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### Repeated Optical Biometry Failure as an Underrecognized Marker of Late In-the-Bag Intraocular Lens Decentration in Axial Myopia: A Case Report

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#### A B S T R A C T

**Background:** Late in-the-bag intraocular lens (IOL) dislocation is a delayed complication of cataract surgery driven by progressive zonular weakness, with axial myopia recognized as an independent risk factor. Its role as a hidden cause of optical biometry failure, however, has received little emphasis in the literature. **Case presentation:** A 58-year-old woman with longstanding axial myopia presented seven years after uneventful right-eye phacoemulsification with progressively blurred vision, monocular diplopia, and ghost images. Best-corrected visual acuity (BCVA) was 6/38 in the right eye improving to 6/15 with pinhole; refractometry revealed a new -4.00 D cylinder at axis 90° with persistent visual distortion consistent with irregular astigmatism. Slit-lamp examination showed inferior decentration of an in-the-bag posterior chamber IOL with a visible inferior haptic. Posterior segment evaluation through the displaced optic was hazy. Repeated optical biometry of the affected eye failed to acquire a valid axial-length signal across three sessions, whereas the fellow eye yielded reliable measurements. The patient was referred to a tertiary vitreoretinal center for IOL repositioning or exchange with possible pars plana vitrectomy and scleral fixation. **Conclusion:** In a myopic pseudophakic eye presenting with new-onset monocular diplopia and an astigmatic shift, repeated failure of optical biometry should be recognized as a critical diagnostic clue to underlying IOL instability, prompting timely tertiary referral and individualized surgical planning.

#### 1. Introduction

Cataract surgery with intraocular lens (IOL) implantation is the most frequently performed elective procedure in ophthalmology and one of the most successful interventions in modern medicine. Refinement of small-incision phacoemulsification, continuous curvilinear capsulorhexis, and modern foldable lens designs has produced highly predictable refractive outcomes and minimal early complications. As the longevity of operated patients continues to lengthen, however, ophthalmologists are increasingly confronted with delayed sequelae that surface years to decades after a technically uneventful primary procedure.<sup>1</sup>

Among these late complications, in-the-bag intraocular lens dislocation has emerged as a clinically important entity whose recognition has grown in parallel with cumulative pseudophakic life-years in the population.<sup>2-5</sup> Population-based cohorts from Olmsted County and Sweden have demonstrated a cumulative dislocation incidence rising from approximately 0.1% at 10 years to 1.7%–1.8% at 25 years after cataract surgery, with steeper gradients observed in subgroups carrying predisposing factors such as pseudoexfoliation, prior vitreoretinal surgery, ocular trauma, uveitis, connective-tissue disorders and—most relevant to the present report—axial myopia.<sup>2,3,5,6,7</sup> The underlying mechanism is

progressive zonular insufficiency: the capsular bag-IOL complex gradually loses its support, drifts inferiorly, and induces optical distortion long after the primary surgery has been forgotten by both surgeon and patient.<sup>4,8</sup> The phenomenon was first systematically described in pseudoexfoliative eyes by Jehan and colleagues in 2001, with a mean interval from primary surgery to dislocation of approximately 85 months,<sup>9</sup> and subsequently corroborated in larger pseudoexfoliative cohorts.<sup>10</sup>

Axial myopia represents a uniquely vulnerable substrate. The elongated globe stretches zonular fibers, accelerates vitreous liquefaction and posterior vitreous detachment, and creates a biomechanical environment in which the capsular bag-IOL complex is poorly buttressed.<sup>5,7,11</sup> Clinically, this often translates into late presentation with progressive blurred vision, monocular diplopia, ghost images, glare, and an unexplained astigmatic shift; conventional Snellen acuity may be only modestly reduced, masking the magnitude of optical degradation produced by tilt, decentration, and higher-order aberrations.<sup>7,12</sup> Because these symptoms can be misattributed to age-related macular disease, posterior capsular opacification, or simple refractive change, the diagnosis of a malpositioned IOL may be substantially delayed.

Beyond their refractive consequences, IOL decentration and tilt also threaten a less appreciated dimension of pseudophakic care—the reliability of preoperative diagnostic technology. Modern optical biometers, including partial-coherence interferometry and swept-source optical coherence tomography (SS-OCT) platforms, rely on coaxial alignment between the patient's visual axis, the IOL optic, and the foveal reflex.<sup>13,14</sup> When that geometry is disrupted by a tilted or inferiorly displaced IOL, the returning interferometric or reflectometric signal becomes too weak or too distorted for the device's algorithm to compute axial length, and the operator receives a non-specific error or repeated low-signal warnings. In practice, this phenomenon is often labeled as a “technical failure”, recorded in the chart, and silently

overcome by switching to ultrasound A-scan—an inferior but workable alternative—rather than interpreted as a meaningful physiological signal of underlying lens malposition.

The novelty and aim of this study are therefore twofold. First, we describe a case of late in-the-bag IOL dislocation in a patient with longstanding axial myopia in whom optical biometry repeatedly failed in the affected eye while remaining valid in the contralateral phakic eye, illustrating the dual challenge of refractive and biometric disturbance produced by a single anatomical insult. Second, we argue that repeated optical biometry failure in a myopic pseudophakic patient with new astigmatic shift or monocular diplopia should be reframed from a nuisance to an underrecognized diagnostic sentinel, prompting structured slit-lamp re-examination of IOL position and early referral when zonular instability is suspected. To our knowledge, the dual presentation of optical and biometric failure in axial myopia has not been highlighted as an integrated clinical syndrome in the recent Indonesian or Southeast Asian ophthalmology literature; the present report seeks to fill that gap.

## 2. Case Presentation

A 58-year-old Indonesian woman was referred to the ophthalmology outpatient clinic of Wangaya Hospital, Denpasar, Bali, with a six-month history of progressively blurred vision in the right eye accompanied by a persistent sensation of seeing a second, fainter image overlying the primary image. She reported that covering the left eye did not eliminate the second image, confirming a monocular rather than binocular origin of the diplopia. The visual disturbance had interfered with reading, watching television, and motorcycle navigation, and had not improved despite recent updates of her spectacle prescription by a local optician.

Her ophthalmic history was notable for longstanding myopia of childhood onset, with a stable spectacle correction of approximately  $-2.50$  diopters sphere in both eyes since adolescence. A first-degree family

history of refractive error was reported, but there was no documented family history of glaucoma, retinal detachment, connective-tissue disorder, or hereditary lens disease. Approximately seven years prior to presentation she had undergone uneventful phacoemulsification with implantation of a posterior chamber acrylic IOL in the right eye at a regional facility. Her records indicated an unremarkable intraoperative course without capsular complication, and an immediate postoperative spherical-equivalent refraction close to emmetropia, with the patient functioning comfortably with low-power reading correction for the first six years. The left eye had not undergone cataract surgery; she had repeatedly declined intervention because of fear of an adverse outcome. There was no history of ocular trauma, intraocular inflammation, prior vitreoretinal procedure, oral or topical corticosteroid use of clinical relevance, or systemic conditions associated with zonular weakness such as Marfan, homocystinuria, or pseudoexfoliation-related glaucoma. Systemic review revealed well-controlled hypertension on amlodipine and no known diabetes mellitus.

On general examination the patient was alert, normotensive, and in no distress. Ophthalmic examination disclosed a best-corrected visual acuity (BCVA) of 6/38 in the right eye, improving to 6/15 with a pinhole, suggesting a refractive component overlaid on a structural source of degradation. The left eye also recorded a BCVA of 6/38 attributable primarily to an immature senile cataract. Intraocular pressures measured by non-contact tonometry were 18 mmHg in the right eye and 12 mmHg in the left eye, within normal limits. Pupillary responses were brisk and symmetrical, with no relative afferent pupillary defect. Extraocular movements were full, and confrontation visual field testing was grossly unremarkable. The complete demographic, refractive, anatomical, and diagnostic profile of the patient is detailed in Table 1, which contrasts the affected right eye with the fellow phakic left eye.

Manifest refractometry of the right eye, repeated on three separate days to ensure reproducibility,

demonstrated a striking departure from her long-stable preoperative profile: the spherical component remained near plano, but a new cylindrical correction of  $-4.00$  diopters at axis  $90^\circ$  was required to achieve maximal acuity. Despite this high cylindrical correction the patient continued to report visual distortion, ghosting and shadowing of letters, suggesting that the residual astigmatism was not regular bow-tie astigmatism but rather an irregular pattern not fully amenable to cylindrical-lens compensation.<sup>7,12</sup> Keratometric and topographic data of the cornea did not reveal a pathological change to account for the magnitude of cylinder, further suggesting that the source of irregular astigmatism resided in the pseudophakic optical pathway rather than the cornea.

Slit-lamp biomicroscopy of the right eye, performed under maximal pharmacological mydriasis, revealed the principal anatomical abnormality of the case. As shown in Figure 1, the capsular bag-IOL complex was decentered inferiorly relative to the pupillary axis, with the inferior haptic of the in-the-bag posterior chamber IOL clearly visible within the pupillary aperture. The diffuse-illumination view in Figure 2 further demonstrated that only the inferior half of the IOL optic remained within the geometric center of the dilated pupil, with the superior optic edge crossing close to the visual axis—an anatomical configuration that accounts for the patient's monocular diplopia, ghost images, and induced irregular astigmatism. A faint Soemmering's ring of residual lens material was visible peripherally, and the capsular bag itself appeared thin and tenuous without overt fibrotic phimosis. No pseudoexfoliative material was detected on the anterior lens capsule, pupillary margin, or zonules of either eye. The anterior chamber was deep and quiet, with no pigmentary dispersion, no inflammatory cells, and no vitreous prolapse. Together these findings were consistent with progressive zonular instability of the capsular bag-IOL complex without an evident systemic predisposing syndrome.

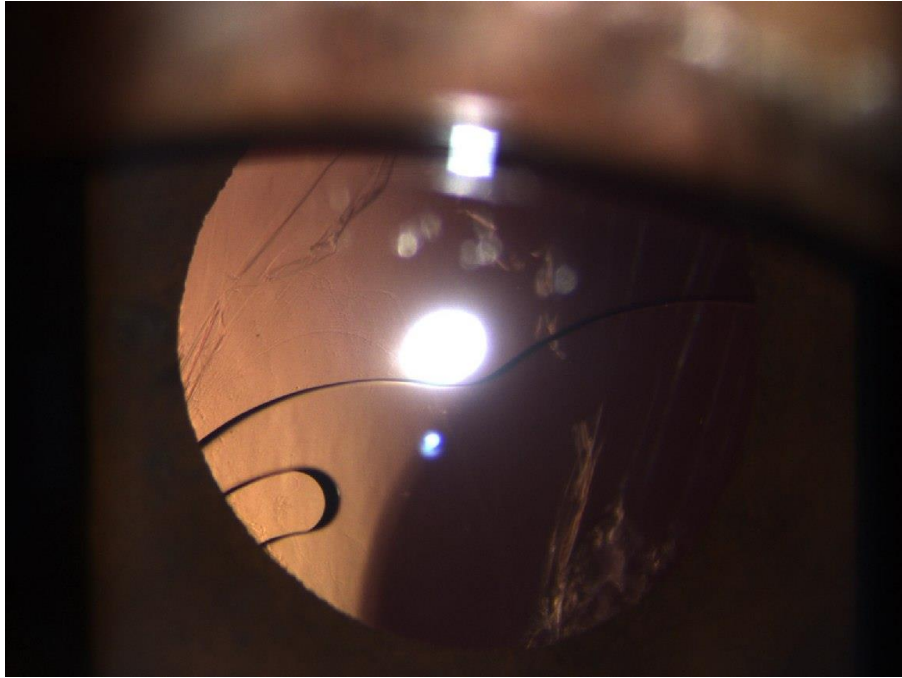


Figure 1. Slit-lamp photograph of the right eye under pharmacological mydriasis showing inferior decentration of the in-the-bag posterior chamber intraocular lens (IOL). The inferior haptic of the IOL is clearly visible within the pupillary aperture, accompanied by a thin, hammock-like configuration of the capsular bag indicating loss of zonular support.



Figure 2. Diffuse slit-lamp view of the right eye demonstrating marked inferior displacement of the IOL optic relative to the pupillary axis. Only the inferior half of the optic remains within the visual axis, accounting for the patient's monocular diplopia, ghost images and induced irregular astigmatism.



Figure 3. Slit-lamp fundus view of the right eye through the decentered IOL, showing a hazy posterior segment with only partial visualization of the optic disc and the emerging retinal vasculature. Optical distortion produced by the malpositioned IOL limits the assessment of subtle retinal pathology.

Posterior segment examination of the right eye was challenging because of optical distortion induced by the malpositioned IOL. Using 90-diopter and 78-diopter handheld lenses with the slit-lamp, the optic disc could be partially visualized, with a cup-to-disc ratio estimated at approximately 0.3 and no overt pallor or notching. The retinal vasculature was traceable into the major arcades without obvious vessel attenuation, sheathing or hemorrhage. The macular reflex was attenuated; no obvious foveal hole, epiretinal membrane, or pigmentary disturbance could be identified within the limitations imposed by the hazy media. Peripheral retinal examination with indirect ophthalmoscopy and scleral indentation did not reveal a retinal break, lattice degeneration, or rhegmatogenous retinal detachment on the day of evaluation. Figure 3 illustrates the partially obscured posterior segment view obtained through the displaced IOL optic. Optical coherence tomography of the macula in the right eye could not be reliably acquired because of poor signal strength secondary to optical misalignment, paralleling the difficulty later encountered with optical biometry. The left fundus showed mild myopic chorioretinal changes and an attached retina with no significant macular pathology.

Preparation for potential surgical realignment required precise determination of axial length and keratometry for IOL power calculation. Optical biometry was performed in both eyes using a partial-coherence interferometry-based platform. In the left eye, despite the presence of an immature senile cataract, the device acquired axial length, anterior chamber depth, keratometry, and white-to-white measurements without difficulty, returning a strong signal-to-noise ratio on each composite scan. In the right eye, however, three sequential measurement sessions yielded only repeated low-signal warnings and an inability to compute an axial-length value, with the device displaying an error code typically indicative of “no fixation signal detected.” Repositioning of the patient's head, re-alignment of the device, fresh artificial-tear lubrication and several minutes of rest between acquisitions did not improve signal capture. The contrast between the biometric reliability of the fellow eye and the unreliability of the operated eye, despite the latter being theoretically pseudophakic and free of dense lens opacities, was striking and clinically informative. Together with the slit-lamp findings, the inability of the optical biometer to acquire a valid axial-length signal was interpreted not as a

technical artifact but as objective evidence that the IOL optic was sufficiently malpositioned to disrupt the coaxial reflection geometry on which optical biometry depends.<sup>13,14</sup>

Taken together, the constellation of an inferiorly decentered in-the-bag IOL with a visible haptic (Figure 1), a markedly displaced optic relative to the pupillary

axis (Figure 2), a hazy posterior segment view (Figure 3), a new -4.00 D cylinder with persistent visual distortion, and reproducible failure of optical biometry only in the affected eye, supported a working diagnosis of late in-the-bag intraocular lens dislocation on a background of bilateral longstanding axial myopia. The numerical and anatomical asymmetry between the two eyes is summarised side-by-side in Table 1.

Table 1. Demographic, refractive, anatomical, and diagnostic findings in patient.

Parameter	Right eye (affected, pseudophakic)	Left eye (fellow, phakic)
Age / Gender	58 years, female	—
Refractive history	Childhood-onset myopia ( $\approx -2.50$ D pre-cataract)	Childhood-onset myopia ( $\approx -2.50$ D)
Cataract surgery	Phacoemulsification + in-the-bag PCIOL, $\sim 7$ years prior, uneventful	Not operated (immature senile cataract)
Presenting complaints	Progressive blurred vision, monocular diplopia, ghost images	Gradual blurring only
BCVA	6/38, improving to 6/15 with pinhole	6/38
Intraocular pressure	18 mmHg	12 mmHg
Manifest refraction	Plano sphere / $-4.00$ D cyl $\times 90^\circ$ (new, irregular)	Stable myopic correction
Slit-lamp findings	Inferior decentration of in-the-bag PCIOL; visible inferior haptic; no pseudoexfoliation	Immature senile cataract; clear anterior segment; no pseudoexfoliation
Anterior chamber	Deep, quiet, no pigment dispersion, no vitreous in AC	Deep, quiet
Fundus	Hazy media; partial view of disc and vasculature; no overt RD	Mild myopic chorioretinal changes; attached retina
Optical biometry*	Failed repeatedly (low-signal / no fixation signal)	Successful acquisition
Working diagnosis	Late in-the-bag IOL dislocation with induced irregular astigmatism	Immature senile cataract on myopic eye
Disposition	Referred to tertiary vitreoretinal center	Elective cataract surgery to be scheduled

Notes: \*Optical biometry was attempted on three separate sessions with repositioning, re-fixation and artificial-tear lubrication, with persistent failure to acquire axial length only in the affected pseudophakic eye. BCVA, best-corrected visual acuity; PCIOL, posterior chamber intraocular lens; D, diopter; AC, anterior chamber; RD, retinal detachment.

Given the diagnostic complexity, the absence of immediately operable conditions at the primary center, and the recognized need for combined vitreoretinal and anterior-segment expertise to safely address an in-the-bag dislocated IOL, the patient was counselled regarding the nature of her condition and the available management options.<sup>6,15,16,17</sup> These were discussed in lay terms supplemented by labeled diagrams. The patient and her family were informed that the malpositioned IOL was the most likely source of both her optical complaints and the biometric difficulty, and that definitive management would require either repositioning the existing IOL with secondary fixation or exchanging it for an alternative lens design. After informed discussion she elected referral to a tertiary academic center with vitreoretinal capability for consideration of IOL repositioning or exchange with

possible pars plana vitrectomy and scleral fixation using a flanged intrascleral haptic technique or sutured scleral fixation as deemed appropriate intraoperatively.<sup>15-17</sup> Interim management at the referring institution included spectacle correction with the best cylindrical lens tolerated, protective eyewear, counselling regarding fall and motorcycle-driving risk, and arrangement for early cataract surgery in the fellow left eye after stabilisation of the right eye.

#### Ethical approval and patient consent

The case report was prepared in accordance with the CARE (CAse REport) guidelines.<sup>20</sup> Written informed consent for publication of clinical findings and photographic material was obtained from the patient; institutional review-board approval is not required at our institution for de-identified single-patient case reports.

### 3. Discussion

Late in-the-bag intraocular lens dislocation has evolved from an unusual case-report curiosity into a clinically and epidemiologically significant complication of contemporary cataract surgery. Population-based data from Olmsted County, Minnesota indicate a cumulative risk of late posterior-chamber IOL dislocation of approximately 0.1% at 10 years and 0.7% at 20 years following uneventful phacoemulsification, rising to 1.7% at 25 years.<sup>2</sup> Prospective Swedish data from Mönestam, examining 100 patients twenty years after their primary cataract surgery, documented a substantially higher prevalence of detectable pseudophacodonesis ( $\approx 5\%$ ) and clinically meaningful IOL dislocation ( $\approx 2\%$ – $6\%$  depending on baseline pseudoexfoliation status).<sup>3</sup> The largest single-institution retrospective series by Dabrowska-Kloda and colleagues catalogued 140 dislocated in-the-bag IOLs over a twenty-year period in Sweden, demonstrating that the annual incidence of presentation has steadily risen as more patients accumulate pseudophakic life-years, with an average interval from primary cataract surgery to dislocation of approximately 8–10 years—closely matching the seven-year interval observed in the present patient.<sup>5</sup> These population-level data are contextualised against six landmark cohorts and the present case in Table 2.

Across these cohorts, a remarkably consistent set of predisposing factors has been identified.

Pseudoexfoliation syndrome is the single most prevalent contributor, accounting for 50–66% of cases in large surgical series.<sup>1,4,8,9,10</sup> Other established risk factors include prior vitreoretinal surgery, ocular trauma, chronic uveitis, retinitis pigmentosa, connective-tissue disorders such as Marfan syndrome, and axial myopia.<sup>2,5,6,7,11</sup> Axial myopia is of particular interest because of its high background prevalence in Asian populations, including Indonesia, and because the underlying biomechanical mechanism is structural rather than depositional. In myopic eyes, axial elongation produces longer, attenuated zonular fibers and accelerated vitreous liquefaction; the resulting loss of vitreous support permits gradual sagging of the capsular bag–IOL complex despite an initially intact zonular apparatus.<sup>5,11</sup> In Hayashi's analysis of in-the-bag versus out-of-the-bag dislocations, increasing axial length was identified as an independent risk factor; Dabrowska-Kloda's series identified increased axial length, pseudophacodonesis, and prior zonular dehiscence as the three most consistent predictors of late presentation.<sup>5,7</sup> The absence of pseudoexfoliative material on careful slit-lamp examination in the present patient, in combination with a documented lifelong myopic refractive status and a non-traumatic course, is consistent with a primarily myopia-driven mechanism, although microscopic capsular contraction and possible focal zonular degeneration cannot be excluded without histopathological correlation.<sup>8</sup>

Table 2. Comparison of the present case with previously published cohorts of late in-the-bag IOL dislocation.

Series (year, country)	n	Mean time / Risk factor	Distinctive feature
Jehan et al., 2001 <sup>9</sup> (USA)	8	$\approx 85$ mo / PXF	First systematic series in PXF
Davis et al., 2009 <sup>4</sup> (USA)	86	$\approx 8.5$ y / PXF ( $\approx 50\%$ )	Largest pathology-correlated series
Pueringer et al., 2011 <sup>2</sup> (USA)	14 471 / 39	Up to 25 y / PXF, vitrectomy, myopia	Cumulative 1.7% @ 25 y; first population estimate
Østern et al., 2014 <sup>10</sup> (Norway)	84	$\approx 9.5$ y / PXF	Scandinavian cohort confirming PXF dominance
Dabrowska-Kloda et al., 2015 <sup>5</sup> (Sweden)	140	$\approx 8.6$ y / PXF, $\uparrow$ AL, zonular dehiscence	Two-decade series; rising incidence
Mönestam, 2019 <sup>3</sup> (Sweden)	100	20 y / PXF (6% vs 2%)	Only long-term prospective cohort
Kristianslund et al., 2017 <sup>15</sup> (Norway)	104 (RCT)	Not stated / PXF; some myopia	Only RCT — repositioning vs iris-claw
Present case, 2026 (Indonesia)	1	$\approx 7$ y / Axial myopia (no PXF)	Biometry failure as sentinel clue

Notes: Superscript numerals correspond to the numbered references. PXF, pseudoexfoliation syndrome; AL, axial length; y, year s; mo, months; RCT, randomized controlled trial.

As Table 2 demonstrates, the dominant risk factor in virtually every large cohort published over the past quarter-century is pseudoexfoliation, with axial myopia recognized as a secondary or contributing factor in a smaller subset. The present case therefore expands the relatively under-represented subgroup of myopia-driven late dislocation in the Asian setting, while introducing biometry failure as a phenotypic refinement not consistently emphasised in the comparator cohorts.

The clinical phenotype of late in-the-bag IOL dislocation is heterogeneous and is shaped by the magnitude and direction of decentration, the degree of optical tilt, the integrity of the zonular apparatus, and the optical biology of the implanted lens. In the present patient, the dominant symptoms—progressive blurring, monocular diplopia, and ghost images—are the classical optical correlates of IOL decentration and tilt.<sup>7,12</sup> Experimental and clinical work by Taketani and colleagues, and the broader body of literature on aspheric IOL alignment, has shown that even moderate tilt of 5°–7° and decentration of 0.5–1.0 mm can generate clinically perceptible coma-like and trefoil higher-order aberrations, contrast sensitivity loss, and dysphotopsia.<sup>12</sup> As the IOL drifts further from the visual axis, two distinct but related phenomena emerge. First, the eye behaves as if it has acquired a new, posteriorly placed prism: a portion of the entering pencil of light traverses the lens edge or even the lens-bag interface, producing duplicate or ghost images displaced from the main retinal image. Second, the asymmetric refraction across the optic introduces an irregular astigmatic component that is no longer well represented by a single cylindrical axis, leading to a residual visual distortion that persists even after the best spectacle cylinder is prescribed—exactly the pattern observed in the present case, in which  $-4.00$  D cyl  $\times$  90° improved acuity to 6/15 (Table 1) but did not abolish the patient's symptomatic distortion.

It is important to emphasise that Snellen visual acuity is an imperfect index of the optical degradation produced by IOL malposition. Patients with moderate

decentration may retain 6/9 or 6/12 acuity yet describe significant dissatisfaction with the quality of their vision, particularly under mesopic or photopic conditions.<sup>7,12</sup> The high pinhole gain noted in our patient (from 6/38 to 6/15, as recorded in Table 1) is itself a clue: by limiting the effective aperture of the eye, the pinhole excludes peripheral light rays passing through the dislocated portion of the optic and reveals the underlying retinal performance, which is comparatively preserved. The same physical principle is exploited therapeutically by small-aperture IOL designs that have been deployed in eyes with irregular corneal optics and pseudophakic higher-order aberrations, although these are rarely first-line solutions in the setting of frank IOL dislocation, where mechanical realignment or exchange remains the definitive strategy.

The second, less appreciated dimension of this case is the failure of optical biometry. Modern partial-coherence interferometry platforms such as the IOLMaster 500, together with swept-source OCT-based biometers such as the IOLMaster 700, Argos, and Anterior, compute axial length by measuring the round-trip optical path between a fixation-coupled beam and the retinal pigment epithelium, then reconstructing physical length by correcting for the group refractive indices of the cornea, aqueous, lens or IOL, and vitreous.<sup>13,14</sup> The validity of this measurement rests on three conditions: that the patient can fixate steadily on the device's target; that the corneal, lens, and retinal surfaces produce co-linear specular reflections along the measurement beam; and that there is no media opacity sufficient to scatter the beam below the signal-to-noise threshold of the instrument. In a pseudophakic eye whose IOL optic has migrated inferiorly relative to the visual axis, the second and third conditions are simultaneously violated: the IOL surface no longer reflects coaxially with the fixation beam, and the disturbed pseudophakic optical pathway scatters and refracts the returning signal. The biometer cannot distinguish this physiological failure from a technical artifact and reports a generic error message. In our patient, the

reproducibility of measurement failure across three independent sessions, despite repositioning and a fully successful contralateral acquisition (Table 1), was strong indirect evidence that the underlying obstacle was anatomical—a malpositioned optic—rather than technical.

This biometric phenomenon has been infrequently highlighted in the literature, perhaps because contemporary practice has trained both technicians and clinicians to view biometry failures as nuisances to be circumvented by ultrasound A-scan rather than as physiological signals worthy of pursuit.<sup>13,14</sup> Yet ultrasound axial-length measurement is itself approximately three times less reproducible than optical biometry in pseudophakic eyes, and its accuracy is itself degraded by IOL position and tilt because the propagation velocity correction depends on assumptions about lens type and location.<sup>13,14</sup> Switching modalities without addressing the underlying anatomical disturbance therefore exchanges one source of inaccuracy for another and, more importantly, postpones the diagnosis of IOL malposition. The clinical lesson distilled from the present case is therefore practical and immediate: in a myopic pseudophakic patient with a new astigmatic shift or monocular diplopia, repeated optical biometry failure should be reframed from a technical inconvenience to a sentinel finding mandating dedicated slit-lamp re-examination of IOL position under maximal mydriasis (as in Figures 1 and 2).

Once the diagnosis of late in-the-bag IOL dislocation is established, the management algorithm depends on the magnitude of decentration, integrity of the capsular bag, presence of vitreous in the anterior chamber, status of the corneal endothelium, and patient-specific factors such as the contralateral refractive state and operative risk. Asymptomatic minor decentration, particularly in patients with significant ocular comorbidity, may be observed and managed with refractive correction. Symptomatic cases, such as the present patient, generally require surgical intervention.<sup>6,15,17</sup> The two principal surgical strategies are repositioning of the existing capsular

bag-IOL complex with secondary scleral or iris fixation, and explantation of the dislocated complex followed by implantation of a new IOL in the sulcus, with iris-claw retropupillary fixation, or with intrascleral haptic fixation.<sup>15-17</sup>

High-quality comparative evidence is now available from the Norwegian randomized clinical trial conducted by Kristianslund and colleagues, in which 104 eyes with late in-the-bag dislocation were randomized to either IOL repositioning by scleral suturing or IOL exchange with a retropupillary iris-claw implant.<sup>15</sup> Both strategies achieved substantial and comparable improvements in best-corrected visual acuity, with no significant difference in re-dislocation rates over follow-up.<sup>15</sup> A subsequent astigmatism analysis from the same cohort confirmed favorable refractive outcomes in both groups, with manageable residual cylinder.<sup>18</sup> A 2019 meta-analysis pooling multiple comparative studies similarly concluded that repositioning and exchange are both safe and effective, with repositioning associated with a lower incidence of anterior vitrectomy and a smaller endothelial cell loss, while exchange tended to achieve marginally more predictable spherical-equivalent refraction.<sup>17</sup> In the era of flanged intrascleral haptic fixation pioneered by Yamane and colleagues, the option to fixate a three-piece IOL in the scleral wall using 30-gauge thin-wall needles and cauterised haptic flanges has further expanded the surgical armamentarium, delivering excellent IOL centration and long-term stability without sutures.<sup>16</sup>

The decision among these options in any individual case depends on intraoperative findings. In a myopic eye with substantial pseudophacodonesis and a partially exposed inferior haptic such as the one shown in Figure 1, a key intraoperative question is whether the existing capsular bag will tolerate the additional manipulation needed for scleral re-fixation, or whether the bag is sufficiently fragile that explantation is preferable. A pre-operative B-scan to exclude retinal detachment and to assess the vitreous cavity, anterior segment optical coherence tomography to estimate the degree of tilt and decentration, and

endothelial cell density measurement to identify endothelial reserve are reasonable preparatory steps when available. In settings where these adjunctive tools are unavailable, careful slit-lamp examination, gonioscopy, and clinical judgment by an experienced anterior-segment surgeon remain the mainstay.

Two additional considerations specific to the present patient deserve emphasis. First, the fellow left eye has an immature senile cataract on a background of bilateral longstanding myopia (Table 1). Although the patient has so far declined cataract surgery, the principles governing late dislocation in the right eye apply to her left eye as well, and may be magnified by any future intraoperative zonular stress.<sup>5,19</sup> Prophylactic measures during left-eye phacoemulsification—gentle hydrodissection, low-flow phacoemulsification settings, generous use of cohesive ophthalmic viscosurgical devices, and, importantly, primary implantation of a capsular tension ring (CTR) if any zonular weakness is suspected intraoperatively—are supported by randomized data from Yang and colleagues, who demonstrated that CTR implantation in eyes with weak zonules significantly improved capsular bag stability, IOL centration, and resistance to late displacement compared with non-CTR controls.<sup>19</sup> In axial myopic eyes specifically, CTR implantation is increasingly considered standard practice when axial length exceeds 26–28 mm.<sup>19</sup>

Second, the patient is at elevated risk of pseudophakic rhegmatogenous retinal detachment, irrespective of how the IOL malposition is managed. Population-based cohorts have repeatedly demonstrated that very high axial myopia (axial length > 26 mm) carries up to a six-fold increased risk of retinal detachment within the years following cataract surgery, and that any procedure entering the vitreous cavity—such as pars plana vitrectomy used to retrieve a posteriorly dislocated lens—further elevates that risk.<sup>11</sup> In Ripandelli's landmark series of 930 eyes with very high myopia, the cumulative incidence of retinal detachment following cataract surgery reached 8% over 36 months of follow-up, compared with 1.2% in

non-operated control eyes.<sup>11</sup> These data argue for a careful peripheral retinal examination at every postoperative visit, prophylactic laser barrage of any pre-existing retinal pathology where appropriate, and structured patient education regarding the warning signs of retinal detachment.

The broader narrative emerging from this case touches on a recurrent theme in modern ophthalmology: as our diagnostic technology becomes more refined, the failures of that technology themselves carry information. Optical biometry was developed to overcome the imprecision of ultrasound A-scan and has succeeded magnificently, transforming the refractive predictability of cataract surgery.<sup>13,14</sup> Yet the very design philosophy that allows the IOLMaster and its successors to deliver sub-100-micron axial-length precision—the strict coaxial reflection geometry—renders the same instruments mute in eyes where that geometry is anatomically violated. Rather than viewing this as a defect, clinicians can re-interpret persistent biometric failure as a constructive signal indicating the need to re-examine the anterior segment in detail. This conceptual reframing is the principal clinical contribution of the present report.

Several limitations should be acknowledged. First, definitive surgical management was undertaken at a tertiary center, and long-term follow-up data are not yet available at the time of this report; the case is therefore presented primarily to highlight the diagnostic, rather than postoperative, lessons. Second, formal axial-length measurement by immersion B-scan ultrasound was attempted but produced wide-range values consistent with a malpositioned IOL and was not used for definitive surgical planning; tertiary-center biometry following IOL retrieval will be more informative. Third, formal wavefront aberrometry, anterior segment optical coherence tomography, and ultrasound biomicroscopy were not available at the primary site to quantify IOL tilt, anterior chamber depth and zonular dehiscence, which would have strengthened the mechanistic interpretation; the discussion above relies on well-

established mechanistic literature.<sup>7,12,16</sup> Fourth, pseudoexfoliation, although clinically excluded on slit-lamp examination, can be confirmed definitively only by histopathology of the capsular bag at the time of explantation.<sup>8</sup> Finally, the report follows the CARE guidelines framework for case reporting; nevertheless, single-case reports cannot establish causality and are intended to generate, rather than test, clinical hypotheses.<sup>20</sup>

From a public-health and educational perspective, this case has additional resonance in the Southeast Asian setting. Indonesia carries one of the largest cataract surgical volumes in the region, and the prevalence of myopia among working-age adults has been rising in parallel with global trends. As surviving pseudophakic cohorts accumulate decades of follow-up, the absolute number of late in-the-bag dislocations is expected to grow, even if the per-eye annual incidence remains numerically small. Regional ophthalmologists therefore stand to encounter this entity with increasing frequency, often in the context of patients who present years after surgery performed at peripheral or rural facilities and whose prior operative records may be incomplete or unavailable. Building a structured triage pathway—anchored on three pillars of careful refraction including pinhole testing, detailed slit-lamp examination under maximal mydriasis, and explicit interpretation of biometric difficulty—may meaningfully shorten the diagnostic interval. Such a pathway translates the lessons of the present case into a reproducible workflow that can be implemented even where advanced anterior-segment imaging is not yet routinely available.<sup>1,2,5,6</sup>

Despite these limitations, the case offers concrete, transferable clinical messages. Cataract surgeons should sustain a high index of suspicion for late IOL dislocation in any myopic pseudophakic patient presenting with new monocular diplopia, ghost images, or unexpected astigmatic shift, even when Snellen acuity remains in the 6/12–6/18 range. Biometry technicians and supervising clinicians should treat repeated optical biometry failure in a pseudophakic eye not as a procedural inconvenience

but as a meaningful clinical signal warranting structured anterior-segment re-examination under mydriasis. Decisions about repositioning versus exchange of a dislocated IOL should be informed by contemporary randomized and meta-analytic evidence, and modern intrascleral haptic fixation should be considered in carefully selected cases with marginal capsular support.<sup>15-17</sup> Equally important, the contralateral myopic eye must be approached with prophylactic discipline at the time of its own future cataract surgery, including primary capsular tension ring implantation when axial length or intraoperative findings raise concern.<sup>5,19</sup>

#### **4. Conclusion**

Late in-the-bag intraocular lens dislocation is an increasingly important long-term complication of cataract surgery, particularly in patients with longstanding axial myopia in whom progressive zonular insufficiency provides fertile ground for delayed displacement of the capsular bag–IOL complex. The present case illustrates the characteristic dual phenotype that this entity produces: an optical phenotype of monocular diplopia, ghost images and irregular astigmatism that resists conventional refractive correction (Figures 1 and 2; Table 1), and a biometric phenotype in which repeated failure of optical biometry in the affected eye, in the presence of seamless contralateral measurement, betrays the anatomical malalignment of the lens optic.

The principal clinical message is that repeated failure of optical biometry in a myopic pseudophakic eye should be treated not as a technical artifact but as a diagnostic sentinel of underlying IOL malposition, warranting structured anterior-segment re-examination, early referral to a center capable of combined anterior- and posterior-segment surgery, and an individualized choice between IOL repositioning and exchange informed by current high-quality evidence (Table 2). Equally important is anticipating the same risk in the contralateral myopic eye and adopting preventive intraoperative strategies at the time of its future cataract surgery, including primary capsular tension ring implantation and

careful zonular assessment. Embedding these principles into routine pseudophakic follow-up across both primary and tertiary settings may meaningfully reduce diagnostic delay, optimize visual rehabilitation and inform safer surgical planning in this growing and clinically vulnerable patient population.

## 5. References

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