Complicated Phaco Cases

Tips, insights, and pearls from the experts.

THIS PAST OCTOBER, THE 18TH ANNUAL SPOTLIGHT ON CATARACT Surgery at the Academy's annual meeting was entitled "Complicated Phaco Cases—My Top 5 Pearls." Cochaired by Nicole Fram, MD, and myself, this four-hour event was focused on challenging cataract and IOL cases. The entire Spotlight session can be seen at AAO Meetings on Demand (aao.org/ondemand), or you can watch videos of the individual presentations at aao.org/cataract-spotlight-AAO2019.

During this event, 16 international cataract experts were each given seven minutes to highlight their five best pearls for a specific type of challenging case; or, as speaker Steve Safran said, "all meat and no potatoes." A shot-clock timer was displayed to assure that the take-home points were summarized in a concise and concentrated manner. The topics included rock-hard nuclei, mature white lenses, pseudoexfoliation with weak zonules, intraoperative floppy iris syndrome and iris prolapse, descending and retained nuclei, post-LASIK and post–radial keratotomy eyes, toxic anterior segment syndrome, and phaco in patients with glaucoma or with ocular surface problems. Complex IOL topics included misaligned toric IOLs, subluxated IOLs, IOL exchange, and Yamane double-flanged IOL fixation. A special topic was discussing complications with cataract patients.

A rotating panel of additional experts then shared their own pearls and strategies for these challenging cases in a free-flowing discussion. Finally, using electronic response pads, audience members were able to add their own opinions and preferences for each of the 16 subject areas. The symposium also attracted a virtual audience that watched the program online in real time and was able to respond to the questions along with the live audience.

Kevin M. Miller, MD, concluded the spotlight symposium by delivering the 15th annual Academy Charles D. Kelman Lecture, entitled "Artificial Iris Implantation." In his lecture, Dr. Miller summarized the history of artificial iris implants, culminating with the only FDA-approved artificial iris device in the United States.

This *EyeNet* article reports the results of the 31 audience response questions, along with written commentary from the event presenters and panelists. Because of the anonymous nature of this polling method, the audience opinions are always candid, and they were discussed in real time during the symposium by our panelists.

—David F. Chang, MD
Cataract Spotlight Program Cochairman

AT LEFT: *Approximately 30 years after this patient underwent RK surgery, he was referred to Richard Schulze Jr., MD, for cataract surgery.*

Case 1: Phaco With an Abnormal Surface

Q1.1 A bilateral cataract patient has epithelial basement membrane disease (EBMD) with irregular topography and hates wearing eyeglasses. What IOL would you recommend?

- Monofocal mini-monovision 38.3%
- Extended depth of field (EDOF) IOL 2.8%
- Multifocal or EDOF IOL if the topography is good following treatment with artificial tears 41.1%
- Multifocal or EDOF IOL if the topography is good following phototherapeutic keratectomy 13.1%
- Other 4.7%

Preeya Gupta EBMD is a common condition of the corneal surface. It can lead to irregular astigmatism and poor vision quality. When this condition involves the central cornea and causes irregular astigmatism on topography, it should be treated with superficial keratectomy before cataract surgery. EBMD can affect biometry and topographic measures, which can lead to refractive surprise.

In one study, we found that over 60% of patients have a refractive shift after EBMD is treated.[1] For those patients interested in multifocal or EDOF technology, the ocular surface should be pristine, and addressing EBMD is part of that process. If the patient has only peripheral and self-limited areas of EBMD, the surgeon may consider proceeding with cataract surgery without prior superficial keratectomy. In this case, however, it is important to have a careful discussion with the patient to inform him or her of a potential refractive shift if the EBDM becomes progressive or requires surgical intervention in the future.

1 Goerlitz-Jessen MF et al. *J Cataract Refract Surg.* 2019;45(8):1119-1123.

Q1.2 An 85-year-old patient with bilateral cataracts and nasal pterygia has never worn distance glasses. How would you manage his corneal astigmatism of +2.00 × 90?

- Phaco only (without any astigmatism treatment) 14.0%
- Toric IOL 12.2%
- Astigmatic keratotomy 0.6%
- Phaco combined with pterygium removal only (no other astigmatism treatment) 2.3%
- Remove pterygium only as first stage; then reassess astigmatism prior to doing phaco as a second-stage procedure 70.9%

Ed Holland The first step in assessing a cataract patient with a pterygium is evaluating the significance of the pterygium and how much astigmatism it is inducing. If there is any amount of astigmatism related to the pterygium, I would definitely not recommend a toric IOL or other astigmatism management. A pterygium can progress over time and change the amount and the axis of astigmatism.

If this patient desires to be free of distance glasses, then I agree with the majority of the audience and would recommend pterygium excision only as the first procedure. I would then allow the cornea to heal and reassess the astigmatism when it's stable. Most of these patients will have a significant change in their astigmatism, and some will have their astigmatism eliminated by the pterygium surgery.

Case 2: Phaco After LASIK

Q2.1 Although you may employ multiple methods, what is your single most trusted post–myopic LASIK method for IOL power selection (no prior LASIK records exist)?

- ASCRS calculator average 34.8%
- ORA (intraoperative aberrometry) 5.2%
- Barrett True-K formula 41.0%
- Haigis-L formula 13.3%
- Other 5.7%

Douglas Koch Accurate selection of IOL power in the post-LASIK eye remains challenging. A myriad of approaches have been developed, but none have consistently demonstrated accuracy of over 70% within 0.5 D of target refraction. Some methods require knowledge of the LASIK-induced refractive change; two of these, the Masket and Barrett True-K, are among the most accurate. However, all too often, prior refractive data are unavailable, and we must rely solely on measurements obtained when the patient presents for cataract surgery—the topic of this question. The attendees' responses are split between the Barrett True-K No History and ASCRS calculator average, which includes the Barrett as well. I would make three points:

- As the audience poll suggests, no formula has a lock on accuracy; we certainly have examples where each of the ASCRS options is superior, particularly the optical coherence tomography (OCT) method.
- ORA is a useful method, on par with most formulas, so I am surprised by the low percentage who prefer it.
- Accurate measurement of posterior corneal power may improve outcomes, but to date the incremental benefit of using OCT devices (Avanti, Optovue; and IOLMaster 700, Carl Zeiss Meditec) has been small.

The challenge remains, and one promising solution is postoperative modification of IOL power with technologies that either change IOL curvature with light (RxSight) or employ laser refractive index shaping (Perfect Lens and Clerio).

Q2.2 A post-LASIK patient with bilateral cataracts and good, uniform topography wants to be spectacle-free. What IOL would you recommend?

- Monofocal mini-monovision 55.4%
- EDOF 27.4%
- Multifocal IOL 9.7%
- Light adjustable IOL (mini-mono) 7.5%
- Other 0.0%

Terry Kim This question is one that typically generates dif-

fering opinions. The audience response here represents the broad range of IOL options that exist for the postrefractive patient who desires cataract surgery without depending on glasses. In my practice, the decision is based on a number of factors, including patient history, clinical examination, diagnostic testing, and—perhaps most important—patient personality and expectations.

With regard to patient history, if the patient had aimed for monovision or mini-monovision with his or her LASIK procedure and was happy with this result, then I'm more apt to replicate this scenario with a monofocal or light adjustable IOL. In patients with a high myopic ablation, I'm more likely to offer an accommodating or EDOF IOL over a multifocal IOL, with the goal of minimizing further loss of contrast sensitivity. Depending on the refractive target of a hyperopic LASIK (i.e., distance correction in both eyes vs. monovision), replicating monovision or entertaining the option of an EDOF, accommodating, or multifocal IOL are reasonable options, since the central corneal power in these patients is typically not as significantly altered by LASIK, leading to a more accurate IOL calculation. A normal corneal exam and uniform corneal topography, along with consistent and corresponding results on the Barrett True-K formula, the ASCRS postrefractive IOL calculator, and ORA intraoperative aberrometry, give me more confidence and comfort in proceeding with a presbyopia-correcting IOL in these post-LASIK patients. And, finally, assessing the patient's personality and having a frank discussion regarding realistic expectations is one of the most important factors in achieving a successful outcome.

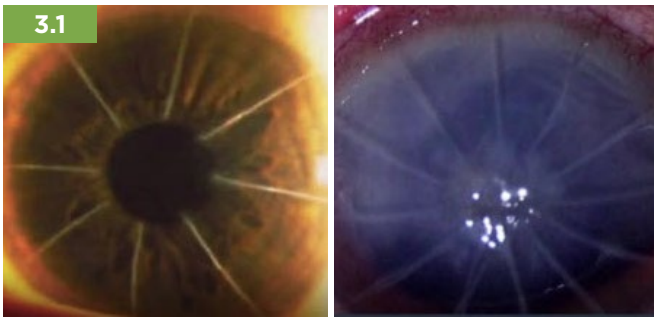
Case 3: Phaco After RK

Q3.1 What is your preferred IOL calculation method for a post–radial keratotomy (RK) patient who needs cataract surgery?

- Use a myopic LASIK formula (e.g., Barrett True-K, Haigis-L) 21.9%
- Average multiple topo power rings for input into formula 4.6%
- ASCRS RK calculator 50.0%
- Option 1, 2, or 3, in combination with ORA 18.4%
- Other 5.1%

George Beiko The audience response favors using the ASCRS RK calculator, and that would be my approach as well—but with a few nuances. Post-RK IOL calculations are among the most frustrating that a cataract surgeon faces because of the corneal irregularity. Since RK flattens both the anterior and posterior corneal surfaces and results in a small optical zone, it is recommended that the flattest keratometry readings be used.

These keratometry values can be derived by using different instruments to measure the anterior corneal curvature and then implementing the flattest K readings for calculation. Alternatively, the average of the 1-, 2-, 3-, and 4-mm



QUESTION 3.1. *In the late 1980s and early 1990s, about 250,000 RK procedures were performed in the United States. These patients may now need cataract surgery.*

ring values on corneal topography can be used (the multizone approach); or, and most easily, the K readings measured by the Zeiss IOLMaster can be directly plugged into the IOL formulas, since these devices measure the central 2.5 mm. For example, the K readings can be entered into the "Average Central Power" field on the ASCRS website for calculating IOL power after refractive surgery (http://iolcalc.ascrs.org/); this will give you access to a modified version of the Holladay 1 formula (with Aramberri Double K method).

The next step is to decide on the target refraction. A myopic refraction based on the number of RK incisions should be targeted; a good guide would be –0.50 D for four-cut RK, –1.00 to –1.50 D for eight-cut RK, and –2.00 D for 12- or more-cut RK. Some further nuances would be that a smaller optical zone of 3 mm and/or longer incisions extending past the limbus would merit a higher myopic target. In terms of the IOL formula, using the Barrett True-K or the Double-K Holladay 1 results in comparable outcomes, with at best 80% of eyes within 1 D of target refraction at more than four months postoperatively. Finally, refractive stability can be expected to be delayed; four weeks for four-cut RK and closer to two to three months for eight- or more-cut RK.

Q3.2 A post-RK patient with bilateral cataracts and +1.25 D cylinder doesn't want to wear glasses. What IOL would you recommend?

- Spherical monofocal IOL 59.3%
- Toric monofocal 26.5%
- Toric EDOF IOL 4.9%
- Light adjustable IOL 6.2%
- Other 3.1%

Sonia Yoo My preferred IOL in post-RK eyes is a spherical monofocal lens. IOL calculations remain challenging in these eyes. A study evaluating the ASCRS IOL calculator for eyes with prior RK showed only 46.7% within ±0.50 D of the intended target, and only 66.7% within ±1.00 D of the intended target.[1] The significant flattening of corneal curvature that occurs with RK causes errors in central corneal power and effective lens position, leading to an underestimation of the predicted lens power and hyperopia after cataract surgery.[2]

Other challenges of performing cataract surgery in these patients stem from irregular astigmatism induced by the

George Beiko, MD

RK incisions, which can sometimes result in a decrease in visual acuity or visual quality postoperatively. Patients who expect to be free of spectacles after cataract surgery may be disappointed if not counseled carefully. Multifocal lenses are best avoided in post-RK eyes because of the loss of best-corrected distance vision that can be seen in such cases.[3] Toric lenses may be used judiciously when the corneal astigmatism is regular. It is important to recognize that the posterior astigmatism may be altered by the RK incisions and that the total corneal astigmatism may differ from the astigmatism measured from your biometer.

EDOF lenses have been reported to have better tolerance for residual refractive error than monofocal lenses with the same material and optical platform.[4] In theory, EDOF lenses or light adjustable lenses might hold promise in post-RK eyes. However, studies of these types of lenses in post-RK eyes have not yet been reported in the peer-reviewed literature.

1 DeMill DL et al. *Clin Ophthalmol.* 2011;5:1243-1247.
2 Lyle AW, Jin GJ. *Arch Ophthalmol.* 1997;115(4):457-461.
3 Martin-Escuer B et al. *Eye* (Lond). 2019;33(6):1000-1007.
4 Son HS et al. *BMC Ophthalmol.* 2019;19(1):187.

Case 4: Toxic Anterior Segment Syndrome

Q4.1 What do you think is the most common cause of toxic anterior segment syndrome (TASS)?

Inadequate instrument cleaning/sterilization	75.2%
Enzymatic cleaner residue on instruments	18.4%
Compounded intraocular drugs	2.9%
Sterilizer reservoir biofilm	2.4%
Other	1.0%

Nick Mamalis TASS is an acute postoperative anterior segment inflammation. This condition is sterile, or noninfectious, and most commonly has a rapid onset within 12 to 24 hours after surgery. Studies at the Intermountain Ocular Research Center of the Moran Eye Center in Salt Lake City have shown that problems with inadequate instrument cleaning and sterilization are the factors most commonly associated with TASS, as 75.2% of the respondents noted. This includes inadequate flushing of phaco and irrigation and aspiration (I&A) handpieces.

Enzymatic detergent residue on surgical instruments after cleaning was the second most common cause noted by the respondents, at 18.4%. Our lab has found that enzymatic detergent residues can remain on surgical instruments even after thorough rinsing and that this can cause TASS. Problems with compounded intraocular drugs or medications are seen much less frequently as a potential cause of TASS, as reflected in the poll results. Of interest, sterilizer reservoir biofilm is a relatively new phenomenon that has been shown to cause TASS and was noted by a small number of respondents. It is important to recognize the most common causes of TASS in order to prevent the occurrence of this potentially devastating complication.

Q4.2 What is your operating room's TASS history (confirmed or suspected)?

Never	45.1%
Less than five cases	42.7%
Five to 10 cases (no TASS clusters)	2.4%
More than 10 cases (no TASS clusters)	1.2%
More than five cases (including a TASS cluster)	8.5%

Eric Donnenfeld TASS is one of the most feared complications of cataract surgery, as it occurs spontaneously and, sometimes, in clusters that can affect large numbers of patients. The first thought is always differentiating between TASS and endophthalmitis. TASS usually presents with a hypopyon and corneal edema on the first day post-op, without pain or vitreous inflammation. The audience responses, which reveal that over 50% of ophthalmologists polled have had a confirmed or suspected case of TASS, speak to how common this complication is in our ORs. The management is high-dose topical corticosteroids, but equally—if not more—important is finding the source of the inflammation. The obvious place to look is the use of new cleaning agents or medications, but in my experience the causes of TASS can be insidious and difficult to determine. An extraordinary resource for ophthalmologists and surgicenters that experience TASS is the Intermountain Ocular Research Center, led by Nick Mamalis.

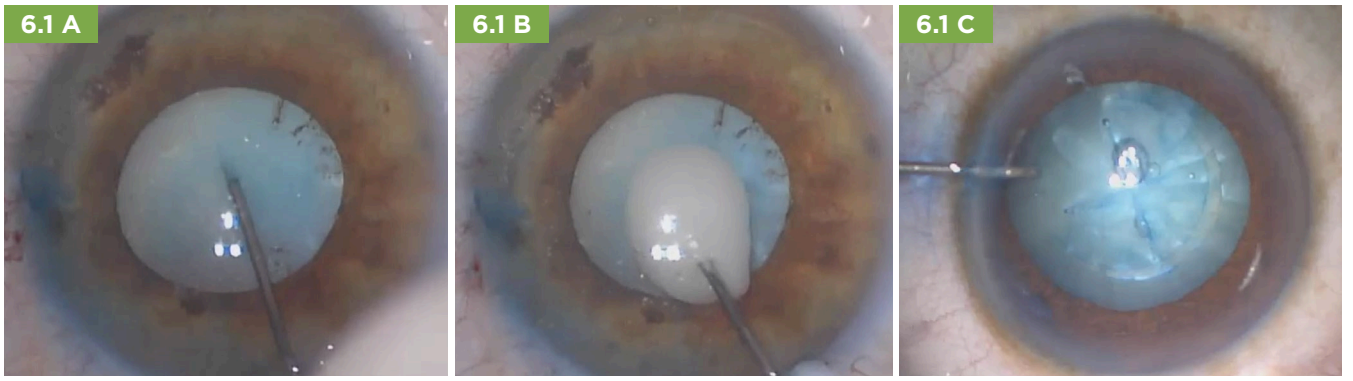
Case 5: Phaco + Glaucoma: Canal-Based MIGS

Q5.1 How many minimally invasive glaucoma surgery (MIGS) procedures have you performed?

I don't perform MIGS	59.1%
One	17.3%
Two	8.4%
Three	7.1%
More than three	8.0%

Tom Samuelson I believe the audience response reflects the fact that MIGS is still in its relative infancy. While the adoption rate continues to grow rapidly, the response showing that 59% don't perform MIGS suggests that a majority of surgeons have not yet adopted this important technology. Of course, on the other side of the equation, 40% have adopted MIGS in one form or another, which is sizable for an emerging technology.

As a consultative glaucoma specialist, I cannot imagine treating glaucoma without utilizing the safer MIGS options that have become available in recent years, especially when performing such surgery together with phacoemulsification. To be sure, I still perform trabeculectomy and place aqueous drainage tubes in substantial numbers, especially in pseudophakic eyes with advanced disease in whom the phaco-MIGS card has already been played. In fact, my own satisfaction with the more efficacious and aggressive options such as trabeculectomy and tube-shunt procedures is at an



QUESTION 6.1. *Circumlinear capsulotomy for mature white cataract.*

all-time high. The reason for my current high satisfaction with these traditional glaucoma procedures is due to improved patient selection. Unlike earlier in my career, pre-MIGS, when trabeculectomy was the first surgical option, I am now performing these higher-risk, higher-reward surgeries on the appropriate patient population—specifically, only those at high risk of functional impairment from glaucoma. I no longer subject patients with mild to moderate glaucoma who are at lower risk of true impairment to such surgeries.

In my opinion, to not adopt MIGS implies one of several possibilities: that many ophthalmic surgeons are simply not involved in surgical glaucoma care, aren't operating on mild to moderate disease, are pushing medical therapy to extremes, or are subjecting some patients to undue surgical risk by skipping the MIGS step and going straight to trabeculectomy or tube-shunt surgery. None of these alternatives seems optimal in 2019 and beyond.

Q5.2 What is your favorite MIGS procedure to combine with phaco in a patient with mild to moderate open-angle glaucoma?

iStent (first generation)	14.2%
iStent (inject)	57.5%
Hydrus	5.2%
Kahook Dual Blade	11.9%
Other	11.2%

Nathan Radcliffe This audience response to this question tells us quite a bit about the MIGS market today. The iStent (Glaukos) is popular in both the first-generation stent and the inject version, but most surgeons have migrated to the inject. This tells us that the audience is learning new techniques and adapting quickly. Presumably, they have chosen the inject due to its favorable safety profile and ability to access several collector channels.

Furthermore, the rest of the market is fairly evenly distributed among Hydrus (Ivantis), the newest entry; Kahook goniotomy (New World Medical); and "other," which I presume is canaloplasty (Sight Science and Ellex) but may also include endocyclophotocoagulation (BVI) or Trabectome (Neomedix). The Hydrus, approved in August 2018, acts as both an intracanalicular scaffold and a trabecular bypass stent. At 6 mm in length, it may be more intimidating to learn. However, a 5% market share after one year with a small sales force tells us that there are surgeons who sought out a larger stent.

I am surprised to see the Kahook Dual Blade with only about 12% of the market, as the stent is clearly popular. This may reflect differences in MIGS choices between the specialized cataract surgeons in attendance at this Spotlight lecture and glaucoma specialists and comprehensive ophthalmologists who may gravitate more toward Kahook. Finally, canaloplasty is growing, with Sight Science developing a robust sales and marketing team. It will be interesting to see how these numbers look at AAO 2020.

Case 6: White Cataract

Q6.1 What is your preferred capsulotomy method for mature white cataracts?

Femtosecond laser capsulotomy	7.2%
Zepto capsulotomy	0.4%
Manual continuous curvilinear capsulorrhexis (CCC; first aspirate cortex with needle)	73.0%
Manual CCC (no cortical aspiration)	18.6%
Would refer this case	0.8%

Elizabeth Yeu The capsulotomy/capsulorrhexis can be one of the most challenging steps in surgery for a white cataract because the lens is under significant pressure within the capsule. The mere entry through the anterior capsule can lead to a spontaneous splitting in opposite directions across the anterior capsule, known as the dreaded "Argentinean flag" sign.

A circumlinear capsulotomy can successfully be created by decompressing the contents within the bag by initially performing a manual needle decompression. A short 27-gauge needle is introduced into the eye, bevel down, through either the paracentesis or the primary wound. The needle is inserted through the anterior capsule exactly where the manual capsulorrhexis would have been started. Then, the surgeon slowly pulls back on syringe in order to remove the milky, liquefied lens material (Fig. 6.1 A). I aspirate just enough to ensure that the lens capsule is flat, not concave from too

Elizabeth Yeu, MD

much removal of lens material, as this can make the capsulorrhexis formation more challenging. Creation of the capsulorrhexis may continue to be challenging until its completion because of the positive pressure. Liquefied lens material may continue to rise out of the bag (Fig. 6.1 B). One may need to aspirate this material throughout, deposit dispersive viscoelastic to deepen the anterior chamber, and flatten the anterior capsule, in order to complete the capsulorrhexis.

Finally, a femtosecond laser–assisted capsulotomy can be helpful. The dock must be very flat. Recall that the laser simultaneously treats across the plane of the lens, from the posterior-to-anterior direction. If the lens is tilted, a very small laser-created opening can lead to splitting of the lens capsule. Also, trypan blue should still be used intraoperatively for laser-assisted capsulotomies because small capsular tags from untreated areas are not uncommon. These occur because the pressurized lens may lead to wrinkling of the capsule, and/or the lens "milk" that is released may occlude the anterior capsule and prevent it from being treated by the laser (Fig. 6.1 C).

Q6.2 How would you proceed following an Argentinean flag capsulotomy tear in a white lens with 3+ nuclear sclerosis?

- Enlarge the capsulotomy and perform phaco in the bag 37.9%
- Prolapse the nucleus anteriorly and phaco it in the anterior chamber 50.9%
- Convert to a large-incision manual extracapsular cataract extraction (ECCE) 7.9%
- Convert to a sutureless, small-incision manual ECCE 3.3%
- Abort surgery and refer the patient 0.0%

Bonnie Henderson The split of the anterior capsule due to increased pressure inside the capsular bag, known as the Argentinean flag sign, is a dreaded but often unavoidable occurrence. The results of the survey show one reassuring result, in that 100% of the respondents felt comfortable managing this situation and did not need to abort the surgery to refer to another surgeon. Nearly 90% of the respondents would proceed with phacoemulsification, with most of the respondents prolapsing the nucleus and leaving the capsular bag alone. This would also be my approach in this situation. Often, the extent of the split is confined to the anterior capsule and has not progressed past the equator to the posterior side. However, continued manipulation of the lens, especially rotating the lens, can cause the split to extend. Therefore, whatever approach a surgeon chooses, it is prudent to minimize any further manipulation of the lens while still inside the capsular bag. Fortunately, when an Argentinean flag sign occurs, the lens is often surrounded by milky cortex with a smaller and softer inner nucleus. The cataract is usually not a large brunescent rock. So prolapsing the lens into the anterior chamber is often done without much difficulty. And since the capsular opening is large due to the split, enlargement of the opening is unnecessary.

I recommend injecting dispersive viscoelastic between the cornea and the lens after it has been prolapsed into the anterior chamber. Providing this additional protection to the corneal endothelium is advisable, since the ultrasonic energy for emulsifying the lens will be closer to the cornea. Once the lens is removed, it is important to maintain a formed anterior chamber to prevent the anterior face of the vitreous from prolapsing anteriorly, which could extend the capsular tear. When the surgeon proceeds to remove the cortex, lowering the irrigation and vacuum parameters will decrease the risk of further extension of the capsular split. Remember to remove the cortex from areas that are not directly under the capsular extension and to leave those two areas last. With sufficient posterior capsular support, the IOL may be safely placed in the bag. Another option is to place a three-piece IOL in the sulcus with optic capture.

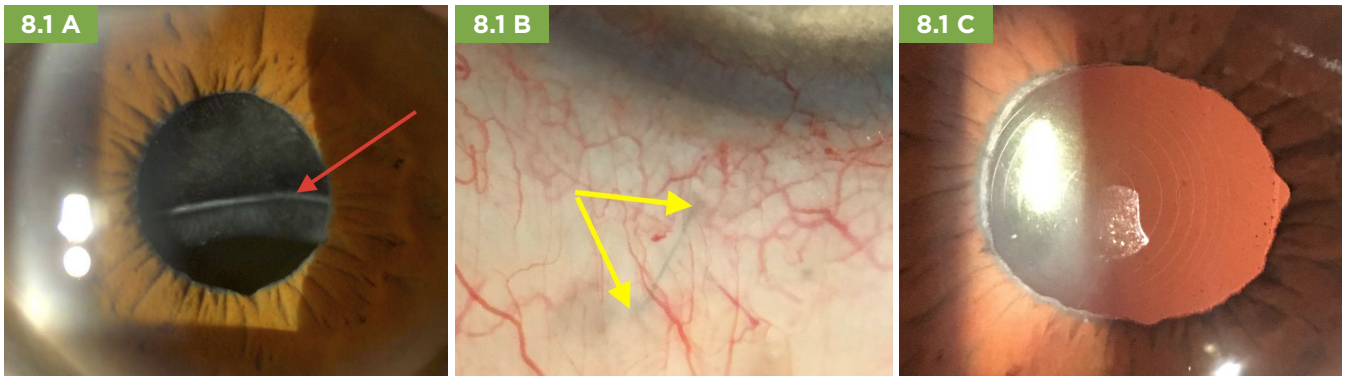
Case 7: Pseudoexfoliation and Zonulopathy

Q7.1 Upon noting severe intraoperative zonulopathy in a pseudoexfoliation (PEX) patient, how would you proceed?

- Commence careful phaco without additional devices 11.6%
- Place a capsular tension ring (CTR) and then phaco in the bag 16.7%
- Place capsule/iris retractors and then phaco in the bag 25.5%
- Place capsule retractors plus a CTR and then phaco in the bag 44.4%
- Convert to a manual ECCE 1.9%

John Berdahl When touching a capsule for the first time and observing striae and a loose lens, you get a sinking feeling. Most of the time we notice phacodonesis preoperatively, but on occasion we are surprised intraoperatively. The audience responses suggest that 44% of surgeons would place capsule retractors and a CTR and then phaco in the bag. The second most common answer was to place capsule retractors and then phaco in the bag. These two responses account for 70% of the total respondents. I would do the same as the respondents.

Depending on the level of zonulopathy, my first step would be to complete an appropriately sized and centered capsulotomy. Occasionally, you need to place a capsule retractor just to complete the capsulotomy, but that is the exception, not the rule. Once the capsulotomy is complete, then I would do hydrodissection and put some viscoelastic between the cataract and the anterior capsule. Next, I would put in at least three capsule retractors. If the lens was stable, then I would proceed with phaco, but if the capsule continued to be floppy in the periphery, I would place a CTR early. Once most of the cataract is removed, I would definitely place a CTR. Usually, we can get the entire cataract out because the capsule retractors do such a nice job of stabilizing the capsule complex. Placing a CTR helps ensure that tension is evenly



distributed throughout the equator of the capsular bag, and it provides a "handlebar" to fixate the lens-bag complex to in the future if needed.

The next big question is: Do we need to somehow fixate the lens-bag complex at the time of surgery? Since the original question implied severe intraoperative zonulopathy, I do think that some sort of fixation method is likely warranted. There are a number of ways to accomplish this. A straightforward method is to put the lens in the sulcus with optic capture of the capsular bag. This helps keep the lens centered, and usually the lens is quite stable. You do need to be careful, however, if the zonulopathy is severe, as the haptics may rotate through the zonules and into the anterior vitreous. My next preferred technique is typically suturing an Ahmed capsular tension segment (CTS) or a Cionni CTR. Depending on the severity of the zonulopathy, one or two points of fixation may be warranted.

Q7.2 What method of posterior chamber (PC) IOL fixation do you favor in a PEX patient with advanced zonulopathy?

In the bag without CTR	3.4%
In the bag with CTR	41.2%
In the bag with Cionni/Malyugin CTR or Ahmed CTS	14.7%
In the sulcus with CCC optic capture	34.3%
In the sulcus without CCC optic capture	6.4%

Boris Malyugin In most cases, generalized zonular weakness is best managed by CTR implantation followed by placement of a single-piece IOL. However, if the capsular bag is still unstable after CTR insertion, it might be a good idea to get additional support by placing the haptics of a three-piece IOL in the ciliary sulcus. To do this, the IOL optic is implanted into the capsular bag and captured by the anterior rhexis opening, while the haptics extend out of the bag with the haptic tips supported in the sulcus. Thus, the weight of the lens is equally distributed between the zonules and the sulcus, improving both the immediate and long-term stability of the implant. As for the Cionni and Malyugin modified CTRs or Ahmed CTS sutured to the scleral wall, I find them most useful for cases with zonular dialysis extending 3 clock-hours and for hereditary lens dislocations such as in Marfan, Marchesani, and similar syndromes.

QUESTION 8.1. *Reoperation to fix subluxation of the bag/CTR/MFIOL complex. (A) Left eye of patient with marked subluxated bag/CTR/MFIOL complex. Arrow indicates upper edge of the IOL below the midpupil plane. Note poor dilation secondary to PEX. (B) Radially oriented 10-0 polyester suture (between arrows) holding CTR complex in place. Three such sutures were placed. (C) Post-op view reveals excellent centration of the MFIOL seen through the poorly dilated pupil.*

Case 8: Capsule Tension Rings

Q8.1 In what percentage of eyes with PEX do you place a CTR?

I don't use CTRs	16.7%
Less than 10%	46.7%
10% to 33%	20.7%
33% to 66%	7.5%
More than 66%	8.4%

Sam Masket We have come to recognize what standard (not modified scleral-sutured) CTRs can and cannot do. Intraoperatively, in cases with zonulopathy, a CTR may help center the capsular bag and place the posterior capsule on stretch, reducing the chances for posterior capsule rupture (PCR). However, evidence is now clear that a CTR does not prevent or preclude progressive anterior capsule phimosis and late zonulysis with bag/CTR/IOL subluxation. That said, a significant proportion of respondents continue to place CTRs in cases with PEX. It is unclear from the structure of the question whether modified (scleral-sutured) CTRs were to be considered. But is there a role for the standard CTR?

One advantage of a standard CTR for cases with PEX or other causes of progressive zonulysis may be manifest later, if the capsular bag decenters and requires fixation to the scleral wall. Certain specialized IOL types, toric and multifocal (MFIOL) in particular, require near-perfect centration for best optical performance. While it is possible to suture-fixate the IOL haptics to the sclera with a lasso-type suture, it is extremely difficult to achieve the degree of IOL centration necessary for specialized IOLs with that method of fixation. However, if a CTR had been placed at the time of the original surgery, it could be suture-fixated to the sclera in three or more places, allowing the surgeon to achieve an excellent outcome.

Sam Masket, MD

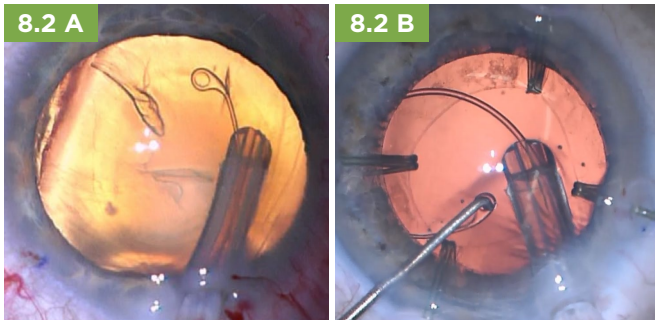
Consider the following case: A 68-year-old man requested MFIOLs and was noted to have PEX only in the left eye. Surgery for the right eye was routine. Although surgery for the left eye was also uncomplicated (a pupil expansion ring was required) and the capsular bag was stable despite PEX, a standard CTR was placed in the bag. The patient enjoyed spectacle-free vision over a number of years. However, six years after surgery, the patient returned with marked subluxation of the bag/CTR/MFIOL complex (Fig. 8.1 A). At reoperation, the CTR (not the IOL haptics) was suture-fixated to the eyewall with 10-0 polyester suture in radial orientation to prevent IOL torque and tilt (Fig. 8.1 B); three sutures, each 120 degrees apart, were placed and tied with slipknots so that suture tension could be titrated and good centration achieved. Postoperatively, the IOL demonstrated excellent centration, and the vision returned to normal (Fig. 8.1 C).

The clinical course of this case suggests that a standard CTR can be considered in PEX cases, allowing it to be fixated to the eyewall if subsequent zonulysis occurs. Given that possibility, to my sense, younger patients and eyes with specialized IOLs would potentially benefit most from the use of standard CTRs in the presence of PEX.

Q8.2 What is your preferred method for implanting a CTR?

- Manual insertion 19.9%
- Preloaded injector 39.8%
- Reusable injector 28.1%
- Option 1, 2, or 3, but with a suture "leash" through the CTR tip 0.5%
- I never use CTRs 11.7%

Tom Oetting I agree with the audience and have a preference for the use of injectors for CTR insertion, particularly the preloaded injectors. These injectors come in various sizes, and the CTR is preloaded to come out toward the left or toward the right. I like to have the CTR come out aimed toward any known area of zonular weakness (Fig. 8.2 A). This strategy helps to minimize iatrogenic injury to the zonules by pushing toward, rather than pulling on, the weak area of zonules. I prefer to use the preloaded injector along with a Sinskey hook to guide the leading eyelet of the CTR to make insertion especially gentle and to avoid other structures like capsule retractors (Fig. 8.2 B). I learned this technique from Dr. Dan Bettis from Kansas City.



QUESTION 8.2. *Using a preloaded injector for CTR insertion.*

Case 9: Intraoperative Iris Prolapse

Q9.1 What is your most commonly used adjunct technique for a patient with intraoperative floppy iris syndrome (IFIS) and a 3.5-mm pupil?

- Viscodilation 2.8%
- Intracameral phenylephrine/epinephrine 35.9%
- Pupil expansion ring 47.5%
- Iris retractors 13.4%
- Other 0.5%

Sam Garg Options to aid in pupil expansion in the setting of clinically evident IFIS are numerous. One should have familiarity and comfort with all of the options listed above, as there is no fail-safe adjunct or technique. All surgeons have their own definition of what constitutes a small pupil and what technique and/or device they favor, depending on the situation and patient.

In my opinion, iris ring expansion devices have helped tremendously in managing the IFIS patient. I prefer to use a larger ring (Malyugin 2.0, 7-mm ring; MST), as I find that the larger size results in extra stretch on the pupil, keeping it taut. Certainly, there is some debate about this, with other surgeons favoring smaller rings (easier to implant/remove, etc.). One negative aspect of iris rings is that the dilation is not titratable, which can lead to some iris chafe. There is also a learning curve with iris rings that can be challenging when first using them. Once the initial learning curve is mastered, use of iris rings has several benefits: faster cases (translating to less corneal damage and less chance for complication), predictable iris expansion, easy implantation and removal, and minimal iris damage, among others. Overall, I am a fan of iris expansion devices for IFIS cases, and I breathe a little easier knowing I have them in my tool belt when approaching these complex cases.

Q9.2 How would you proceed when posterior pressure accompanies iris prolapse during cortical aspiration?

- Resume I&A via new incision 50.9%
- Pars plana vitreous tap 24.5%
- Stop surgery and resume in one hour 22.6%
- Excise prolapsed iris and abort surgery 1.9%
- Abort surgery and leave iris prolapsed externally 0.0%

Dick Lindstrom The management of iris prolapse in the face of positive posterior pressure is a common challenge during cataract surgery. Before attempting to reposit the iris, it is important to stop and take the time required to diagnose the cause. The primary issue, simply stated, is greater pressure behind the iris than anterior to it. A short or posterior incision entry into the anterior chamber is a common cause. In this case, softening the eye by releasing fluid through the paracentesis; gentle repositioning of the iris into the eye, followed by closing the first incision; and creating a new incision before completing I&A work well. This was the dominant choice of the audience at 50.9%.

Tom Oetting, MD

If, despite fluid release from the paracentesis, the chamber shallows more and the eye remains rock hard, it is important to rule out the most dangerous cause, a suprachoroidal hemorrhage. These patients have significant pain, especially if being operated on under topical anesthesia. A dark shadow in the red reflex is usually present, and examination with an indirect ophthalmoscope or intraoperative contact lens is confirmatory. In this situation, the case must be aborted and a pars plana vitreous tap is contraindicated. Usually, with the help of a cohesive viscoelastic, the iris can be reposited, a suture placed, and the case aborted. Consultation with a retina specialist is usually advised.

The management of IFIS, PEX, and zonulysis is discussed in other case presentations. Iris hooks and capsule retractors can be valuable in these cases. Capsular block syndrome is another cause. It is more frequent in axial myopes and can be released by simply lifting the iris from its adhesion to the capsule. Irrigation fluid misdirection can result in a rock-hard eye and may be caused by fluid passing through either the zonules or a capsular opening, resulting in a shallow anterior chamber and iris prolapse. Here, performing a pars plana vitreous tap, as recommended by 24.5% of the audience, and stopping surgery and sending the patient to the recovery room for one to two hours before returning to the OR and completing the case, as recommended by 22.6%, are both effective. The extremely hyperopic or nanophthalmic eye with a very crowded anterior chamber can usually be managed with a small anterior vitrectomy at the start of the case.

The management of iris prolapse in the face of positive posterior pressure is an important skill. It requires a pause in surgery during which the differential diagnosis is reviewed. Once the proper diagnosis is made, appropriate treatment can be instituted.

Case 10: Rock-Hard Nucleus

Q10.1 What is your preferred technique for an ultrabrunescent, rock-hard cataract?

- Divide-and-conquer phaco 32.1%
- Phaco chop 26.9%
- Prechop (e.g., miLOOP) 14.6%
- Femtosecond laser–assisted cataract surgery (FLACS) 3.8%
- Manual ECCE 22.6%

Rudy Nuijts For a rock-hard nucleus, I prefer to perform a chop technique unless it is a really black cataract, where an ECCE is indicated. Compared with a routine case, I tend to enlarge the capsulorrhexis to facilitate nuclear prolapse into the anterior chamber in anticipation of the possible need to convert to ECCE. To protect the endothelium, a generous and replenishing use of dispersive viscoelastic is indicated during the entire phacofragmentation phase. Modern phaco technology, with torsional and pulsation modes, helps to reduce the amount of phaco energy applied and to limit the amount of endothelial trauma. FLACS does not appear to be popular in the poll, even though it may decrease total phaco energy through its ability to create prefragmentation planes in the brunescent nucleus.

Q10.2 How experienced are you with manual ECCE?

- Very experienced 24.6%
- Some experience (and comfortable with) 18.2%
- Some experience (but not very comfortable) 27.1%
- Very limited (or no) experience 18.2%
- Also comfortable with sutureless manual small-incision cataract surgery (MSICS) 11.8%

Susan MacDonald It is good to see that over 50% of respondents have some experience with ECCE or MSICS. For those who responded that they do not feel comfortable with ECCE, there are several opportunities to get adequate training. Both the Academy and ASCRS offer wet labs at their annual meetings, and SEE International has several training programs throughout the year.

QUESTION 10.2. *Using a vectis to remove the nucleus in a MSICS procedure.*

What is the benefit of adding these skills? There are situations in which these techniques may be superior to phacoemulsification, and adding these skills expands surgical options for managing complex mature cataracts. Cataract surgeons who become proficient in these techniques will have all the tools they need to manage the most difficult dense cataracts.

Compared to classic ECCE, MSICS uses a smaller incision, does not require sutures, induces less astigmatism, is easier to learn, uses fewer instruments and supplies, and is faster to perform. Complication rates are also lower.[1]

Drs. Haripriya and Chang demonstrated this in their study comparing complication rates of phacoemulsification and MSICS and found them comparable in the hands of an experienced surgeon.[1] MSICS does not require the use of expensive technology, elaborate instrumentation, or large quantities of consumables, and it is easier to learn. Because the equipment is simple, there is no need for a well-trained technical staff to maintain it.

The simplicity of the MSICS technique allows a surgeon to operate in different settings where phacoemulsification is not available and the need for cataract surgery is great. Cataracts continue to be a leading cause of blindness. Since 87% of cataract blindness is in developing countries, it is important to have techniques that are inexpensive, efficient, and easy to teach.

1 Haripriya A et al. *J Cataract Refract Surg.* 2012;38(8):1360-1369.

Susan MacDonald, MD

Case 11: Descending/Retained Nucleus

Q11.2 How would you manage a nuclear quadrant in the posterior chamber after noting PCR and vitreous prolapse into the anterior chamber?

- Viscoelevate the nuclear fragment, manually extract it, and then perform an anterior vitrectomy 17.4%
- Viscoelevate the nuclear fragment, perform a limbal anterior vitrectomy, and then resume phaco 30.3%
- Viscoelevate the nuclear fragment, perform a pars plana anterior vitrectomy, and then resume phaco 9.1%
- Perform an anterior vitrectomy and then let the nucleus descend before aborting surgery 36.4%
- Abort surgery and refer the patient 6.8%

Allen Ho In this scenario of capsular rupture and vitreous prolapse into the anterior chamber, 93% of respondents would perform vitrectomy (anterior approach preferred, but 9% would choose a pars plana approach). Only about 7% would abort surgery and refer to a retina specialist—always a reasonable consideration for a patient (and for OR case flow). That the vast majority of cataract surgeons will manage with some type of vitrectomy is a reminder of the words of Dr. Lisa Arbisser: "Practice your fire drill." Because cataract surgeons are so outstanding at avoiding this scenario, a fire drill for this uncommon event makes great sense. These concepts are likely familiar to the readers, and here's a play by play:

- Stabilize fluidics and inject side-port ophthalmic viscoelastic device (OVD) before removing the phaco probe; create a closed anterior chamber (suture your original coaxial cataract incision).
- Protect the cornea and the retina with OVD.
- Use separate anterior chamber infusion and vitrectomy incisions (watertight for stability).
- Stain the vitreous with triamcinolone ("throwing a sheet over the ghost"—another Dr. Arbisser quote that I love).
- Cut vitreous (don't pull) with high-rate vitreous cutting.
- Know that small lens fragments can be observed and do well.
- Place an IOL if possible (sulcus can work well).

Remember that retina specialists are your goalies, and we've got your back.

Soon-Phaik Chee Vitreous in the anterior chamber in the presence of a PCR needs to be dealt with before phacoemulsification of the remnant nucleus. The anterior chamber should be filled with dispersive OVD, displacing the vitreous to the side of the PCR when possible, so that one can access the nuclear fragment before removing the phaco probe. The fragment in the posterior chamber is then elevated into the dispersive OVD trap using two Sinskey hooks acting together like chopsticks. A separate snug limbal incision is created for a 23-gauge posterior vitrectomy cutter. Diluted triamcinolone acetonide is injected into the anterior chamber to stain the vitreous. A 23-gauge anterior chamber maintainer is inserted into a new, snug limbal incision between 2 and 4 clock-hours away from the phaco side port.

The infusion is started at a low bottle height or low pressure, directing the fluid away from the fragment. Vitrectomy is initiated at high cut rate and low flow rate and vacuum, keeping the cutting port deep to the plane of the posterior capsule. This pulls vitreous posteriorly as it is cut, prevents enlargement of the PCR, and minimizes vitreous traction. Once all the presenting vitreous and the vitreous deep to the posterior capsule has been cleared, the vitrector is switched to the aspiration mode, and cortex is stripped from the capsular bag fornix and aspirated. More dispersive OVD is injected to fill the anterior chamber to stabilize the fragment and prevent vitreous herniation, and the infusion is then switched off and removed.

The residual capsule support should be assessed at this juncture. If possible, round off the posterior capsular tear using capsulorrhexis forceps to limit its extension. Depending on the size and location of the PCR, a single-piece acrylic IOL is inserted into the capsular bag if there is adequate support, or a three-piece IOL is inserted into the anterior chamber completely or in the sulcus (preferable, with posterior optic capture). Adjusting the phaco parameters down, the surgeon slowly emulsifies the remnant quadrant of nucleus whole, ensuring that the anterior chamber remains adequately pressurized to prevent further vitreous herniation. Care needs to be taken to keep the phaco tip from hitting and marking the IOL, while staying away from the cornea, as the space for manipulation is smaller than usual. A three-piece IOL in the anterior chamber should then be manipulated into the sulcus and optic-captured if possible. Next, the incisions are hydrated. Diluted triamcinolone should be reinjected into the anterior chamber, and the vitrector with the anterior chamber maintainer used to clear residual OVD and vitreous strands, if any. The pupil is constricted before removal of instruments, the incisions are sealed, and all incisions are rechecked. Finally, intracameral antibiotic is administered.

Surprisingly, over a third of the audience elected to perform an anterior vitrectomy and then let the nucleus drop. It is uncertain if this refers to coaxial anterior vitrectomy, which should be abandoned today, and only dissociated vitrectomy performed to minimize vitreous loss.

Close to another third opted to viscoelevate the nuclear fragment, perform a limbal anterior vitrectomy, and then resume phaco. In principle, this is similar to what I would do. A trimmed Sheets glide may also be used to support the nucleus for phaco. Without a scaffold, nuclear fragments may still drop, and one should avoid chopping the nucleus to minimize this risk.

Almost a tenth of the audience would perform vitrectomy using a pars plana approach. While this has been advocated by many experts as being safer because the vitreous is pulled posteriorly, one needs to be trained to do this safely. The issue is that the trocar cannula system is difficult to insert when the eye is soft. In addition, local anesthesia will need to be given.

About 17% would manually extract the fragment after viscoelevation and then do anterior vitrectomy, while a small number opted to abort the surgery, presumably referring to a vitreoretinal colleague to complete the case. There is no shame in choosing the last option, which is a safe option. However, the cataract surgeon who learns how to manage the nucleus and vitreous safely will be able to reduce the postoperative chair time.

Case 12: Discussing Complications With Patients

Q12.1 Would you apologize to the patient ("I'm sorry") if the wrong IOL was implanted, resulting in a +6.00 post-op refractive error?

Yes	89.5%
No—not my fault (e.g., RN opened wrong IOL)	0.6%
No—can be fixed with IOL exchange	7.4%
No—would increase the likelihood of lawsuit	0.0%
Would ask malpractice carrier for advice	2.5%

Bob Osher I am glad that the overwhelming majority of surgeons would offer an apology to the patient. This is the correct approach (short of suicide) for a 6-D refractive surprise. Perhaps an explanation for the error might also be appropriate, but at the very least, a sincere apology, reassurance, and a plan to exchange the lens are recommended. Patients are more likely to be understanding if they know that the surgeon feels contrite and concerned and is willing to try his or her hardest to fix the problem. The apology should be issued just after you have picked yourself up off of the floor and regained full consciousness!

Q12.2 How many times have you been sued (or had intent filed) by cataract patient?

Never	73.5%
Once	21.6%
Two or three times	3.8%
More than three times	0.0%
I don't do cataract surgery	1.1%

Bryan Lee The majority of the audience fortunately has not been sued by a cataract patient. However, a surgeon's risk of being sued at least once is statistically very high. As both the number of cataract surgeries and the expectations grow, good doctor-patient communication becomes even more essential. Although we are all squeezed for time, surgeons should have a careful informed consent conversation and set preoperative expectations appropriately. Complications are rare but usually can be defended successfully as long as the informed consent is proper, the documentation is clear and thorough, and the complication is handled correctly with appropriate and timely referral when necessary. Hopefully, surgeons can forestall a lawsuit by maintaining the best possible relationship with unhappy patients, making it clear that they are partners who will work through problems together.

KELMAN LECTURE. *Kevin M. Miller, MD, was the 2019 Charles D. Kelman lecturer. He is shown here with Drs. Chang (left) and Fram (right).*

Case 13: Misaligned Toric IOL

Q13.1 What is your preferred method for aligning the axis of a toric IOL?

Manual ink marking	73.5%
Manual marking with ORA	14.6%
Digital axis marking with or without ORA	7.6%
Femto-capsulotomy marking	2.2%
Other	2.2%

Zaina Al-Mohtaseb There are three points during the procedure at which alignment errors can occur: the initial reference marking, the marking of the alignment axis, and the actual IOL alignment. An error at any of these points can affect the outcome of surgery—in fact, for every degree of misalignment, about 3.3% of the cylinder power is lost. There are many ways to mark the alignment axis, including manual marking, ORA, automated alignment (Zeiss Callisto or Alcon Verion, for example), and femto-capsulotomy marks.

There are multiple special markers—including graduated rings that can be used for manual intraoperative marking of the steep corneal meridian based on the manual reference marks placed while the patient is sitting upright—to account for potential ocular rotation errors. Automated alignment systems involve preoperative mapping of the astigmatic axis relative to visible anatomic landmarks, followed by digital intraoperative alignment; these systems avoid the need for manual reference marks. Aberrometry-based alignment methods such as the ORA measure the refraction and astigmatic error intraoperatively and guide the surgeon in aligning the toric IOL.

It is not surprising that 73.5% of surgeons prefer to use manual ink markings for aligning the axis of the toric IOL,

since that is the cheapest method and has been used the longest. It is essential to be precise in marking the patient, though, and to make sure to cover the other eye. Some issues with manual marking include the width of the ink marks, which can be as large as 5 or even 10 degrees. In patients with high astigmatic correction, every degree of misalignment matters significantly.

I use a combination approach, which includes manual marking, femto-marking, and ORA. We are going to start using a digital marking system in our ambulatory surgery center soon. Although expensive, high-tech tools that utilize digital marking can avoid problems with manual marking. As these systems get upgraded, become more sophisticated, and connect with preoperative measurements and postoperative outcomes, they will become more and more useful for the surgeon—but price will always affect adoption rates.

Q13.2 How would you manage a +2.25 toric IOL that is misaligned by 10 degrees?

- Would leave it alone....16.4%
- Recommend toric IOL rotation in the office....1.8%
- Recommend toric IOL rotation in the OR....36.8%
- Inform the patient and leave it up to them....43.3%
- Would refer elsewhere for toric IOL rotation....1.8%

Mitch Weikert Studies have shown that toric IOL misalignment is common and averages approximately 4 to 7 degrees, with up to 7% of eyes off by more than 10 degrees (even with the use of automated alignment systems). A rotation of 10 degrees will decrease the effective astigmatism correction by about 33% and can also induce astigmatism in a direction opposite to the IOL misalignment.

Misalignment can be caused by incorrect reference marking, improper intraoperative positioning, or postoperative rotation. Post-op IOL rotation typically occurs within 24 hours, and the risk may be greatest within the first hour after surgery.

IOL alignment can be easily verified by rotating an on-axis slit beam to line up the toric marks etched on the IOL, imaging with a biometer or topographer equipped with a built-in reticle, or using a readily available smartphone app. Surgical correction is easiest within the first few weeks, so dilation with alignment verification is recommended as early as post-op day 1 if the uncorrected visual acuity is less than 20/40 without other explanations.

The decision to intervene depends on the degree of misalignment, the toric power of the IOL, the residual refractive error and astigmatism component, and the subjective impact on the patient's vision. The greatest portion of the audience elected to inform the patient and leave the decision up to him or her, which is certainly reasonable and will probably hinge on the patient's subjective assessment of visual function. Over a third would elect to realign in the OR, while only 2% would try this at the slit lamp. A return to the OR will carry additional expense, so it may be advisable to discuss this possibility with patients prior to the original surgery. A relatively surprising 16% would leave it alone, but I suspect this might change if presented with more dissatisfied patients. One option not offered in the question is enhancement with laser refractive surgery, such as LASIK, PRK, or corneal relaxing incisions, which can be reasonable options in many cases.

Case 14: Subluxated IOL (Use It or Lose It?)

Q14.1 How would you manage a peripherally subluxated three-piece monofocal IOL in the sulcus (with partial capsular support)?

- Suture the haptic(s) to iris....15.4%
- Suture the haptic(s) to sclera....22.8%
- Secure the haptics with intrascleral haptic fixation (ISHF; e.g., Yamane, glued techniques)....8.8%
- Exchange it for an anterior chamber or iris-claw IOL....5.9%
- I would refer these patients....47.1%

Brandon Ayres There are several options for refixation or exchange with a subluxated three-piece IOL in the sulcus. For older patients, suture fixation to the iris is an excellent option. In some instances, the IOL can be rotated into a position where there is adequate capsular support, allowing good centration. Once the IOL is in position, the haptics are sutured to the iris to prevent the IOL from rotating out of position and dislocating again. Small incisions and the ability to use the existing IOL are the advantages of this technique. Unfortunately, IOL rotation, iris chafe, inflammation, and bleeding have been described with iris-fixated IOLs.

In younger patients, in cases where the IOL is damaged, or in cases with iris damage, my preference is ISHF (e.g., Yamane technique). This technique allows fixation of the current IOL or a new three-piece IOL to the scleral wall. There are many advantages to ISHF, including rotational stability of the IOL, no need for suture material, small incision size, and the ability to use most modern three-piece IOLs.

The technique for ISHF looks deceptively easy. It relies on the use of a 27- or 30-gauge thin-walled needle and requires attention to detail and practice for a good outcome. Over the past several months, a variety of companies have produced kits and guides to help standardize the procedure and give surgeons the proper tools to perform it. This technique has quickly become my procedure of choice for IOL placement in the absence of capsular support. IOL decentration and tilt can be problematic with this technique.

Q14.2 How would you manage late bag-IOL subluxation in a PEX patient with a CTR?

- Scleral-suture fixation of the CTR....41.8%
- Explant the IOL and suture-fixate a new PC IOL..0.7%
- Explant the IOL and perform ISHF with a new PC IOL (Yamane, glued)....5.5%
- Explant the IOL and implant an AC or iris-claw IOL....7.5%
- I would refer these patients....44.5%

Garry Condon As the audience response suggests, the majority of these cases can be managed with scleral fixation of the bag-IOL complex, regardless of whether a CTR is present. There are various well-described techniques for placing two scleral lasso sutures 180 degrees apart that incorporate needle passage through the capsular bag. Most are performed ab externo and require only microincisions that minimize intraoperative risks. In my experience, even with the most dramatic subluxation or dislocation, the existing IOL can be retained while avoiding more invasive IOL exchange.

Microforceps and small-gauge vitrectomy instrumentation make this all the more possible. However, I have found that even with a CTR in the bag, it's easier and more secure to pass the suture through the bag between the optic and the haptic close to what I call the IOL "armpit." The bag is often thin and fragile more peripherally, risking tearing along the ring when the suture is barely tensioned. The capsule is generally more robust centrally, and a square-edged haptic fibrosed in the bag affords great support for the suture near this haptic-IOL junction. Rotating the bag-IOL complex to the favored orientation is fairly easy in these PEX cases with minimal residual intact zonules. A poorly dilating pupil makes the more central portion of the bag-IOL complex easier to visualize and work on, as opposed to the more peripheral ring.

Case 15: IOL Explantation

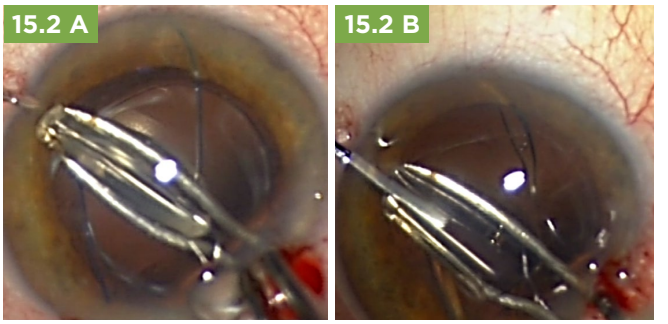
Q15.1 What is your most common indication for performing an IOL exchange?

IOL power error	35.7%
PC IOL subluxation/dislocation	38.1%
AC IOL complication	4.0%
Halos or dysphotopsia from a diffractive IOL	16.7%
Other	5.6%

Thomas Kohnen IOL exchange is required in several instances. In our clinic—also reflected in the audience responses—PC IOL subluxation/dislocation is the No. 1 cause. The most common reason is late dislocation of the IOL–capsular bag complex (10 to 20 years after implantation) in PEX patients. The challenge is always to prevent IOL dislocation into the vitreous cavity; therefore, timely surgical intervention is necessary.

Options include refixation of the IOL–capsular bag complex or removal with subsequent implantation of a new IOL. The latter intervention involves either IOL fixation techniques including scleral fixation (suturing, gluing, or tacking) or iris fixation (iris suturing or iris-claw IOL). In most cases, I prefer to remove the IOL and the capsular bag, which often has a huge Soemmering ring, and to implant an iris-claw IOL with retropupillary fixation.

The second most common reason for IOL exchange, according to the respondents, is incorrect IOL power. However, in my current clinical practice, this cause has been tremendously reduced by the use of modern IOL calculation formulas (geometric, artificial intelligence, ray tracing). In most cases, the exchange is done by cutting the IOL inside the eye into pieces and removing them through an unenlarged primary implantation incision.



QUESTION 15.2. *Explantation of two piggybacked IOLs from the same eye.*

Finally, another reason for IOL exchange is optical phenomena (halos, glare, dysphotopsia), most often seen with presbyopia-correcting IOLs. However, these symptoms can be reduced to a minimum with correct IOL selection, proper preoperative information for the patient, and modern-style IOLs such as trifocal or quadrifocal or new types of EDOF IOLs.

Q15.2 What is your preferred technique for explanting a single-piece acrylic IOL?

Bisect it with an IOL cutter	61.3%
Cut 90% across the optic and remove the IOL hinged, but still in one piece	30.6%
Use forceps to refold the IOL inside the eye	6.3%
Other method	1.8%

Ehud Assia IOL explantation can be a challenging procedure that may lead to severe complications such as zonular dialysis, capsular tears, and vitreous loss. Implantation of a different IOL is then more complicated, and the results may be less favorable than expected. The most difficult step in IOL exchange is separating the IOL from the fibrosed capsular bag and releasing the capsular adhesions, especially if explantation is done a long time, often years, after implantation. PC IOLs were designed to provide long-term stability for the IOL, and the haptics are obscured from direct visualization.

Occasionally, it is advisable to cut the haptics and leave them inside the capsular bag, rather than struggling with the delicate tissues and jeopardizing the lens capsule and zonules. Removal of the IOL from the anterior chamber can then be accomplished by cutting the IOL inside the anterior chamber (completely or partially) or folding the IOL with the appropriate forceps and removing it as one block. Although this maneuver may require a larger opening (3.0-3.5 mm), removal of the IOL is often simpler than it looks.

In one case, I removed two piggybacked IOLs from the same eye by folding the lenses: a three-piece lens positioned in the sulcus (Fig. 15.2 A) and a one-piece IOL located within the capsular bag (Fig. 15.2 B). The cornea remained crystal clear after the operation. Most surgeons (almost 92% in this

Ehud Assia, MD

poll) prefer cutting the IOL inside the anterior chamber, either completely in two pieces (61%) or partially, leaving a hinge (31%). The use of specially designed IOL cutters or microsurgical instrument such as microgaspers and microscissors may facilitate this delicate procedure. Whatever the technique, however, extreme care should be taken to protect the corneal endothelium, as postoperative corneal edema is probably the most common complication of this procedure.

Case 16: Yamane Double-Flanged IOL Fixation

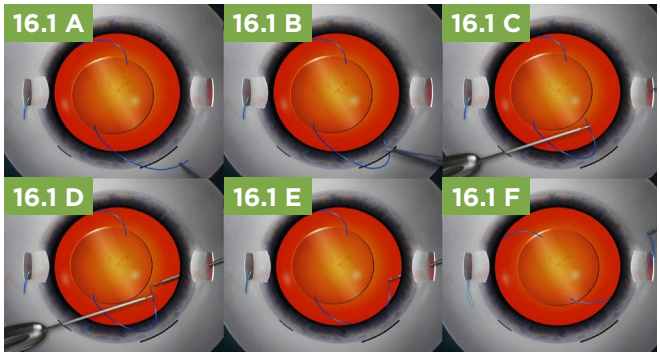
Q16.1 What is your preference for IOL fixation when there is no capsular support?

- Iris-claw or AC IOL 30.2%
- Iris-sutured PC IOL 6.3%
- Transscleral-sutured PC IOL 10.3%
- Glued ISHF PC IOL 4.8%
- Yamane ISHF PC IOL 16.7%
- I would refer these patients 31.7%

Amar Agarwal When we analyze the polls for IOL fixation in eyes with deficient or absent capsules, we notice that the glued IOL/Yamane technique comes to 21.5%. The advantage of the glued IOL over the Yamane is that there is negligible tilt in glued IOL cases. The advantage of Yamane over the glued IOL is that it is easier and does not require flap creation or glue. Following are five pearls that I would advise surgeons to follow to master the glued technique:

- Make the flaps or entry point of the sclerotomies 180 degrees apart and always have fluid in the eye. Do not do the surgery with only viscoelastics in the eye.
- See that enough of the haptic is externalized. Do not go far posterior to create the sclerotomies for haptic externalization. If the white-to-white measurement is more than 11 mm, perform a small peripheral iridectomy next to the scleral flaps so that when you make the sclerotomy (0.5-1.0 mm from the limbus), you will be able to pass through the iridectomy and not damage the iris. This way enough haptic is externalized to tuck.
- Master the handshake technique (Fig. 16.1). Use two forceps to adjust properly so that the tip of the haptic is caught and externalized.
- When tucking the haptic into the Scharioth pocket, make sure that the IOL is well centered and that it is not tilted after the tuck—this is crucial. To do this, tuck and untuck each haptic until the IOL is well centered.
- Master the single-pass four-throw pupilloplasty. This technique can easily be done if you see an optic capture during the surgery. If the case is one of corneal injury or high astigmatism, you can perform pinhole pupilloplasty and make the pupil 1.5 mm to negate the astigmatism.

To understand why these patients with glued IOL are happy, let us consider a camera. If we break the lens of the camera and suture it back to the camera body, there will be movement of the image. If we glue the camera lens to the camera body, there will be no movement. This is what happens with a glued IOL; there is negligible pseudophacodonesis, which helps give better quality of vision.



QUESTION 16.1. *Handshake technique for trailing haptic. (A) The trailing haptic is caught with the first glued IOL forceps. (B) Haptic is flexed into the anterior chamber. (C) Haptic is transferred from the first forceps to the second using the handshake technique. The second forceps is passed through the side port. (D) First forceps is passed through the sclerotomy under the scleral flap. (E) Haptic is transferred from second forceps back to the first using the handshake technique. (F) Haptic is externalized.*

Q16.2 What is your personal experience with the Yamane technique?

- Experienced and very comfortable 5.5%
- I've tried it but am still in my early learning curve 11.8%
- I've tried it but have abandoned this method 2.4%
- I've never tried it but I am planning to 44.1%
- I'm not planning to try it 36.2%

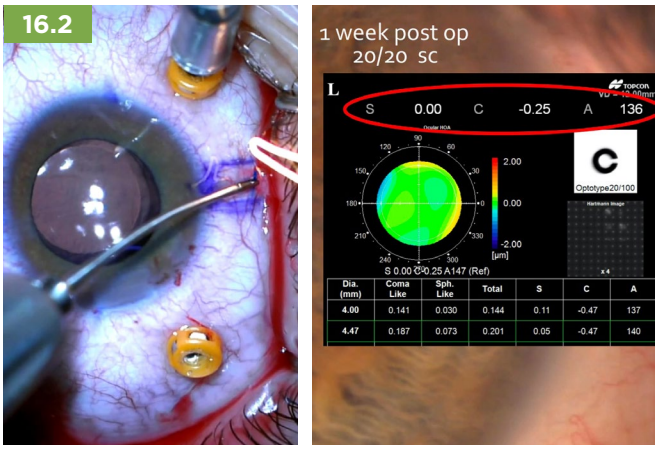
Steve Safran My own personal experience with the Yamane technique has been very positive and rewarding. I completely shifted over from "flaps and grooves" to this approach after doing my first case almost three years ago, and I'm not looking back. In my first 100 Yamane cases, I did not have a single patient return to the OR for a dislocation or complication, and I did not see a single case of induced cystoid macula edema. I've learned to combine this technique with Descemet stripping automated endothelial keratoplasty, iris repair, and glaucoma surgeries and find that it provides excellent stability to the lens immediately, so that these other manipulations are not at risk of causing dislocation.

In my opinion, the key to achieving such success with Yamane ISHF lies in the lessons learned from doing many hundreds of previous scleral fixation surgeries with sutures, flaps, and grooves, often combined with optic capture; thus, the Yamane experience had a firm foundation in a developed skill set. I believe that consistent success with Yamane ISHF also requires the following: the right three-piece lens (with polyvinylidene fluoride [PVDF] haptics), vitrectomy done via pars plana, an infusion line in place with self-sealing incisions to control intraocular contents, meticulous

Agarwal A et al. *J Cataract Refract Surg.* 2013;39(3):317-322.

marking, and use of TSK 30-gauge needles and 25-gauge microforceps. Those who attempt this procedure without the right tools or techniques will likely find it a disappointing venture.

I don't think that this is a procedure for every surgeon, but I think it's important that all surgeons are aware of the power of this technique and consider either learning it or referring to a colleague who has mastered it. This approach can offer benefits when properly done, especially compared with alternative methods. It is encouraging to see that so many surgeons are considering learning Yamane ISHF, but I think that, ultimately, it will be a procedure adopted and performed with most success by those who have more than just a passing interest in doing these kinds of cases and who do them more than just occasionally.



QUESTION 16.2. *Yamane technique.*

Financial Disclosures

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