauge needle, and the leading haptic is inserted into the needle lumen using microforceps. (F) The haptic tip is externalized to the conjunctiva and cauterized to form a flange. (G) Aspiration and irrigation of residual OVD. (H) Hydration of the wound edges is performed, and the procedure is completed

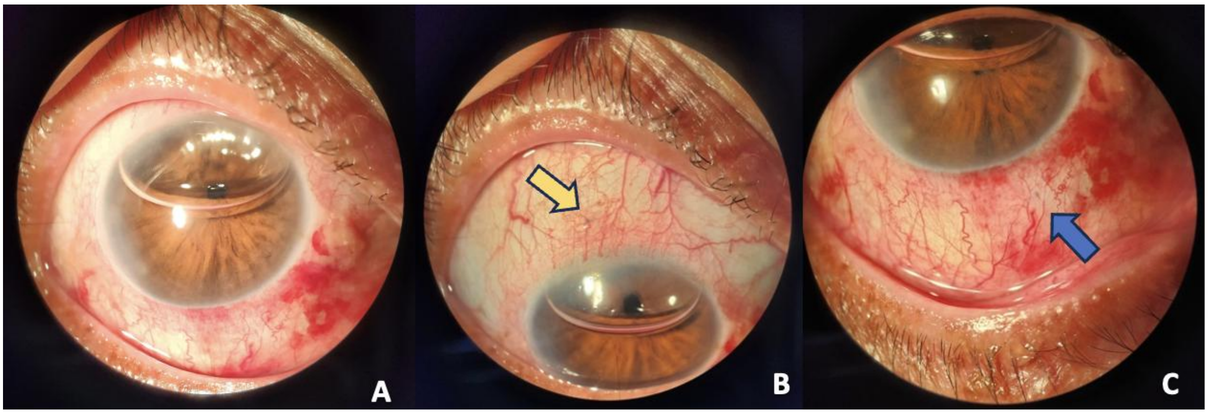

Figure 4. Right-eye anterior segment examination one day post-surgery. (A) Anterior segment, (B) Flange (+) at 11 o'clock position (yellow arrow), (C) Flange (+) at 5 o'clock position (blue arrow).

One day after surgery, anterior segment examination of the RE (Figure 4) demonstrated a relatively clear cornea, with flanges noted at the 5 o'clock and 11 o'clock positions. The anterior chamber contained air. The intraocular lens was scleral-fixated with good centration. One week post-surgery control, he claimed that there were no complaints, and his right eye vision was clearer. The visual acuity of the right eye was found to be 0.32, and the best visual acuity with S-1.75 C-0.50 x10 correction was 0.4. Intraocular pressure in the right eye was 15 mmHg. One month after surgery follow up, there were no complaints, and the vision in his right eye was clearer. The visual acuity was 0.125 and 0.16 on his RE and LE, respectively. The refractometer of the RE showed S-1.25 C-1.00x12, and the best visual acuity with S-1.00 C-0.50x10 correction was 0.4. In this patient, the visual acuity did not reach 1.0 due to optic disc atrophy. One month after surgery, anterior segment examination of the RE revealed a clear cornea. On further examination, two piggyback intraocular lenses were observed (Figure 5).

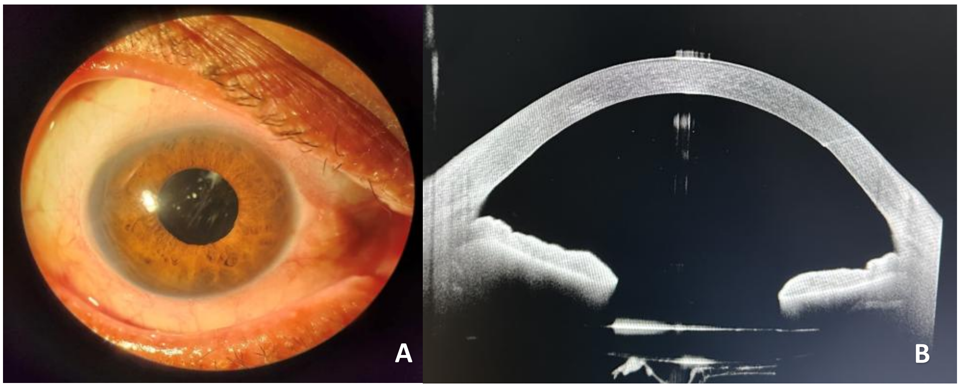

Figure 5. One-month post-surgery examination. (A) Right eye anterior segment examination (B) Anterior® examination.

DISCUSSION

The development of surgical techniques, new IOL technologies, advances in biometric methods, and IOL power calculations can improve visual acuity results while increasing patient expectations for cataract surgery outcomes. Postoperative visual acuity results that did not match the target may occur. Refractive surprise is defined as a difference in spherical equivalent of more than ±1.00 dioptres from the expected refractive target after surgery.[11-13] In our first case, she complained that her left eye had become blurry after cataract surgery and lens implantation ten months earlier. The results of objective and subjective refraction examinations after her cataract surgery were S+6.00, indicating more than 1 dioptre. Therefore, she experienced refractive surprise, specifically, hyperopic surprise. In our second case, the results of objective and subjective refraction examinations after his cataract surgery five years ago in the right eye were S-14.00, indicating more than 1 dioptre, and he was diagnosed with refractive surprise in the form of myopic surprise.

Refractive surprise may be addressed using non-surgical options, including spectacles or contact lenses, or through surgical interventions when indicated.[14] There are several surgical treatment options to correct refractive errors after cataract surgery, such as the corneal refractive surgery approach or laser vision correction (LVC) and the IOL surgical approach. Laser vision correction consists of laser in situ keratomileusis (LASIK) or photorefractive keratectomy (PRK), which may be considered for more minor refractive errors.[15] The IOL replacement procedures and piggyback lens implantation were considered for larger refractive errors. Piggyback IOL implantation can be an alternative in patients with a high risk of IOL replacement procedures, such as in cases of posterior capsule tears or zonulopathy.[16]

Piggyback IOL implantation is technically easier to perform, and the final refractive outcome is more predictable.[15] For a piggyback IOL implantation procedure to be successful, the primary IOL must be entirely in the capsular sac and deep anterior chamber with an open angle to allow sufficient space for secondary IOL placement.[17] The calculation of piggyback lens power is based on the patient's refractive error value and can be calculated simply using the post-operative SE. In cases with hyperopic surprise the IOL strength is 1.5 times the manifested SE dioptric, while in myopic surprise the IOL power is 1.2 times the recorded SE diopter.[18] Our first patient received a three-piece intraocular lens IOL which was a hydrophilic acrylic three-piece IOL with a power of +9.00D. The power is determined by calculating 1.5 times the manifested SE, where with SE +5.75 D, the result was 8,625 D. However, due to the unavailability of IOL power that matched the calculation, the IOL with the closest power was selected, which was +9.00 D.

The choice of technique for managing refractive surprise must be individualized.[15] In Case I, piggyback IOL implantation was preferred as the patient had a hyperopic surprise with intact capsular support, allowing safe sulcus placement of a supplementary IOL. In Case II, the large myopic surprise could not be effectively corrected with piggybacking; therefore, IOL exchange with scleral fixation using the Yamane technique was performed to achieve better refractive accuracy and stability. These cases highlight that surgical strategy should be tailored according to residual refractive error, ocular anatomy, and the feasibility of IOL placement.

The piggyback IOL implantation surgical technique is considered easier because the primary IOL was left in place.[19] Foldable piggyback IOL was inserted through a small 3 mm incision using an injector or forceps and directed into the sulcus. The incision wound was hydrated with balanced salt solution.[20] In our first patient, the piggyback IOL implantation operation was conducted well according to the procedure, and there were no intraoperative complications.

The IOL exchange can be an alternative in cases of refractive surprise. The IOL exchange technically has greater challenges because it requires more intraocular manipulation, which can lead to the risk of capsule damage and vitreous loss.[14] Factors impacting the choice of surgical technique include the size of the refractive error, history of other eye diseases, and operator experience. One dioptre, zonular weakness and lens capsule fibrosis cause piggyback IOL to be impossible.

CONCLUSION

Cataract surgery plays a crucial role in achieving optimal postoperative refraction; however, residual refractive errors and unexpected outcomes may still occur, leading to dissatisfaction among both patients and surgeons. Piggyback IOL implantation and IOL exchange are proven, safe, and effective solutions for correcting these refractive surprises.

CONFLICT OF INTEREST

The authors confirm that they have no conflicts of interest to disclose.

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DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

SUPPLEMENTARY MATERIAL(S)

No supplementary materials are associated with this manuscript.

AUTHOR CONTRIBUTIONS

All authors contributed equally to this manuscript. All authors read and approved the final manuscript.

DECLARATION OF USING AI IN THE WRITING PROCESS

AI-assisted technologies were used only to improve language clarity and grammar. No AI tool was used to generate original content, analyze data, or draw scientific conclusions. All authors reviewed and approved the final content.

LIST OF ABBREVIATIONS

IOL: intraocular lens, PVDF: polyvinylidene fluoride, PPCRA: pigmented paravenous retinochoroidal atrophy, LE: left eye, RE: right eye, D: Dioptri, K: keratometry, AC: anterior chamber, OVD: ophthalmic viscosurgical device, PVDF: Polyvinylidene fluoride, LVC: laser vision correction, PRK: photorefractive keratectomy, LASIK: laser in situ keratomileusis, SE: spherical equivalent.

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