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Bilaterally subluxed diffractive intraocular lenses: big expectations and even bigger comorbidities.

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Bilaterally subluxed diffractive intraocular lenses: big expectations and even bigger comorbidities

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A 78-year-old woman with an ocular history of cataract surgery with a diffractive intraocular lens (IOL) in each eye has developed fluctuating vision, greater in the right eye than the left eye, after 4 years. She has a history of inactive central serous retinopathy and a vision potential of 20/25 + 2 in the right eye and 20/25 in the left eye. She has well-controlled diabetes, hypertension, and hypercholesterolemia. She has enjoyed her spectacle independence for some time and wishes to have her vision restored.

On examination, her uncorrected distance visual acuity (UDVA) was 20/50 in the right eye and 20/25 in the left eye and her uncorrected near visual acuity (UNVA) was J3 in the right eye and J1 in the left eye. Intraocular pressures (IOPs) measured 22 mm Hg in the right eye and 18 mm Hg in the left eye. Pupils had limited reactivity with irregularity in the right eye but no obvious relative afferent pupillary defect. Motility and confrontation visual fields were unremarkable in both eyes. Retinal acuity meter was 20/20 in both eyes, and manifest refraction was plano −1.25 × 105 20/40, J3 in the right eye and +0.50 × 20/25, J1 in the left eye.

Pertinent findings on slitlamp examination included temporal iris atrophy and transillumination defects greater in the right eye than the left eye, peripupillary pseudoexfoliative changes in both eyes, significant inferior subluxation of a diffractive 3-piece posterior chamber IOL in the capsular bag with lens-pitting peripherally and few central, moderate pseudophacodonesis, and an open posterior capsule in the right eye. In the left eye, she had mild inferior subluxation of a single-piece acrylic diffractive IOL in the capsular bag with moderate pseudophacodonesis and an open posterior capsule (Figure 1).

All other anterior segment findings were unremarkable. On dilated posterior examination, she had a cup-to-disc ratio of 0.50 in the right eye and 0.65 in the left eye without edema hemorrhage or pallor. There were attenuated vessels in both eyes, posterior vitreous detachment in both eyes, and a few small drusen peripherally in both eyes. There was retinal pigment epithelium irregularity and dropout parafoveal in the right eye and subfoveal in the left eye (Figure 2). There was no evidence of macular edema, subretinal fluid, choroidal thickening, or neovascular membranes. The periphery was unremarkable in both eyes.

What testing would you obtain preoperatively to help guide your decision-making? How would you counsel the patient regarding comorbid conditions and expectations?

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The combination of lens decentration and diffractive optics is associated with a significant decrease in visual quality even if the lens optic occupies the entire visual axis. Lens subluxation, caused by pseudoexfoliation (and age), may progress, and if not treated promptly can lead to further dislocation and a more complicated surgery. Although the visual acuity in the left eye is preserved, surgical intervention is indicated in both eyes.

There are 2 options to correct the lens subluxation: IOL exchange or reposition and refixation of the same IOL. IOL exchange in eyes with severe zonular dehiscence or weakness and an open posterior capsule requires removal of the IOL and the capsule, anterior vitrectomy, and fixation of an alternative IOL. By contrast, repositioning of the same IOL can be performed through 2 side-port incisions and 4 needle holes, in a relatively closed system and usually even without vitrectomy.

Optically, the IOLs are as good as they were on the day of implantation 4 years ago, and the visual potential is apparently good. My first choice would, therefore, be repositioning of the existing IOLs by scleral fixation, preferably using the 6-0 prolene and flange technique. A 30-gauge needle is inserted at 2 mm from the limbus, passing behind the haptic, and it then penetrates the capsule as close as possible to the optic–haptic junction. A 6-0 prolene suture is inserted through a paracentesis on the opposite side, threaded through the needle, and externalized. The same needle is then inserted on the same meridian at 1 mm from the limbus and passes in front of the haptic. The other end of the suture is inserted through the same paracentesis and

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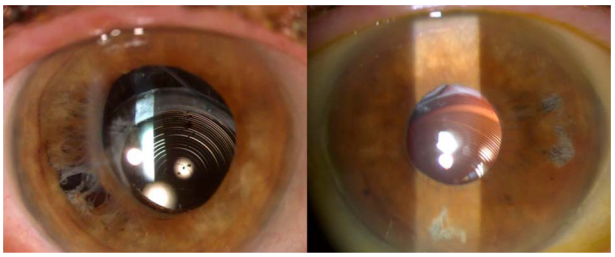

Figure 1. *Left*: Slitlamp photograph of the right eye with significant temporal transillumination defects and an inferiorly subluxed 3-piece acrylic diffractive IOL. *Right*: Slitlamp photograph of the left eye with mild temporal transillumination defects and an inferiorly subluxed single-piece acrylic IOL in the capsular bag with pseudoexfoliative changes on the anterior capsule.

externalized through the 30-gauge needle. The same procedure is performed in a similar manner on the opposite side. The sutures are pulled, the IOL is centered, and 4 flanges are created using low temperature diathermy.

An alternative elegant technique is to secure the fibrosed lens capsule using a capsule-stabilizing device. This may be quite challenging using a modified ring (Cionni) or segment (Ahmed); however, using a capsular anchor (AssiAnchor, Hanita Lenses) only a localized 2-hour pocket between the lens capsule and the IOL optic is required. The internal flange is created before the anchor is inserted into the anterior chamber (Figure 3). The central rod of the device is positioned in front of the lens capsule, and the 2 lateral prongs are positioned behind the capsule to create a capsular clip. The wide contact with the lens capsule provides a stable grip and a low risk for IOL tilt.

Scleral fixation may cause a slight deviation from the intended effective lens position, and therefore, spectacle independence cannot be guaranteed; however, good optical results and long-term satisfactory outcome usually can be achieved.

Disclosures: *The author has no financial or proprietary interest in any material or method mentioned.*

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This 78-year-old woman has likely enjoyed several years of good vision with her diffractive IOL technologies in both eyes. Now, with progressive dislocation of the 3-piece diffractive IOL in her right eye, she likely has induced lenticular astigmatism in her refraction, and loss of UDVA, CDVA, and CNVA. She is fortunate that despite mild dislocation of the single-piece diffractive IOL in her left eye, she continues to maintain 20/25 UDVA and J1 near vision in her fellow eye.

With the observation of pseudoexfoliative changes in the right eye, bilateral IOL dislocations with phacodonesis, and enlargement of optic nerves in both eyes, I would obtain optic nerve and ganglion cell optical coherence tomography (OCT) images to assess for retinal nerve fiber layer (RNFL) and ganglion cell layer thinning as well as automated perimetry to assess for visual field defects in both eyes. Pseudoexfoliation syndrome can often be associated with glaucomatous nerve damage, and with a borderline IOP of 22 mm Hg in the right eye, I would want to evaluate for this comorbid condition. Studies have shown that the presence of pseudoexfoliation is a known risk factor for more rapid glaucoma progression and that IOPs can be more challenging to treat in these cases.[1] Gonioscopy can also be performed to assess the angle structures if glaucoma is suspected.

The presence of glaucomatous nerve changes and visual field defects needs to be discussed in detail with the patient to set appropriate expectations for postoperative vision if an IOL repositioning or IOL exchange was attempted. The patient may experience a diminution in contrast sensitivity and minimal improvement in uncorrected and corrected vision if there are significant nerve fiber and ganglion cell thinning and visual field defects encroaching on the central vision. In addition, risks of sustained IOPs postsurgery need to be discussed, and the patient must be counseled about the need for long-term IOP-lowering therapy after surgery and, even in more severe cases,

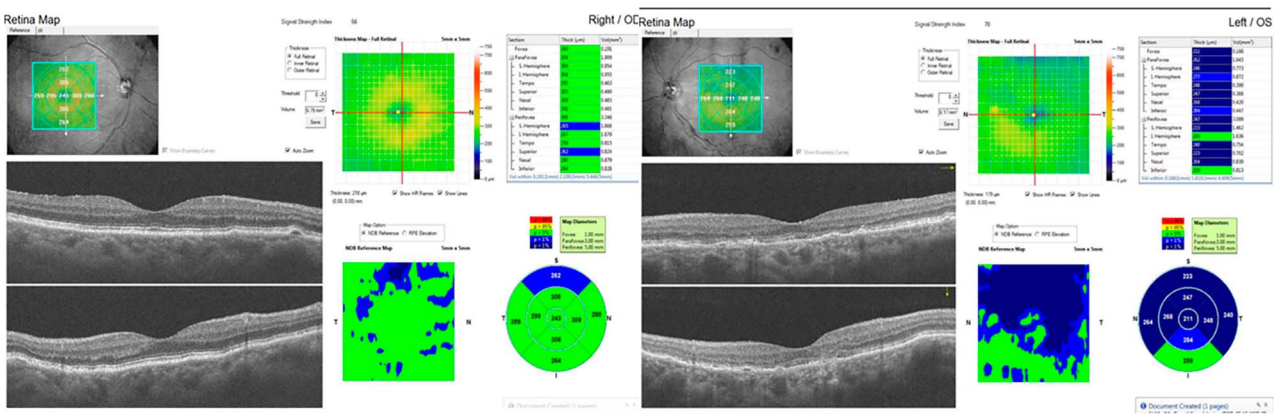

Figure 2. *Left*: Macular SD-OCT in the right eye with mild epiretinal membrane and mild parafoveal RPE changes. *Right*: Macular SD-OCT in the left eye with moderate RPE changes and subfoveal RPE dropout. RPE = retinal pigment epithelium

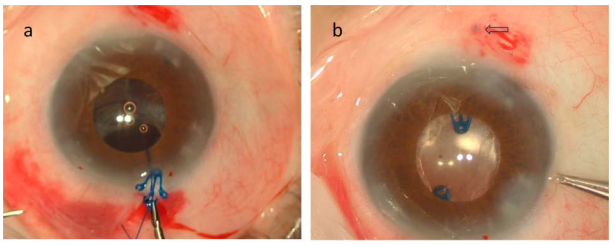

Figure 3. *A*: The central rod of the device is positioned in front of the lens capsule, and the 2 lateral prongs are positioned behind the capsule to create a capsular clip. *B*: A single 30-gauge needle pass is required on each side to externalize the 6-0 prolene suture and secure the IOL. Care must be taken to assure that the flanges are covered well by the conjunctiva and Tenon (*arrow*).

angle-based or incisional glaucoma surgery. These findings must also be balanced with the preexisting retinal changes, although they are mild in nature, to discuss final image quality. It is, however, reassuring that potential acuity meter testing suggests 20/25 + 2 vision in the right eye and 20/20 vision in the left eye.

In addition, in pseudoexfoliation cases, pupillary dilation may be limited. Ultrasound biomicroscopy (UBM) can be performed to better evaluate the position of the IOL and its proximity to the iris tissue. The iris tissue damage seen clinically along with increased IOP suggests uveitis-glaucoma-hyphema (UGH) syndrome, and the UBM images can help confirm this diagnosis. The patient should be counseled that if UGH is left untreated, they can continue to have intraocular inflammation and pressure changes in the eye.

I would also obtain topography to confirm if the cylinder in the patient's refraction is lenticular vs corneal and to also see if there is corneal astigmatism that could warrant correction. Endothelial cell counts and pachymetry can also be obtained to assess if the patient is at risk for corneal decompensation or prolonged corneal edema if a lens surgery is pursued.

In addition, as part of my clinical evaluation, I would lay the patient supine to assess for the degree of posterior dislocation of the IOL. If the IOL remains largely stable with the patient laying supine without significant posterior dislocation, it will be easier to refixate the lens–capsular bag complex to the scleral wall using off-label prolene or Gore-Tex suture. Marked posterior dislocation of the lens–bag complex can suggest insufficient zonular fibers to support scleral refixation of the lens–bag complex, and an IOL exchange may need to be planned for, with the help of a retinal specialist to perform a simultaneous pars plana vitrectomy if the lens falls back posteriorly. Finally, I would also evaluate for the presence of a capsular tension ring (CTR) in the right eye. With a 3-piece IOL, given the thinner haptic design, there is a less robust optic/haptic junction that can be ensnared to fixate the complex to the scleral wall. If a CTR is present, it can be used as a more stable point of fixation for the IOL–bag complex to the scleral wall given its rigid nature.

If a CTR is not present, the surgeon can attempt to remove the capsular bag and maintain the 3-piece diffractive IOL in the eye to attempt either iris or scleral fixation of the IOL; however, the material of the IOL haptics can render intrascleral haptic fixation techniques more challenging; iris tissue with preexisting transillumination defects and thinning can be harder to suture to, and the effective lens position of the diffractive 3-piece IOL will change with both of these techniques, likely resulting in residual refractive error. Finally, full removal of the diffractive IOL and capsular bag and scleral fixation of a 3-piece monofocal IOL can be an option, and may be a more suitable option if there is glaucomatous nerve damage, to provide the patient with best image quality; however, the need for postoperative refractive correction must be discussed with the patient.

Given the stable visual acuity in the left eye and mild IOL dislocation, I would recommend observation and no urgent surgical intervention.

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The management of multifocal IOLs in patients with evolving ocular pathologies exemplifies the intricate balance between the technical aspects of IOL management and individualized patient care in the context of ocular comorbidities.

This 78-year-old woman experienced significant improvement in her vision with multifocal IOLs, achieving spectacle independence before bilateral IOL subluxation. Despite inactive CSR, previous intraoperative temporal iris damage, and signs concerning for mild glaucoma with a large cup-to-disc ratio, she is interested in having her spectacle independence restored.

A comprehensive assessment including detailed ocular examination focusing on the current status of the IOLs, the retina, and a glaucoma evaluation with OCT RNFL to evaluate for glaucomatous damage would be important for patient education and prognosis. Furthermore, it is important to determine whether the history of CSR was remote or after cataract surgery. Although traditional thinking would typically exclude patients with macular pathology from multifocal technology, some studies have suggested that these patients can still benefit.[1,2]

The plan should align with the patient's lifestyle, visual requirements, and health status, and a thorough discussion about each surgical option, the risks, and potential outcomes

is required. The decision between refixation of the existing IOLs or opting for explantation and exchange with monofocal IOLs hinges on several factors. In addition to the patient's retinal history and the signs of mild glaucoma, the most important factor is the patient's commitment to spectacle independence and her risk tolerance. Regarding the patient's right eye, both refixation and exchange of dislocated 3-piece IOLs using scleral fixation have been shown to be effective, with similar visual outcomes and complication rates.[3] However, in this case, we believe that the benefits of preserving the existing multifocal IOLs outweigh the risk of exchange. Of note, the evidence of iris damage from previous surgery may complicate IOL exchange with a larger incision vs the smaller incisions required for refixation.

As the patient desires the opportunity to continue to benefit from her implanted IOLs, it would be reasonable to refixate both IOLs, especially given her potential visual acuity and desire for spectacle independence. Even with a subluxated diffractive IOL in her left eye, her uncorrected distance and near vision are 20/25 and J1, respectively. This suggests that she may adapt well to minor decentration with repositioning of her existing multifocal IOLs.

Given that the right eye has a 3-piece IOL, it is reasonable to attempt refixation of this lens through intrascleral haptic fixation, while the single-piece IOL in the left eye could be refixated using Gore-Tex, polypropylene belt loops, or through the punch-and-rescue technique, depending on the surgeon preference.[4,5] Placement of Gore-Tex sutures 180 degrees apart and equidistant from the limbus with an antitorque configuration is also important to reduce tilt and decentration. Intraoperative OCT could be used to ensure minimal tilt and decentration, and aligning the IOL with the coaxial microscope's light reflex and the first Purkinje image is recommended. One final consideration would be to include minimally invasive glaucoma surgery as part of the surgical intervention if she were definitively diagnosed with glaucoma.

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This is a very complex patient with numerous different issues that require consideration when developing a plan. The main question to answer is should she be offered scleral fixation of her dislocated diffractive multifocal IOLs or if she should undergo IOL exchange for a monofocal IOL. She will require biometry and corneal topography before any further decision-making so as to guide lens choice and counseling.

Putting aside the question of her numerous ocular comorbidities, we must consider the potential of refixating her existing IOLs. Diffractive IOLs rely on excellent centration and require near-zero residual refractive error to perform optimally.[1] For this patient, refixation of her IOLs is technically possible but bears consideration of the potential drawbacks of this approach. Refixation of her right IOL could be performed through intrascleral haptic fixation of the haptics of her 3-piece diffractive IOL.[2,3] Her left single-piece IOL could be refixated through looping a suture through the bag–haptic complex using one of several eloquent techniques.[4]

In addition to the numerous potential complications of scleral fixation, there are 2 unique considerations for diffractive multifocal IOLs.[5,6] Predicting the exact centration and lens position of a scleral-fixated IOL can be difficult, and any patient undergoing this needs to be counseled that there is a substantial likelihood they will have residual refractive error.[7] In the setting of a diffractive multifocal IOL and in a patient with expectations of spectacle independence, this unpredictability in the lens position could mean that the patient would need to wear spectacle correction for distance, near, or at all times. This refractive error could be treated with laser vision correction to provide resumption of spectacle independence.[8]

The second potential issue with scleral refixation of diffractive multifocal IOLs is centration. The tolerance to decentration of these lenses is dependent on numerous factors including central optic zone size, IOL power, keratometry, and lens position within the eye.[9] As centration can be very difficult to perfect when performing scleral fixation, excellent mastery of the surgical technique to do so is critical if attempting this procedure with multifocal IOLs. Even with this, proper consent of the patient regarding potential for postoperative photic phenomena or dissatisfaction with quality of vision is important because centration cannot be guaranteed.

The other major consideration for this patient is the advisability of maintaining her diffractive lenses in the setting of her multiple ocular comorbidities. All diffractive multifocal IOLs result in decreased light transmission to the retina and thus decreased contrast sensitivity.[1] In the setting of retinal disease that can decrease retinal sensitivity further, a diffractive multifocal IOL may result in unacceptably poor image

quality. This patient has a history of central serous chorioretinopathy and evidence of early macular degeneration and is already demonstrating evidence of photoreceptor loss. She also has diabetes and thus has a greater risk for developing macular edema after any intraocular procedure than the average patient. In addition, she has an asymmetrically enlarged cup-to-disc ratio, which can be an indication of glaucoma or glaucoma suspect status. Even early-stage glaucoma can cause loss of contrast sensitivity, which may compound issues with a diffractive multifocal IOL.[10]

Given the numerous ocular comorbidities of this patient, all of which have the potential to interact negatively with a diffractive multifocal IOL; combined with the manifest challenges of refixation of these lenses, we would advise lens exchange with a monofocal IOL. If the patient is amenable and is tolerant of anisometropia, an attempt can be made to target monovision. An eloquent solution would be exchange with scleral fixation of a light adjustable lens, which would enable postoperative adjustment with a potential monovision target.[11]

Complex patients such as this will continue to become more common because our patients who have received diffractive multifocal IOLs age and develop more ocular comorbidities. Decision-making in these cases is difficult to generalize and will need to be carefully considered on an individual basis in light of each surgeon's experience to yield the best outcome.

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EDITOR'S COMMENTS

This case exemplifies the complex decision-making of IOL choice in the setting of pseudoexfoliation and multiple comorbid conditions. Advanced technology IOLs (ATIOLs), such as diffractive and toric IOLs, require proper centration for optimal visual performance.[1] This patient had known pseudoexfoliation and was highly motivated to have spectacle independence. The initial surgeon did not feel pseudoexfoliation was a contraindication for diffractive technology despite the potential for delayed spontaneous dislocation/subluxation. A single-piece acrylic multifocal IOL was placed fully within the capsule bag in the left eye and despite a complex surgery in the right eye, as evident by the iris damage and a 3-piece IOL in the sulcus, a diffractive technology was chosen. It is well known that there is potential for late spontaneous subluxation 7 to 10 years postoperatively in the pseudoexfoliation patient population despite uneventful surgery.[2] Therefore, many surgeons will either avoid diffractive technology altogether or routinely place a CTR when utilizing ATIOLs to facilitate refixation in the event of subluxation. In a randomized study, Kocabora et al. demonstrated that there was no difference in dislocation/subluxation rates with a CTR vs no CTR in the uncomplicated pseudoexfoliation patient population.[3] However, having a CTR may allow for more precise IOL fixation of ATIOLs with 2- or 3-point fixation of diffractive ATIOLs.[4,5]

In this case, the patient was consented carefully that an attempt would be made to lasso-fixate the diffractive 3-piece IOL in the right eye. A pupilloplasty would also be performed to decrease the likelihood of glare and visual discomfort postoperatively. However, if the intraoperative centration was not achieved an IOL exchange with scleral fixation would be performed. This patient had an expectation of some presbyopia correction and right eye dominance was confirmed preoperatively. A back-up plan of a mini-monovision strategy was discussed ahead of time in the event that the current diffractive technology could not be refixated. The patient also had extensive retina and glaucoma evaluation prior to surgery. Fortunately, her retinal exam was stable for over 10 years and RNFL and visual field testing were normal. For these reasons, the right eye 3-piece IOL was lasso-fixated with off-label GoreTex suture at the mid-point of the 3-piece IOL PMMA haptics.

To facilitate accurate centration of the IOL, prior to the sub-Tenon block, the patient was asked to look at the center of the two coaxial microscope lights, which was used as the visual axis centration guide and marked. After scleral fixation, the pupil was constricted with intracameral miotics and an imbricating iris suture was placed using 10-

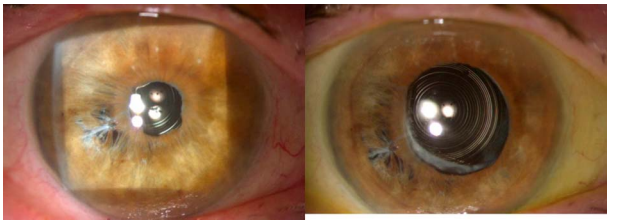

Figure 4. Slitlamp photograph of the right eye in the undilated (*left*) and dilated position (*right*). Note the slight temporal decentration of the diffractive 3-piece IOL central rings and pupilloplasty.

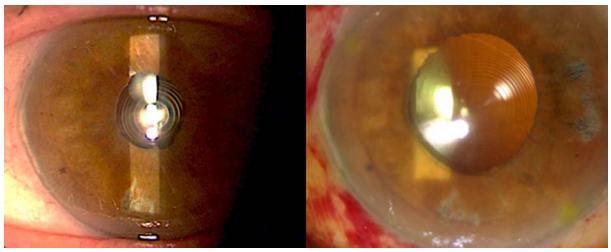

Figure 5. Slitlamp photograph of the left eye in the undliated (*left*) and dilated (*right*) position. Note the ideal centration of the single-piece acrylic diffractive IOL central rings in the undilated and dilated pupil. Centration assisted by digital image guidance.

0 polypropylene with modified Siepser sliding knot. Note the slight decentration of the central IOL rings with respect to the pupil (Figure 4). Surprisingly, the patient achieved a UDVA of 20/20-2 and UNVA of 20/20 despite slight decentration of the central rings. Fortunately, she had no recurrence of the CSR or progression of maculopathy.

Five years later, the patient began experiencing increased fluctuating vision and pigment dispersion in the left eye. Fortunately, the IOP was well controlled off medication and glaucoma testing remained normal. It was decided to proceed with lasso refixation of the in-the-bag single piece acrylic diffractive IOL. In this case, intraoperative technology had advanced, and a digital marking system was used to improve IOL centration as there was no CTR to assist with 3-point fixation. A reference image was obtained by the IOLMaster 700 (Zeiss Meditec) and the Callisto digital marker was employed intraoperatively to locate the visual axis pre- and post-lasso fixation. Of note, an ideal position for lasso fixation of a single-piece acrylic IOL is at the optic haptic junction rather than the midpoint of the 3-piece IOL to ensure symmetrical tension on the haptics (See Figure 6, Video 1). The IOL was fixated with excellent centration and a UDVA of 20/25+1 and UNVA 20/20 (Figure 5).

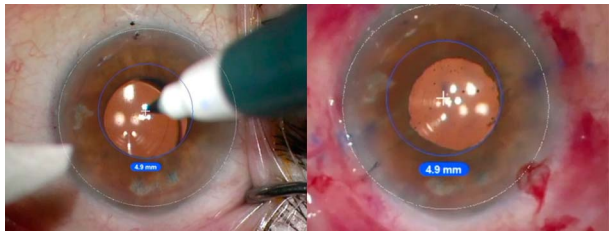

Figure 6. Intraoperative images of the digital image guidance visual axis measurement and marking.

This case demonstrates the unique challenge of balancing patient desires for spectacle independence and comorbid conditions such as delayed zonulopathy, previous maculopathy, and potential for optic neuropathy. Careful diagnostic evaluation, consenting, and consideration of routine CTR placement to facilitate refixation may expand the ATIOL options for this patient population.

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