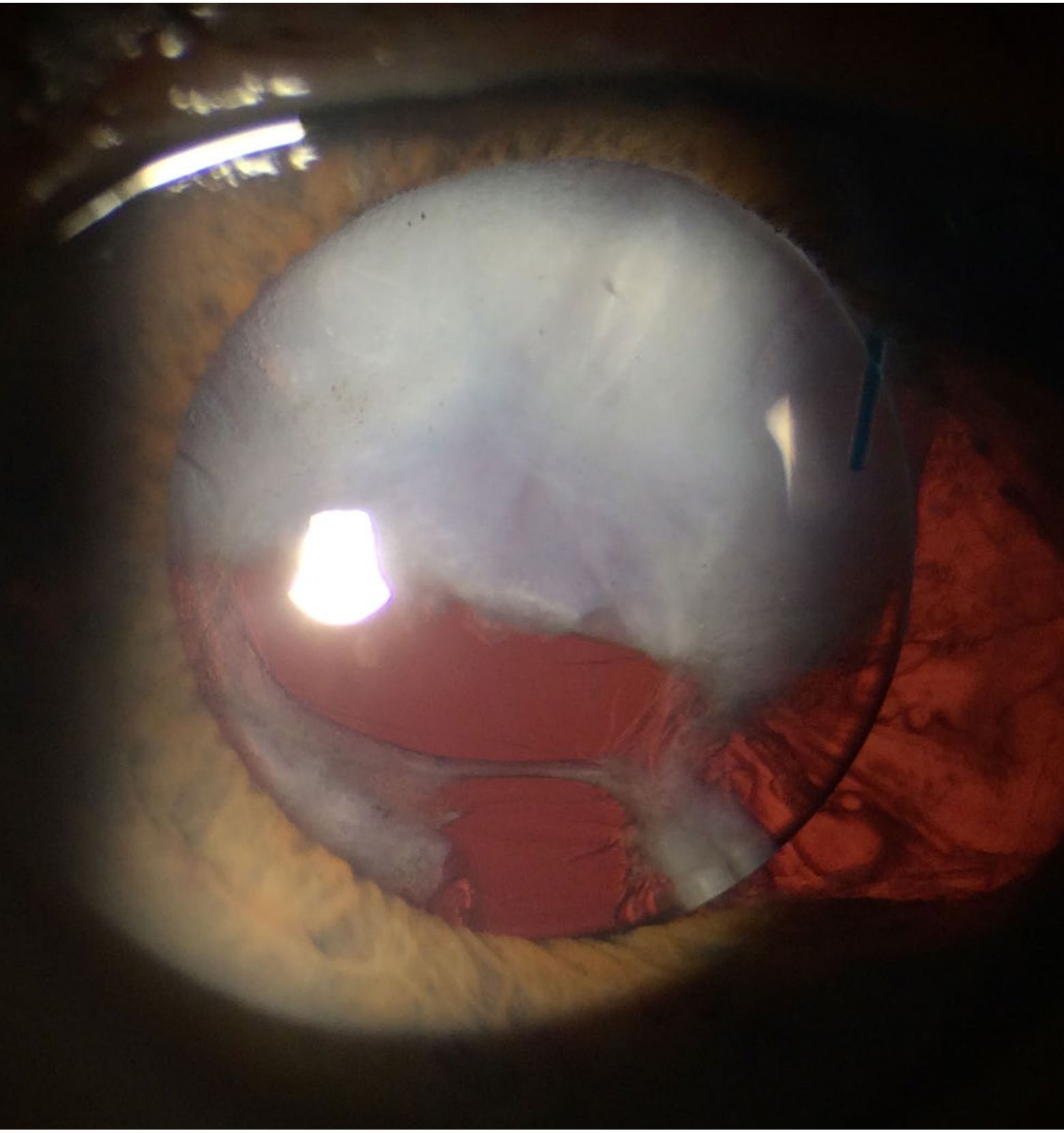


Cataract Complications

Eight difficult cases that require complex management decisions.

THIS PAST NOVEMBER, THE 16TH ANNUAL SPOTLIGHT ON CATARACT SURGERY Symposium at AAO 2017 was entitled "Clinical Decision-Making With Cataract Complications: You Make the Call." Cochaired by Mitchell P. Weikert, MD, and myself, this 4-hour symposium was organized around 8 video cases that presented a range of cataract surgical challenges and complications.

The 8 cases were selected from my own practice. As I presented the videos, I would pause at selected points to note a complication or introduce the need to make a management decision. The attendees were then asked to make clinical decisions using their electronic audience response keypads. This was followed by several rapid-fire didactic presentations by invited experts on topics of relevance to the case. Next, a rotating panel of 2 discussants (who had never viewed the case) was asked to make a management recommendation before the video of the outcome was shown. Following additional audience polling about preferences and practices, the 2 panelists would provide their own opinions and pearls.

In all, nearly 40 presenters and panelists spoke about a wide variety of topics, including managing a postvitrectomy cataract, posterior capsular rupture in a multifocal or toric IOL patient, traumatic cataracts, ultrabrunescent cataracts, small pupils, crowded anterior segments, unhappy multifocal IOL patients, iris prolapse, traumatic iris defects, and retained cortex. Alan S. Crandall, MD, concluded the symposium by delivering the 13th annual Academy Charles D. Kelman Lecture, "Phaco at 50: The Collision of Cataract and Glaucoma (Plus)."

This *EyeNet* article reports the results of the 35 audience response questions, accompanied by written commentary from the symposium speakers and panelists. The polled respondents included both the onsite audience and those viewing online. Because of the anonymous nature of this polling method, the audience opinions were candid, and they were discussed in real time during the symposium by our panelists. The entire symposium with videos and PowerPoint was viewed live online by a virtual audience; it also was captured for online archiving and can purchased as part of AAO Meetings on Demand (aao.org/store).

Cataract Monday continues to comprise a daylong, continuous series of cataract symposia. The afternoon featured the ASCRS cosponsored symposium, "Refractive Cataract Surgery Today: Maximizing Your Outcomes."

—David F. Chang, MD
Cataract Spotlight Program Cochairman

David F. Chang, MD

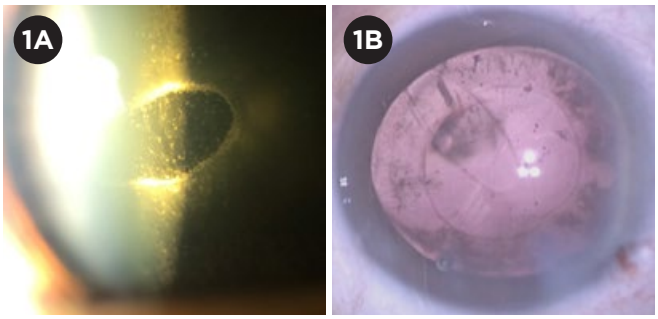
FROM CASE 8. *This case involved retained cortex and a large stromal iris defect (left).*

Case 1: Postvitrectomy Cataract

This 58-year-old patient underwent a 3-port vitrectomy and epiretinal membrane peeling 8 weeks before she presented with a rapidly advancing cataract (Fig. 1A).

Q1.1 How would you approach this cataract with a suspected posterior capsular (PC) defect?

- Perform hydrodelineation and partial hydrodissection 12.7%
- Perform hydrodelineation and partial viscodissection 11.8%
- Hydrodelineate only 52.9%
- Skip all "hydro steps" 16.7%
- Refer this patient 5.9%



CASE 1. *(1A) The preoperative slit-lamp photo of this posterior subcapsular cataract shows a PC abnormality. (1B) Following phaco and I/A, there is a PC defect with an intact capsulorrhexis.*

Steve Safran The slit-lamp image of this postvitrectomy cataract appears to show a PC defect in the inferonasal quadrant of the lens. The position of this defect and its shape, given the history of a prior pars plana vitrectomy (PPV), suggests that it occurred during placement of a trocar at 8 o'clock, which most likely was used for infusion during the membrane peeling procedure. It also appears that the edges of this defect have rolled or thickened somewhat, which suggests that some fibrosis has occurred during the 8-week postoperative period. The posterior surface of the lens itself appears fairly continuous and transparent in this area, so it appears that there is no herniation and minimal damage/disruption of the lens itself other than the formation of the secondary cataract. The audience response to the question posed about the hydro steps would indicate an awareness of the risk for extending this capsular defect and possibly blowing lens material through the defect with aggressive hydrodissection. Any aggressive increase in capsular pressure created during hydrodissection or even with aggressive hydrodelineation here can raise the pressure within the capsular bag—and in a vitrectomized eye, that could cause lens material to herniate through the defect and move posteriorly very quickly. In such a situation, I would do very gentle hydrodelineation to create some separation between the nucleus and epinucleus. I would then perform a horizontal chop at an angle perpendicular to the capsular defect while supporting the lens from behind with the chopper in the second hand, to minimize risk of extending the defect. Generally, these postvitrectomy cataracts will have a fairly dense central nugget with a softer outer shell, and it should not require much pressure with hydrodelineation to create separation with minimal infusion pressure. If the nucleus was too dense to gently hydrodelineate and it resisted the fluid wave, I'd abandon hydro steps altogether and move straight to horizontal chop (as described above) and then do a second chop and remove that first quadrant with a combination of vacuum and pulling/tumbling with the chopper. I would use a lower bottle height/infusion pressure during phaco and reduced vacuum settings as well. After I removed the first quadrant, I'd gently try to rotate the lens. If it remained resistant, I'd chop off another piece and then try to gently displace the remaining nucleus more centrally, if needed, to loosen it up a bit and facilitate rotation. After the first quadrant is removed, dispersive viscoelastic could be safely injected gently under the lens to help loosen and support the nucleus with little or no risk of raising pressure within the capsular bag.

Q1.2 After removing the nucleus, there is a very adherent epinucleus. What would you do next?

- Angle and aim the phaco tip more posteriorly 0.7%
- Rotate or claw the epinucleus out of the bag with the chopper 3.7%
- Pause to hydrodissect the epinucleus free 4.4%
- Pause to viscodissect the epinucleus free 58.8%
- Switch to the I/A tip 32.4%

Bob Cionni This patient has an open posterior capsule following vitrectomy. Any forces that expand the capsular bag will likely open the tear further and risk loss of the epinucleus into the vitreous cavity. This potential risk is accentuated by the lack of vitreous, which would otherwise lend support to any lenticular debris.[1] As hydrodissection will expand the bag, extend the tear, and potentially flush the epinucleus posteriorly, I would avoid it. The audience seems to agree, as only a small percentage chose this option. Instead, gentle, limited viscodissection with a dispersive ophthalmic viscoelastic device (OVD) would be my preferred approach to loosen the epinucleus, followed by its removal with either the I/A or the phaco tip. Most of the audience agreed with this approach. Although a high percentage favored switching to the I/A tip, if the epinucleus is dense, using the phaco tip after viscodissection may be a better choice in order to lessen the likelihood of losing your grasp of the epinucleus and perhaps flushing it posteriorly through the posterior capsule tear.

1 Osher R et al. *VJCRS.* 2009;2.

Q1.3 Now that the epinucleus is loosened, how will you remove it?

- Phaco tip (using low vacuum) 33.6%
- Coaxial I/A tip 23.4%
- Biaxial I/A tip 25.0%
- "Dry" aspiration with OVD 10.2%
- Vitrectomy cutter tip 7.8%

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Tal Raviv I agree with the audience: There are many valid approaches here. Once the epinucleus is loosened, we must proceed with the presumption of an existing capsular defect. To have the most control, I would switch to the coaxial I/A and work in a slow methodical way beginning farthest away from the compromised area and moving outside in. Care must be taken to maintain the chamber and prevent capsular trampolining that may extend a tear. A biaxial approach would work equally well, if that is the surgeon's preferred I/A technique or if the area of concern was subincisional. If the very last piece was adherent to the capsule, I would use a dispersive OVD to dissect it—and, if needed, I would perform a dry aspiration.

Q1.4 How would you proceed to remove the remaining epinucleus after a large PC rent is discovered?

- Continue I/A 9.2%
- First perform an anterior vitrectomy (via limbus); then I/A 29.0%
- First perform an anterior vitrectomy (via pars plana); then I/A 15.3%
- Viscolevitate the epinucleus (via limbus); then I/A 44.3%
- Viscolevitate the epinucleus (pars plana posterior assisted levitation, or PAL); then I/A 2.3%

Dennis Han As a retina surgeon, my role has been to support the anterior segment surgeon in cases in which vitreous involvement is highly likely during cataract surgery. However, in this case, if the epinucleus is successfully separated and there is no vitreous presentation through the PC defect, it is reasonable to proceed with removal of lens material with phaco or I/A, whichever can be done most efficiently. I would keep the instrument port occluded with lens material to minimize flow, as—even in a previously vitrectomized eye—some vitreous may remain immediately behind the lens. Thus, viscolevitation of the epinucleus makes sense. If vitreous is encountered, phaco or I/A should be temporarily suspended, and an anterior vitrectomy should be performed. For this, I favor a limbal approach over a pars plana approach to eliminate the risk of pars plana sclerotomy site complications.

Q1.5 This patient hates glasses. Preoperatively, she requested a presbyopia-correcting IOL. What would you do now, considering the PC defect (Fig. 1B)?

- Single piece extended-depth-of-focus (EDOF) IOL in bag 9.8%
- 3-piece multifocal IOL in sulcus with continuous curvilinear capsulorrhexis (CCC) capture 37.9%
- Single-piece monofocal IOL only (in bag) 7.8%
- 3-piece monofocal IOL only (in sulcus) 43.1%
- Other 1.3%

Bonnie Henderson IOL choice in a case with an unexpected capsular tear can pose a challenge. In this patient, there is an opening in the posterior capsule that does not originate as an extension of the anterior capsulorrhexis. Instead, the anterior capsule is intact and, more importantly, the opening is centered. Because of these factors, the audience choice of IOL type is not surprising—37.9% still chose to implant a multifocal IOL in the sulcus with optic capture even with a compromised posterior capsule. If the anterior capsulorrhexis were not intact, this percentage would have been much lower. The most common choice (43.1%) was to implant a 3-piece monofocal IOL in the sulcus. This is a safe option to prevent further damage to the posterior capsule. However, this option does not deliver the spectacle independence that the patient desires. Given the patient's previous history of a PPV and membrane peel, the patient may decide to forego the benefits of a multifocal or EDOF IOL if [she is] worried about the loss of contrast sensitivity associated with these lenses. So, a monofocal IOL remains a good conservative choice. As for the audience, 7.8% of attendees chose a single-piece monofocal IOL. This points to the advances made in IOL delivery systems. Today, single-piece monofocal IOLs can be delivered gently in a controlled fashion, which allows surgeons to use them even in a setting of a PC tear. Nearly the same percentage of the respondents (9.8%) chose to implant a single-piece EDOF IOL in the capsular bag. However, of all the choices, this would be the trickiest because of the need for perfect centration. With a PC tear, vitreous could prolapse anteriorly during the implantation or during the viscoelastic removal, destabilizing the capsule and IOL. Although an EDOF IOL in the bag could be successful, a reverse optic capture (ROC) may improve the chances of long-term centration.

Case 2: Posterior Capsular Defect

This 68-year-old patient is ecstatic with her 20/20 and J1 uncorrected vision following a diffractive multifocal IOL (AcrySof ReStor 3.0, Alcon) in her first eye. She is expecting to receive the same IOL model in her second eye, but a large nasal PC defect is noted after nuclear removal.

Q2.1 How would you remove the cortex in the presence of the PC defect?

- Coaxial cortical I/A 10.5%
- Biaxial cortical I/A 19.6%
- "Dry" cortical aspiration with OVD 39.2%
- Cortical I/A with vitrectomy cutter tip 10.5%
- Perform vitrectomy first prior to cortical I/A 20.3%

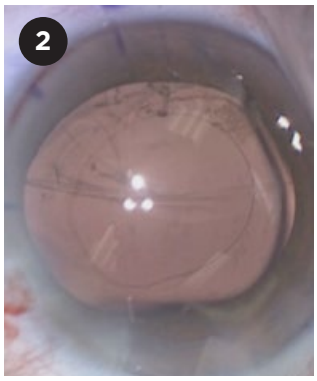
Boris Malyugin Most of the responders (39.2%) would use the dry cortical aspiration in the presence of the PC defect. That would be my personal preference, too. The main advantage of that technique is that it helps in avoiding hydration of the vitreous and preventing displacement of the vitreous strands into the anterior chamber. One important prerequisite for the dry aspiration technique is the absence of vitreous prolapse through the capsular defect into the anterior chamber. If that is the case, vitrectomy should be performed first (this option was chosen by 20.3%), followed by resid-

ual cortex aspiration by the same vitrectomy probe or the aspiration handpiece. Dispersive OVD (Viscoat, Alcon) is very helpful to accomplish dry aspiration because it is not as easily evacuated from the eye compared with the cohesive OVD (sodium hyaluronate 1%). The surgeon can either use the cannula directly attached to the syringe with balanced salt solution (BSS) or the aspiration handpiece from the bimanual I/A set. And, of course, it is necessary to be vigilant not to aspirate the vitreous, which sometimes can be confused with the strands of cortex.

Q2.2 What backup IOLs do you have for a single-piece multifocal IOL?

- I don't have any backup on hand.....16.4%
- I have 1-piece multifocal backup IOLs only.....10.3%
- I have both 1-piece and 3-piece multifocal backup IOLs.....35.8%
- I don't implant multifocal IOLs.....37.6%

Nick Mamalis This is a difficult situation, in which a patient had uncomplicated surgery in her first eye with a diffractive multifocal IOL and an excellent result. In the second eye, the patient had a large nasal PC defect found after nuclear removal, which can create potential problems with the possible use of a multifocal IOL in the second eye. An open posterior capsule may preclude the use of a capsule-fixated multifocal IOL or certainly make the use of such a lens more problematic. It is very important in this setting that the surgeon has a backup IOL in case he or she is unable to use the initially selected multifocal IOL. What is interesting about the polling of the audience members regarding backup IOLs is that 37.6% of the audience stated that they don't implant multifocal IOLs in the first place. In terms of the other answers, the most commonly chosen answer was that surgeons have both 1-piece and 3-piece multifocal backup IOLs on hand for this situation (35.8%). A 3-piece multifocal IOL would be an excellent choice for a patient who has a PC tear, which would preclude placement of a lens within the capsular bag. The haptics of the lens could be placed in the ciliary sulcus and the optic captured behind the intact anterior capsule, which would allow good fixation of the implant and excellent centration. The problem is that some manufacturers no longer have a 3-piece multifocal IOL available. In addition, there is the added expense of having a second consignment of 3-piece multifocal lenses available. The surgeon may get around this problem by ordering a backup 3-piece multifocal lens for cases in which a single-piece multifocal lens implant is planned. For those audience members (10.3%) who have 1-piece multifocal backup IOLs only, it is very important to be aware that a 1-piece hydrophobic acrylic IOL is not designed for placement within the ciliary sulcus. Because these lenses are designed with a relatively thick, square-edged haptic, there is the possibility of problems with pigment dispersion and subsequent glaucoma if they are placed in the sulcus. Furthermore, there is significant chance of uveitis-glaucoma-hyphema (UGH) syndrome with these lenses, if they are implanted in the ciliary sulcus. If a 1-piece multifocal is the only backup available, the surgeon may consider the possibility of placing the haptics of the lens in the capsular bag with placement of the optic in front of the anterior capsule in a so-called ROC. This would allow the intact anterior capsule to help fixate the IOL and prevent any possible dislocation or decentration and avoid the problems of the 1-piece haptics within the ciliary sulcus. It is interesting that having a 3-piece monofocal IOL available as a backup in this setting was not asked of the audience participants. This IOL is a reasonable choice for a backup lens in the setting of a PC tear in which the multifocal lens cannot be placed into the capsular bag. It is very important that careful preoperative counseling of the patient is done to let the patient know ahead of time that if surgical complications occur, it may not be possible to implant a multifocal IOL and that a monofocal lens may have to be used.



CASE 2. *Following phaco and I/A, there is a large nasal PC defect with an intact capsulorrhexis.*

Q2.3 Lacking a backup 3-piece multifocal IOL with this large PC tear, what would you implant?

- 3-piece monofocal in sulcus (target plano).....36.2%
- 3-piece monofocal in sulcus (target –1.00).....25.2%
- Implant 1-piece multifocal IOL despite PC tear...18.9%
- Leave aphakic—order 3-piece multifocal IOL and reoperate.....18.9%
- Leave aphakic—refer.....0.8%

Jason Jones More than 60% of the audience chose a monofocal IOL in the sulcus with the majority electing plano as the target and the remainder choosing a mild near target of –1.00. This is a conservative option and can be enhanced with optic capture through an intact anterior capsulorrhexis. The remaining audience essentially split between attempting implantation of a single-piece multifocal IOL despite the PC tear and leaving the eye aphakic and reoperating with a 3-piece multifocal IOL at a later date. Although a single-piece lens can sometimes be implanted despite a PC tear, depending on the size and location of the tear (which is fairly large in this case), the flexible nature of the single-piece design makes this choice tenuous. And ordering a 3-piece lens for a later reoperation exposes the patient to additional risk of another surgery as well as inviting concerns and doubts from the patient and family. Only a few respondents chose to leave the eye aphakic and refer, which is an undesirable option. In my practice, if presented with a similar situation of a second eye surgery having a PC tear, I would elect to implant the single-piece multifocal IOL using ROC. This places the haptics behind the anterior capsule and prolapses the optic anteriorly through the intact capsulorrhexis. I have used this technique

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in the rare situation in which I want to use a single-piece lens in the setting of a PC tear. Over many years of follow-up (my longest follow-up is 10 years at this time), I have found this technique to be well tolerated in terms of safety and well suited to refractive outcome. For those surgeons who are uncomfortable with ROC and without a 3-piece multifocal IOL on hand, I would recommend using a monofocal in the sulcus with optic capture. I would target either plano or slight myopia depending on surgeon preference; if this proves unacceptable, then a second operation could be performed with a 3-piece multifocal IOL using optic capture.

Q2.4 What would you implant if this were, instead, the first eye surgery?

- 3-piece monofocal in sulcus (target plano)..... 73.2%
- 3-piece monofocal in sulcus (target –1.00)..... 21.6%
- Implant 1-piece multifocal IOL despite PC tear..... 4.6%
- Leave aphakic—order 3-piece multifocal IOL and reoperate 0.7%
- Leave aphakic—refer..... 0.0%

Bill Wiley Because of the PC rent, the most conservative approach would be in line with the majority of the audience. A 3-piece monofocal IOL placed in the sulcus targeted for plano is a very reasonable choice if this were the patient's first eye. If a monofocal plano target was achieved in the first eye, there would be multiple options for the patient to choose from for the second eye. Distance monofocal (to match the first IOL), near monofocal (to achieve a monovision outcome), or a multifocal could be considered in the second eye, depending on the patient's motivation. With that said, a 1-piece multifocal could be considered even in situations of a PC rent. Assuming there is a well-centered and -sized capsulorrhexis, the lens can be placed in the bag with optic capture in the anterior rhexis. For this to be considered, the rhexis must be well centered and smaller than the size of the optic. This is achievable with a manual rhexis; however, this may be made easier when an automated rhexis is performed with a femtosecond laser or a device like the Zepto (Mynosys). Lens-in-the-bag with anterior optic capture may slightly alter the effective lens position and theoretically will result in a slightly myopic outcome, which may be more pronounced in higher dioptic powers. An IOL power adjustment may be reasonable depending on the initial IOL power and original predicted refractive target.

Q2.5 What would you tell the patient immediately postop?

- Don't mention any complication, unless a problem later arises..... 10.4%
- Discuss unexpected "difficulty" but offer no specifics—"everything's fine" 28.8%
- Discuss the PC tear, but not the lack of 3-piece multifocal IOL backup 24.0%
- Discuss PC tear and lack of 3-piece multifocal IOL backup..... 36.8%

Rich Tipperman In this patient (who experienced a PC rupture and subsequently had a 1-piece multifocal IOL placed with ROC), it is interesting that 90% of the audience is evenly split—almost in thirds—as to what to tell the patient. Discussing complications with patients is always difficult, but I believe that transparency is the best approach. As such, the first choice would not be a reasonable approach, and it is interesting that only 10% of the audience favored this answer. The second choice is a "bare minimum" explanation, wherein the patient at least knows that something was not routine at the time of surgery. One could argue that a voluminous discussion of potential complications would not empower the patient in any way and likely would just create more stress and fear. Even when everything goes well surgically, some cataract operations are easier while others are more difficult, and patients can intuitively understand this concept. I have always been surprised when I see a patient for a second opinion and the patient is having obvious problems, but the surgeon has told the person that everything is fine or normal. The patient realizes that his or her postoperative course is not "normal" or "routine"—and as a result, the surgeon's attempt to provide reassurance by saying "everything is fine" undermines the physician-patient relationship. At the very least, telling patients that their surgery was difficult but you expect them to heal well helps maintain a therapeutic relationship. The final 2 choices are actually somewhat similar, depending on the surgeon's perspective and experience. By this, I mean that many surgeons would prefer to place a 1-piece IOL with ROC rather than a 3-piece IOL in the sulcus with posterior optic capture. As such, the direction of the discussion may vary depending on the surgeon's clinical judgment. Nonetheless, complete transparency is always a good choice when speaking with patients who experience unexpected or unplanned surgical experiences.

Case 3: Toric IOL

This 96-year-old patient is more than 3 years out from a T5 toric IOL in his right eye with minimal residual cylinder. He is scheduled for surgery in the left eye with a T6 toric IOL (preop +0.50 +3.00 × 180). However, as the I/A tip is withdrawn, there is a temporal PC tear with vitreous strands to the clear-corneal incision.

Q3.1 Through what port will you perform the anterior vitrectomy?

- Clear-corneal incision + coaxial infusion..... 13.9%
- Clear-corneal incision + split limbal infusion..... 27.7%
- New limbal incision + split limbal infusion 34.3%
- Pars plana + limbal infusion cannula 18.2%
- Pars plana + pars plana infusion cannula 5.8%

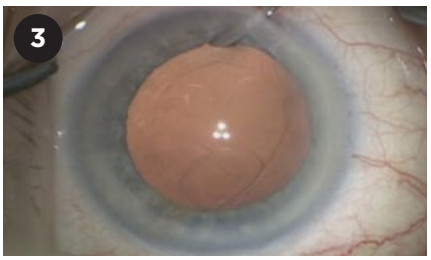
Steve Charles The audience response is concerning and indicates the need for further education on anterior vitrectomy. Surgeons who teach anterior vitrectomy agree that infusion and the vitreous cutter should be separate—that is, coaxial infusion should never be utilized. In addition, there

is consensus that the vitreous cutter should not be inserted through the clear-corneal incision. A limbal side port should always be used for infusion. Optimally the vitreous cutter should be used through the pars plana. Surgeons who are not trained in pars plana incision utilization or are uncomfortable with this approach should use a second side port for the vitreous cutter.

Q3.2 What IOL will you implant with the PC tear?

- Toric 1-piece acrylic IOL in bag 13.1%
- Toric 1-piece acrylic IOL in bag with ROC 40.6%
- Nontoric 1-piece acrylic IOL in bag 7.5%
- Nontoric 3-piece IOL in sulcus 36.9%
- Enlarge temporal (axis 180) incision to implant an anterior chamber or a posterior chamber PMMA IOL (sulcus) 1.9%

Marie-José Tassignon Given the situation pictured in Fig. 3, there is still a chance this patient can be implanted with the planned toric IOL. Based on the scores of the audience, half of them agreed with this statement. However, the conditions for implanting a toric IOL must be met prior to deciding on implantation (e.g., a stable capsule and no vitreous prolapse into the anterior chamber). Half of the audience predicted further possible complications and chose a safer option (not implanting a toric IOL). If the preoperative examination demonstrated the right eye (already operated eye) being dominant and there is suppression of the left eye, the surgeon might be more comfortable implanting a nontoric IOL. However, binocularity would benefit from toric IOL implantation in all other orthoptic conditions. What is the risk-benefit analysis of implanting a toric IOL in this eye? The pros are: 1) a good anterior capsulorrhexis that is well centered in the pupillary area; 2) the capsular bag is totally emptied of any lens material; and 3) the iris and anterior chamber are quiet. In contrast, the cons are: 1) a PC tear; 2) vitreous prolapse with vitreous strand in the pupillary area; and 3) positive pressure from the vitreous side. The first and mandatory condition prior to deciding in favor of toric IOL implantation is to release the posterior pressure by performing a partial vitrectomy. This can be done from an anterior or posterior approach. The anterior approach is more demanding regarding the bimanual pressurization of the eye. The surgeon should start with a low bottle level and low aspiration values and the vitrector opening facing the retina. This approach would have my preference in this case, as the PC tear is round and relatively small. I do not favor a pars plana approach because this may cause scleritis, destruction of the zonular vitreous, and vitreoretinal traction at the level of the vitreous base. Because of the vitreous prolapse through the wound, it is known that the anterior hyaloid is ruptured. All vitreous must thus be removed. Kenacort (triamcinolone acetonide) can be used, but since it is an off-label use, the surgeon will need patient consent. On the assumption that all vitreous has been removed, the PC tear will not bulge anteriorly any more as shown in Fig. 3 but will have its rim moved posteriorly and its opening eventually will become a little smaller (but certainly not larger). In my hands, the first choice of IOL would be a toric bag-in-the-lens, which needs a posterior capsulorrhexis of the same size as the anterior. Once the partial vitrectomy has been completed, this is still possible to do by supporting the backside of the posterior capsule with viscoelastic material in order to fully separate the anterior hyaloid from the posterior capsule. This lens would ensure a stable and well-centered position.



CASE 3. *Following I/A, there is a temporal PC defect with vitreous strands to the clear-corneal incision.*

Q3.3 Would you do ROC of a 1-piece acrylic IOL?

- I have tried it with good results 25.9%
- I have tried it but am not happy with the results 4.9%
- I haven't tried it and am not interested 10.8%
- I haven't tried it but am interested in trying 58.4%

Rich Hoffman ROC is an important technique to be aware of, especially given the increasing utilization of single-piece lenses. Single-piece IOLs that are placed in the ciliary sulcus without fixation have been reported to cause pigment dispersion, glaucoma, and recurrent hyphemas and vitreous hemorrhages.[1] Most of these complications are due to the sharp-edged haptics rubbing up against the posterior surface of the iris. Although capturing the optic of these sulcus lenses posteriorly through an intact anterior capsulorrhexis will prevent movement of the IOL, the haptics will still be flexed forward into an undesirable position with regard to iris chafing. Jones et al.[2] published a nice article demonstrating that placing a single-piece IOL in the capsular bag and prolapsing the optic anteriorly through the intact anterior capsulorrhexis (e.g., ROC) resulted in well-centered IOLs with no vision-threatening complications. In the vast majority of cases, iris pigment dispersion will be avoided with this orientation. If a single-piece or 3-piece IOL is placed in the capsular bag and subsequently subluxes at the time of surgery or postoperatively, ROC is an excellent maneuver for rescuing these lenses and recentering them. There will usually be a small myopic shift due to the new effective lens position being slightly more anterior than what was calculated; however, this small shift is usually quite acceptable. ROC can also be quite useful when a toric lens has been placed or needs to be placed in an eye with a compromised posterior capsule. If a toric lens will not remain oriented along the desired axis, or if subsequent subluxation is a strong possibility due to a significantly compromised capsule, ROC will allow the lens to be centered and accurately oriented along the steep meridian, with little to no chance of rotation following the maneuver. This would be

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especially useful in patients who have had their first eye successfully treated with a high-powered toric IOL and require a similarly high-powered toric IOL in their second eye, which now has a compromised posterior capsule. Interestingly, over 84% of respondents have tried ROC with good results or are interested in trying it. I believe the 10% of respondents who are not interested in trying this maneuver may one day change their minds when faced with a subluxed single-piece IOL inside of a compromised capsular bag. Tearing a capsule while implanting these lenses is rare but can happen.

1 Chang DF et al. *J Cataract Refract Surg.* 2009;35(8):1445-1458.
2 Jones JJ et al. *Ophthalmic Surg Lasers Imaging.* 2012;43(6):480-488.

Q3.4 The toric IOL was placed within the capsular bag and was centered at 180 axis at the conclusion of surgery. What would you do for a symptomatic 15-degree toric IOL misalignment presenting at postop week 3?

- Leave it alone and correct with spectacles 50.3%
- Reposition the toric IOL in the bag 9.7%
- Reposition the toric IOL and perform ROC 32.0%
- Exchange the toric IOL for a 3-piece, nontoric IOL in sulcus 2.9%
- Refer the patient 5.1%

Doug Koch I am surprised by this response. Patients choose and pay extra for a toric IOL to reduce dependence on glasses, so most will be unhappy if glasses are required to see well at the targeted distance (far or near). The question indicates that the patient is symptomatic, so I recommend offering the option of surgical correction to the patient. If it is a low-power toric, then the residual astigmatism will be around 1 diopter. I typically treat this with corneal-relaxing incisions, which are highly effective, can be done in the office, and are quick and minimally invasive for the patient. For residual astigmatism over 1.25 D, I usually recommend IOL rotation if the spherical power is accurate and either PRK/LASIK or an IOL exchange if a spherical error of at least 0.5 D exists.

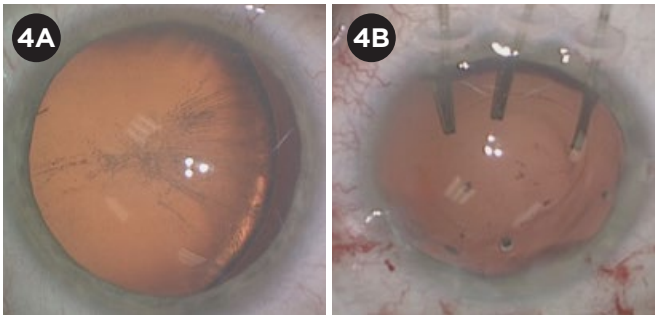
Case 4: Traumatic Cataract

This 62-year-old patient is referred for a traumatic cataract. Although there is no phacodonesis or vitreous prolapse, there is a shallow anterior chamber, moderate nuclear sclerosis, and a significant traumatic mydriasis.

Q4.1 Do you generally operate on traumatic cataracts?

- No—I refer all of these cases 17.8%
- Yes, unless there is a zonular dialysis 7.2%
- Yes, unless there is phacodonesis (would operate on option 2) 10.6%
- Yes, unless the lens is subluxated (would operate on options 2 and 3) 15.6%
- I would operate on all of the above 48.9%

Brad Shingleton It is a tribute to the skill and confidence of ophthalmologists worldwide and the technology available to all of us that nearly half of the respondents would tackle this



CASE 4. *(4A) A traumatic cataract with nasal zonular dialysis and severe traumatic mydriasis. (4B) The capsular bag is preserved with the aid of capsule retractors.*

challenging cataract. Challenge is the appropriate word, and an appreciation of this challenge is reflected in the response of the more than 50% of respondents for whom referral may be considered. Caution is indicated regardless of one's choice to refer or operate because zonular and pupillary management issues can frequently complicate traumatic cataract surgery. All surgeons addressing these cases must have a plan to deal with zonular dialysis, vitreous presentation, IOL fixation in absence of capsule support, and visually significant mydriasis. I deal with traumatic cataracts on a regular basis and spend extra time preoperatively anticipating special needs that may arise related to scheduling, length of operation, anesthesia issues, surgical approach, equipment and materials (capsule support elements, microforceps, sutures, and capsule dyes), and IOL choices. We also arrange to have posterior segment backup immediately available so that all intraoperative eventualities can be taken care of in a single trip to the operating room (OR).

Q4.2 What is your next step after the capsulotomy step reveals severe 360-degree zonulopathy?

- Hydrodissect and proceed with phaco 4.8%
- Insert a capsular tension ring (CTR) prior to phaco 18.2%
- Insert iris retractors around CCC prior to phaco 19.8%
- Insert capsule retractors prior to phaco 52.4%
- Insert capsule tension segment prior to phaco 4.8%

Kevin M. Miller The audience members were somewhat divided on how they would proceed at this point. The most common response was to insert capsule retractors prior to phaco. I agree that this is the way to go. I favor placing capsule retractors in the areas of zonular laxity or dehiscence to stabilize the bag and serve as artificial zonules. Hydrodissection might be done before their placement if the zonules were able to tolerate it. The surgeon should place as many capsule retractors as necessary to provide 360-degree stability. (Note: Capsule retractors are different from iris retractors. Iris retractors are single stranded and much more likely to cut through the capsulorrhexis than capsule retractors.) Once the cataract and most of the cortex have been removed by a

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gentle phaco technique, a CTR can be implanted to expand the equatorial diameter of the capsule bag and redistribute forces from weaker zonules to stronger zonules. Premature placement of a CTR risks trapping cortex, thus making its removal more difficult. It's important when implanting a CTR to not let it get caught inside the loop of a capsule retractor. Newer generation retractors have a smaller loop that prevents this from happening.

Q4.3 Now that the capsular bag has been preserved, how will you fixate the IOL?

- Bag fixation without a CTR 4.3%
- Bag fixation following CTR insertion 37.4%
- Bag fixation following sutured CTR or capsular tension segment (CTS) 35.3%
- Place a 3-piece IOL in sulcus 15.8%
- Scleral IOL fixation 5.8%
- Other 1.4%

Yuri McKee For focal zonulopathy of 3 clock hours or less, a CTR is appropriate for stabilization of an intact capsule. For 3 to 6 clock hours, the placement of a suture-supported Ahmed segment (FCI Ophthalmics) results in a more stable capsule and IOL. More significant loss of zonules will require the use of multiple Ahmed segments or a Cionni CTR (FCI Ophthalmics) with suture support. For this case, I believe the majority of audience responses are appropriate. It is, however, important to keep in mind that suture-supported IOLs and capsules can have a limited life span of 10-15 years in many cases due to degradation of nylon sutures. The off-label use of Gore-Tex (ePTFE) sutures solves this problem, but the surgical technique for using this ePTFE material is slightly more complicated than for nylon or polypropylene material. While many options exist for fixation of an IOL in the setting of poor zonular support, few are as simple, relatively speaking, as intrascleral haptic fixation (ISHF). This technique is useful in many situations, ranging from 4 to 6 clock hours of zonular dehiscence up to complete loss of the capsular bag. The advantage of ISHF over suture-based techniques includes lack of pseudophacodonesis and a simpler surgical approach through small limbal incisions. The glued IOL technique was popularized by Amar Agarwal and based on Gabor Scharioth's scleral tunnel technique. Yamane devised an ISHF technique that simplified the surgery and eliminated the use of fibrin glue. Known as the "double-needle technique," this version of ISHF relies on the use of a thin-walled 30-gauge needle (TSK) to create the scleral tunnels via a transconjunctival approach. The haptics of the IOL are threaded into the needle lumen and externalized via the scleral tunnels. The haptic tips are gently melted by the proximity of a heat-loop cautery, which creates a terminal rivet. These riveted haptic tips are buried into the scleral tunnels beneath the conjunctiva. The result is a stable, well-centered posterior chamber IOL in the absence of capsular support accomplished in the least-invasive fashion possible. As with all ISHF approaches, the Yamane technique requires the haptic exit sites to be exactly 180 degrees apart and the scleral tunnels to be exactly the same length. Care should be taken when applying heat to the haptic terminals. The polymer melts quickly, shortening the haptic. Once the rivet forms, no additional heat application is useful. Not more than 0.5 mm of haptic should be lost in the melting process. An important aspect of any ISHF technique is the placement of an intraocular infusion line. These eyes are prone to intraoperative hypotony due to the absence of an intact hyaloid face. As with any new technique, it is strongly recommended that the delicate skills are perfected in the wet lab and learned under the tutelage of a surgeon who is experienced with these maneuvers.

Q4.4 What is your strategy for the severe traumatic mydriasis?

- Defer and return to the OR for later repair if needed 24.8%
- Defer and refer patient if repair is needed 10.7%
- Use continuous suture for cerclage pupilloplasty 30.6%
- Use interrupted sutures for cerclage pupilloplasty 31.4%
- Implant an artificial iris device 2.5%

Mike Snyder The approach to managing a severe traumatic mydriasis generated a wide variation of responses from the audience. About a third of respondents preferred to defer iris management (either by themselves or others) to a second surgical intervention on an as-needed basis. Given the very large pupil of the eye presented, halos and possible shadow images due to exposure of the edge of the lens optic are nearly inevitable. Sometimes these symptoms can actually be worse than they were preoperatively, as the natural lens fills the entire pupillary space. Those who chose to defer because of concerns of breaking the capsule with the sharp needle tip while performing a cerclage have a legitimate concern; repairing the iris in a subsequent surgery makes this less of a risk, as the capsules will have fused together by that time (though the risks of a second surgery should be considered as well). Those who would defer based on optimism of an absence of photic symptoms following surgery are likely to be disappointed. Given the lightly colored nature of the iris and, likely, a light choroid as well, there is a particularly high likelihood of photic symptoms. Of the nearly two-thirds (62%) of surgeons who preferred a cerclage repair of the mydriatic pupil, there was a nearly even split between continuous circumferential cerclage (30.6%) and multiple interrupted sutures (31.4%). Continuous circumferential suture, as initially taught by Ogawa,[1] is technically more demanding and more time consuming than interrupted sutures, but it yields a cosmetically superior result, especially in the lightly colored iris. An equally effective functional result can be achieved with either approach. In lightly colored irides, it can be difficult to ascertain before cerclage whether the iris pigment epithelium (IPE) remains intact. Some patients can achieve anatomically successful relief of the mydriasis with suture repair, but if the IPE is damaged, light-related symptoms can persist. Furthermore, it may be possible to

"cheese-wire" a suture repair, sometimes multiple times (see Fig. 4C online). The fewest number of attendee respondents chose an artificial iris device (2.5%). This rather low number likely represents the current lack of an FDA-approved iris prosthetic device in the United States. At this time, only those surgeons in the investigational device exemption study have access to the custom-matched, flexible artificial iris. This study is drawing to a close, and we are hopeful that approval will permit wider surgeon access to this option. International surgeons have broad access to a variety of iris prosthetic devices, which offer varying degrees of cosmetic improvement. When placed at the time of cataract surgery, as in this case, an artificial iris may be more expeditious and more facile than a cerclage suture, and it nearly assures photic reduction.

1 Ogawa GS. *Ophthalmic Surgery and Lasers.* 1998;29(12):1001-1009.

Case 5: Ultrabrunescent Cataract

This 66-year-old has a 20/20 pseudophakic right eye and is interested in surgery in her left eye despite long-standing poor vision. She has a black lens as well as open-angle glaucoma, and her intraocular pressure (IOP) is 22 mm Hg on 2 topical meds. A MIGS (microinvasive glaucoma surgery) device is planned.

Q5.1 How would you approach this 5+ ultrabrunescent cataract?

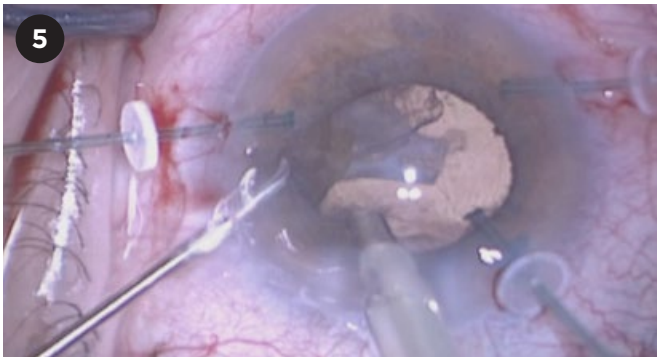
- Manual phaco 38.3%
- Femtosecond laser-assisted phaco 10.9%
- Manual extracapsular cataract extraction (ECCE, large incision) 26.3%
- Manual ECCE (small incision) 15.4%
- I would refer the patient 9.1%

Soon-Phaik Chee There are 2 main problems to deal with in this patient: 1) a brunescent cataract, and 2) glaucoma that is not well controlled. Preoperative endothelial cell count and assessment of the optic nerve are important for counseling the patient regarding the risks and benefits of cataract surgery. I would also perform an ultrasound biomicroscopy to assess the state of the zonules, as these may be deficient and/or at risk during surgery with the anticipated surgical manipulations. A dense cataract such as this is likely to hinder clinical examination of the optic nerve, but the history and examination for a relative afferent pupillary defect may be helpful in determining whether there is significant preexisting glaucomatous optic neuropathy that may preclude the use of a femtosecond laser. In view of the possible need for further glaucoma surgery following MIGS, cataract surgery sparing the conjunctiva is preferred. Cataract removal by phacoemulsification is thus preferred to ECCE. However, in a black lens, dealing with the leathery posterior nuclear plate can be especially challenging. In addition, there may be areas of capsular fibrosis that are difficult to tear through. I would therefore use the femtosecond laser in this case to perform the capsulotomy and nuclear fragmentation, using the maximum energy. One may prefer a slightly larger capsulotomy in an ultrabrunescent cataract, but I generally keep to a 5.0-mm capsulotomy. I would select a grid pattern that softens and segments the nucleus into multiple small pieces, keeping the posterior offset at 500 µm and maximizing the extent of radial fragmentation. In such a challenging case, I prefer to use manual incisions. It is important to top up the dispersive viscoelastic frequently during surgery and to keep the phaco tip away from the endothelium, stepping down the phaco parameters as the nuclear fragments are consumed. The MIGS device can then be implanted.

Q5.2 Following capsulorrhexis and hydrodissection, the nucleus won't rotate. How would you proceed?

- Initiate some sculpting and then try rotating again 36.5%
- Attempt to use 2 instruments to rotate 18.9%
- Insert capsule retractors and then rotate 3.8%
- Sculpt and crack the nucleus without employing rotation 33.3%
- Phaco chop without employing rotation 7.5%

Abhay Vasavada Ultradense brunescent cataracts are often difficult to rotate. One of the major challenges is that the bulky nucleus may not allow the passage of a fluid wave across the capsular bag. Furthermore, it is not uncommon to have dense corticocapsular adhesions in such cataracts. These make the large nucleus adhere to the capsular bag equator and resist rotation. My strategy in such cases is to inject small amounts of fluid in multiple quadrants. I do not aim for a complete fluid wave, for fear of inducing a capsular blowout (there is minimal space available with such a large nucleus, and the capsule can often be less elastic). If the nucleus does not rotate, I prefer to create a division in the nucleus. I find that the chop technique is more efficient for dividing dense nuclei. Horizontal, vertical, or modified versions of the stop-and-chop technique may be used, depending on the surgeon's ergonomic comfort. However, many times, these leathery nuclei do not divide completely in a single chop, and I find the multilevel chop technique very useful. In this technique, an initial partial thickness crack is created without aiming for a complete division. Then, the phaco tip is occluded in the lens substance at a deeper plane, and the original crack is



CASE 5. *With a large nuclear fragment behind the iris, the phaco tip aspirates the posterior capsule due to postocclusion surge, creating a capsular defect.*

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extended both centrally and in a deeper vertical plane. Creating a division opens up the subcapsular space and allows the fluid to create a cleavage between the lens and capsular bag. Many times, this is sufficient to make the nucleus mobile. However, if the nucleus doesn't rotate even after a division is created, I then perform gentle, multiquadrant hydrodissection, injecting small amounts of fluid in multiple places. The key is to understand that hydrodissection can be repeated as many times as required to make the nucleus mobile. Proceed further only once the lens is freely mobile; otherwise you might be inviting trouble. Also, as surgeons we need to understand that focal, gentle hydrodissection can be performed at any stage of surgery, even during sculpting, chopping, or fragment removal. Looking at the audience responses, about 40% of the surgeons feel that some form of nucleus division should be carried out without attempting further rotation. However, nearly 37% of the participants feel that sculpting should be performed and then rotation attempted. I differ in this point, as I feel that sculpting alone will not help make rotation easier. Either additional hydrodissection or nucleus division would be preferable.

Q5.3 The posterior capsule tears with the last nuclear quadrant still present. What would you do next?

- Enlarge the incision and manually extract the remaining quadrant 6.1%
- Resume phaco after injecting a barrier of OVD over the capsular defect 38.3%
- Resume phaco after inserting a scaffold beneath the nuclear quadrant 25.0%
- Resume phaco after performing an anterior vitrectomy 11.7%
- Resume phaco after performing an anterior vitrectomy and inserting a scaffold 18.9%

Amar Agarwal If one has a PC rupture with retained lens fragments, one of the best ways to manage it is to perform an IOL scaffold. The audience has voted for the same; if we combine the third and fifth answers, we see that support for the IOL scaffold comes to nearly 44%. The basic principle of the scaffold technique is as follows: When a PC rupture is present with the nuclear fragment still in the eye, just lift the nucleus and bring it anteriorly above the iris with the PAL technique. Then do a little bit of vitrectomy if needed, and inject a 3-piece IOL above the iris but under the nucleus. The haptics of the IOL can be placed as follows: 1) both above the iris, 2) 1 haptic above the iris and the other kept out of the incision, or 3) both above the rhexis, if it is seen clearly. In any event, we have thus created our own posterior capsule with the IOL, which acts as a temporary platform (e.g., a scaffold) and prevents the nuclear fragments from falling. Next, use the phaco handpiece to emulsify the fragment. At this stage, one can use gas forced infusion so that the corneal endothelium is away from the phaco handpiece, as the anterior chamber will become deep. Once the nucleus is removed, apply iris hooks. This will help us better visualize and clear up the cortex with the vitrectomy probe. If the rhexis is present, just dial the IOL above the rhexis; if there is no capsular support, one can do a glued IOL by transferring the haptics from above the iris to behind the iris using the handshake technique. Thus we have done 3 techniques—PAL, IOL scaffold, and glued IOL—which form the triumvirate technique. Finally remove the iris hooks and close the case. A couple of final points: Remember to do the entire surgery by fixing a trocar anterior chamber maintainer so that fluid is in the eye, which maintains the eye. Also, hypersonic vitrectomy has just been brought out by Bausch + Lomb. One can do vitrectomy and nuclear emulsification with the same 23-gauge hypersonic vitrectomy probe.

Q5.4 With this PC tear, through what port will you perform the anterior vitrectomy?

- Clear-corneal incision + coaxial infusion 5.0%
- Clear-corneal incision + split limbal infusion 23.3%
- New limbal incision + split limbal infusion 35.2%
- Pars plana + limbal infusion cannula 30.8%
- Pars plana + pars plana infusion cannula 5.7%

Carl Regillo There is no wrong way to proceed as long as you adhere to the basic principles of a good, safe anterior vitrectomy by moving slowly with the vitreous cutter and avoiding blind maneuvers so that traction on the vitreous base and the risk of iatrogenic peripheral retinal tears are minimized. A small amount of triamcinolone to "dust" the vitreous gel is a useful intraoperative tool; it ensures a complete anterior vitrectomy and the lack of any vitreous adherence to anterior structures at the end of the case. Stretching the pupil with whatever technique you are comfortable is also important if the pupil becomes small during this stage of surgery. This helps make sure that there is a complete anterior cleanup with removal of all lens material, including the cortex. It also facilitates assessment of the remaining capsule in order to properly determine the best lens implant and position. Going back to the specific question of which port to use for the anterior vitrectomy, my recommendation for the cataract surgeon is either "clear-corneal incision + split limbal infusion" or, if comfortable with the pars plana approach, "pars plana + limbal infusion cannula." The use of coaxial infusion is best avoided, and pars plana infusion is not necessary for a limited anterior vitrectomy.

Thomas Samuelson While I believe that surgeons should employ the procedures and techniques most in line with their experience, comfort level, and skill set, I firmly believe that all surgeons should commit themselves to upgrading their skills as better surgical methods evolve. Accordingly, I encourage the 5% of surgeons in this audience who currently use coaxial infusion/vitrectomy to update their anterior vitrectomy technique. It is counterintuitive to have the irrigation cannula and the vitrector on the same sleeve. While coaxial I/A works well for cortical cleanup in the setting of cataract surgery, coaxial vitrectomy is suboptimal. Unlike cortex—which is fixed to the capsule and finite—vitreous is free floating, and the goal is to remove only the amount that might become incarcerated in wounds or within anterior

segment structures. Coaxial vitrectomy is inefficient and results in removal of more vitreous than is necessary, because the infusion hydrates and mobilizes additional vitreous. A better technique is to create a closed system, which generally requires a new, smaller incision than the original cataract wound and an infusion port separate from the vitrectomy port. I have not found it necessary to move the infusion port to the pars plana for each case. Rather, I believe a tight limbal infusion site, separate from the vitrectomy site, is perfectly adequate. However, I believe that a vitrectomy via a pars plana sclerotomy is the most efficient and physiological method to remove the vitreous, removing the vitreous from a posterior vantage point rather than pulling vitreous anteriorly. That said, I believe that a limbal vitrectomy via a closed system, with a separate infusion site, is perfectly reasonable, and it might be preferred in some instances. Finally, triamcinolone is often very helpful to identify and stain any occult vitreous strands that may remain in the anterior segment.

Q5.5 Following PC rupture and an anterior vitrectomy, would you still implant a MIGS device?

- Yes—I would use an iStent (Glaukos) 19.5%
- Yes—I would use the CyPass (Alcon) 2.4%
- Yes—I would use another MIGS procedure 3.3%
- No, I don't perform MIGS 53.7%
- I perform MIGS, but wouldn't in this case due to the PC rupture 21.1%

Reay Brown Just over half of the respondents don't perform MIGS at all. But this means that almost half do—a remarkably rapid adoption rate for a technically sophisticated procedure that has only been available for 5 years. Of the respondents who do perform MIGS, almost half would not follow through with a planned MIGS procedure in this case. The decision to perform MIGS in the context of a complication depends on many factors—the severity of the glaucoma, surgeon familiarity [with the procedure], the expectation for visual recovery, the extent of the complication, and whether proceeding with the implant is even technically possible. In most complications—including a capsule rupture—it should still be possible to safely and successfully implant the MIGS device. In a PC rupture, once the lens optic is captured and the vitreous removed, the angle should be widely open for placement of the iStent or a goniotomy with the Kahook Dual Blade (New World Medical) or Trab360 (Sight Sciences). Of the respondents who would implant a MIGS device in this case, most would favor an iStent. This would be the safest MIGS option and would be my choice here. One possible concern about a CyPass suprachoroidal stent after a PC rupture with vitreous loss is the risk of anterior chamber shallowing postoperatively. In this particular case, the history of limited vision can be used to argue both for going ahead with the implant and for aborting the surgery. In this case, if I wasn't too worn out from battling the dense lens and PC rupture—and I had good visibility—I would still implant an iStent. But at the same time, I would have a low threshold for skipping the MIGS device altogether.

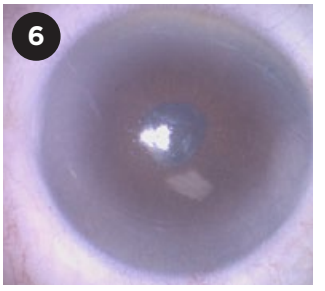
Case 6: Small Pupil and Shallow Anterior Chamber

This 85-year-old patient's pseudophakic right eye was always her best eye, but it has now declined to counting fingers due to geographic age-related macular degeneration (AMD). She desires surgery in her left eye, which has hand motions vision, a black lens, a fixed small pupil with 360 degrees of posterior synechiae, and an extremely shallow anterior chamber. The axial length is 21.34 mm.

Q6.1 How would you manage the patient's small pupil?

- Viscodilate it (e.g., Healon5) 5.0%
- Manual pupil stretching 6.4%
- Partial sphincterotomies followed by manual pupil stretching 2.8%
- Pupil expansion ring (e.g., Malyugin) 46.8%
- Iris retractors 37.6%
- Other method 1.4%

Kendall Donaldson The optimal management in this case should include a variety of tools and techniques to facilitate the removal of this cataract while hastening visual recovery for a patient who is visually compromised in both eyes. A small eye (axial length of 21.34 mm) limits the working space for removal of such a dense lens. In conjunction with a small pupil, the dense lens and potentially compromised zonules in an older patient can be a recipe for disaster if not approached in a careful fashion utilizing all available tools. I would start by attempting to instill some capsular dye for visualization. I would then follow this with viscodilation and lysis of the synechiae in preparation for placement of a Malyugin ring (MST). Once the ring is in place, the case instantly becomes more manageable. Of the respondents, 46.8% chose placement of a Malyugin ring. Placement of iris hooks or other stretching techniques could certainly be effectively used, depending on the surgeon's familiarity with those techniques. If necessary, the OVD could then be irrigated and the capsule re-stained for improved visualization. A nuclear disassembly technique such as chopping could be used to limit the energy dissipated during lens fragmentation while also reducing stress on potentially compromised zonules. Alternatively, if a femtosecond laser is housed in the OR, it could be used under sterile conditions to prefragment the lens in preparation for manual evacuation. In such cases, it is wise to allow extra time and to be prepared with all potential tools before the case begins. As with any challenging case, this leads to a better experience for the surgical team and improves outcomes for our patients.



CASE 6. *Mature black cataract with a fixed small pupil and an extremely shallow anterior chamber.*

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Q6.2 How would you approach this 5+ black cataract with an extremely shallow anterior chamber?

Phaco with extra OVD and mannitol	51.3%
Phaco following a vitreous tap	9.0%
Femtosecond laser assisted phaco	3.2%
Manual ECCE (large incision)	21.8%
Manual ECCE (small incision)	5.8%
I would refer the patient	9.0%

Samuel Masket It is interesting to note the bimodal distribution of responses; roughly 50% of the audience would attempt "routine" phaco with the aid of intravenous mannitol, whereas nearly 25% would prefer a "standard" manual ECCE approach. And, perhaps most interesting, nearly 10% would refer rather than accept the risks of surgery. Only a small number would consider a femtosecond laser (FLACS) approach. However, given the small fixed pupil, FLACS becomes impossible unless the laser is available in a sterile OR setting, allowing the pupil to be managed prior to the laser treatment. The concern regarding ECCE is the risk of suprachoroidal hemorrhage. The need for anticoagulation and the presence of chronic obstructive pulmonary disease, hypertension, and a short thick neck are among those factors that must be taken into account when considering large-incision cataract surgery in the elderly individual with a short axial length, as in the case at hand. Alternatively, phaco for this patient brings risks for cornea and iris damage and an increased likelihood for PC rupture. A key factor for me in deciding which mode to select is the cornea, and the endothelial cell status would tip me in one direction or the other. That said, given the cutting ability of some of our newer phaco needles, I would opt for phaco with mannitol pretreatment, unless the endothelium was significantly compromised. If a cohesive OVD created adequate space for pupil synechiolysis, placement of a Malyugin ring, and comfort for capsulorrhexis, I would proceed with caution in a stop-and-chop fashion, adding dispersive OVD as needed for corneal protection. If space was inadequate for those maneuvers, I would remove a small amount of vitreous via the pars plana via a single port 23-gauge trocar for the vitrector while OVD was added to the chamber; the sclerotomy is closed temporarily during cataract removal should it be necessary to remove additional vitreous. Finally, cases of this nature are often accompanied by zonulopathy, and capsule support devices should be used as necessary.

KELMAN LECTURE. *Alan S. Crandall, MD, was the 2017 Charles D. Kelman lecturer. He is shown here with Drs. Chang (left) and Weikert (right).*

Q6.3 The surgeon elected to perform a manual small-incision ECCE. What IOL would you implant with this technique?

A foldable acrylic IOL	37.8%
A foldable silicone IOL	6.1%
A PMMA IOL	48.9%
I don't do manual ECCE	6.1%
Another IOL	1.1%

Susan MacDonald Small-incision ECCE surgery is an excellent, safe technique for a mature black cataract. When considering lens choice for these cases, it is important to consider the size of the capsulorrhexis. The surgeon may choose to make the capsulorrhexis larger than 5.5 mm in order to assist in delivery of the lens into the anterior chamber; if so, it is important to choose a large lens that will stay in the capsular bag, and my choice would be a PMMA lens.

Q6.4 Describe your level of experience with manual large-incision ECCE.

Very experienced	40.7%
Some experience, and I am comfortable performing	19.1%
Some experience, but I am not that comfortable performing	11.6%
Very limited (or no) experience	23.6%
I am also comfortable with sutureless, manual small-incision cataract surgery (SICS)	5.0%

Aravind Haripriya It's good to know that a majority of the surgeons are comfortable with the manual large-incision ECCE technique. However, there is room for many surgeons to also learn the SICS technique, which will be a valuable addition to the cataract surgeon's armamentarium. The biggest advantage of the SICS technique over ECCE is that the surgery is a closed chamber technique. In this patient—where the axial length is short and anterior chamber is extremely shallow—doing a SICS reduces the chances of an explosive hemorrhage while enabling a good clinical outcome and early visual rehabilitation. My personal preference in this situation is a SICS technique. I would initially create a large sclerocorneal tunnel and stretch the pupil using 2 Kuglen hooks, so that the pupil can accommodate the large nucleus. In addition, numerous minisphincterotomies are very useful to enlarge the pupil further. It is good to plan for a 6.5-mm capsulorrhexis so that the nucleus can be prolapsed through it into the anterior chamber. Following gentle

hydrodissection, 1 pole of the nucleus is prolapsed out into the anterior chamber using a Sinskey hook. The prolapsed pole is supported from below using a cyclodialysis spatula in the nondominant hand. Using this spatula as a fulcrum, the rest of the nucleus is wheeled out of the capsular bag into the anterior chamber. The nucleus is then extracted from the eye using an irrigating vectis after coating the endothelium with viscoelastic. Following cortex aspiration with a Simcoe cannula (Accutome), a PMMA IOL is placed in the bag.

Case 7: Unhappy Multifocal IOL Patient

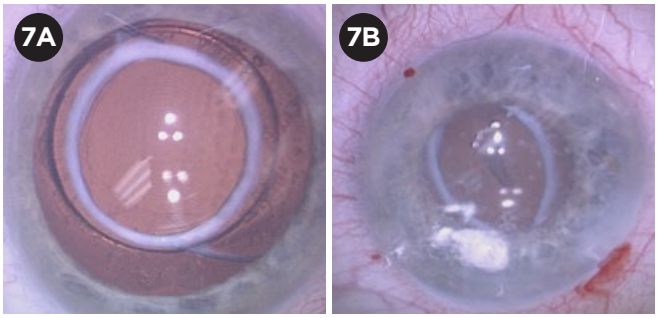
This 67-year-old is unhappy with a right Tecnis +4 add multifocal IOL (Johnson & Johnson) implanted 30 months ago due to halos, glare, and "waxy, washed-out" vision. An Nd:YAG capsulotomy did not improve the symptoms, nor have they improved with time. The right eye is 20/30+ with a –0.50 + 0.50 × 65 refraction and a well-centered multifocal IOL with an overlapping capsulorrhexis.

Q7.1 What would you recommend?

- Discourage IOL exchange and allow more time for neuroadaptation 21.0%
- Implant a multifocal IOL in the left eye 5.0%
- Implant an EDOF IOL in the left eye 2.0%
- Implant a monofocal IOL in the left eye; then decide on the right eye based on her experience 36.0%
- Perform IOL exchange with a monofocal IOL 17.0%
- Refer for IOL exchange with a monofocal IOL 19.0%

Steven Dell This IOL needs to be removed and replaced with a monofocal. In the largest published meta-analysis of multifocal implantation, my colleagues and I found that although these lenses were well tolerated, and photic phenomena were typically outweighed by the improved near function, a small cohort of patients remained unhappy until they underwent an exchange.[1] Our data also indicated that residual refractive error was perhaps the most important source of postop dissatisfaction. This patient's refractive error is too small to account for the complaints. In our study, unwanted photic phenomena tended to improve with time, but after 30 months, it is unreasonable to expect further improvement. The presence of an open capsule highlights a critical decision point in the management of unhappy multifocal patients. IOL exchange is much simpler with an intact capsule, but sometimes the patient's complaints can mimic those found with posterior capsular opacification (PCO). The key is to determine whether there was an interval of time postoperatively when the vision was acceptable, followed by deterioration. That would argue for PCO as the culprit. A little over one-third of the audience suggested exchange for a monofocal, but interestingly, about the same number suggested that the other eye should first receive a monofocal, followed by reevaluation. While there is some logic to that conservative approach, I think the multifocal needs to be replaced.

1 Rosen E et al. *J Cataract Refract Surg.* 2016;42(2):310-328.



CASE 7. *(7A) Well-centered Tecnis multifocal IOL with overlapping capsulorrhexis. There is a large central YAG posterior capsulotomy. (7B) Following IOL exchange without a vitrectomy and CCC optic capture, there is a strand of vitreous (triamcinolone stained) incarcerated in the paracentesis.*

Q7.2 After the multifocal IOL is explanted, the posterior capsule is open but there is no obvious vitreous prolapse. Prior to implanting the replacement 3-piece IOL in the sulcus, what would you do?

- Perform anterior vitrectomy via a limbal incision 3.9%
- Perform anterior vitrectomy via a pars plana incision 1.6%
- Inject triamcinolone and then decide 69.0%
- Implant the 3-piece IOL in the sulcus without any vitrectomy 5.4%
- The fourth option, but with capsulorrhexis optic capture 20.2%

Kerry Solomon Explanting a multifocal IOL should be part of every refractive cataract surgeon's armamentarium. Several years ago, multifocal IOLs were most commonly explanted because of issues with quality of vision. Fortunately, the quality of vision experienced with today's multifocal and EDOF IOLs is dramatically improved for both distance and near vision. As a result, the most common reasons currently given for explanting multifocal or EDOF lenses are the need for a power adjustment or the presence of night vision symptoms. In the setting of an open capsule with no vitreous present, placing a 3-piece IOL in the sulcus with optic capture (as 20% of the respondents suggested) makes sense after a multifocal IOL is explanted. Having the optic inside the capsular bag will improve the consistency of the IOL calculation for the new lens, because of the optic resting in the capsule (more accurate ELP, or effective lens position). Additionally, optic capture serves as an excellent way to tamponade the open posterior capsule, preventing short- and long-term vitreous prolapse by restoring the 2 chambers of the eye (essentially separating the posterior and anterior segments, as the intact posterior capsule once did). In turn, this may decrease the likelihood of vitreous or retinal traction, macular edema, retinal detachment, or other complications. Most (69%) of the respondents suggested using triamcinolone first to confirm the presence or absence of vitreous. This is a great step to ensure that no vitreous is present. In the presence of vitreous, a vitrectomy should be performed, and

David F. Chang, MD

then the same plan of sulcus fixation with optic capture can be followed.

Q7.3 Following sulcus IOL implantation and optic capture, triamcinolone staining reveals a vitreous strand incarcerated in the side port incision (Fig. 7). What now?

- Conclude surgery and leave the vitreous strand in the paracentesis 0.6%
- Sweep the vitreous free from the incision, but no vitrectomy 5.4%
- Snip the vitreous strand with microscissors 26.3%
- Perform a limbal anterior vitrectomy 58.7%
- Perform a pars plana anterior vitrectomy 9.0%

Thomas Kohnen The presence of vitreous strands in the wound after posterior chamber sulcus implantation and optic capture (as seen in this case with triamcinolone staining) indicates that vitreous prolapse has occurred. After PC rupture, a posterior chamber IOL can still be implanted into the capsular bag, if the rent is small and relatively central—and if the anterior capsular (AC) margins are well defined. If possible, the PC tear should be converted to a posterior CCC. If the rent exceeds 4-5 mm in length or there is extensive zonular loss, the capsular bag is not adequate for IOL support. In such cases, the ciliary sulcus is opened with an OVD, and the iris is retracted in all quadrants so that the status of the peripheral capsule and zonules can be assessed. The IOL is inserted with its haptics oriented away from the area of the rent and positioned in areas of intact zonules and capsule. Another alternative, if the AC rim is intact, is sulcus placement of the IOL, with capture of the optic through the capsulorrhexis or laser capsulotomy. To allow this maneuver to take place, the AC opening must be intact when the cataract or refractive lens procedure is started. Optic capture of the IOL optic enables a more secure fixation of the sulcus-placed IOL (e.g., for toric IOLs). If vitreous is present in the anterior segment before IOL implantation (again, this is best demonstrated with triamcinolone staining), vitrectomy should be performed first, with the necessary caution taken to prevent extension of the rent. Depending on the type of capsular tear, vitrectomy is performed through either the limbal incision or the pars plana. The former approach is used when the tear is located near the incision, as this permits vitrectomy with minimal risk of enlargement of the tear. A pars plana approach is preferred when the tear is remote from the incision and therefore less accessible anteriorly. In either case, irrigation is provided with an infusion cannula in the paracentesis opening or via a 23-gauge trocar inserted through the pars plana.

DISCUSSANTS. *Dr. Chang (far left) presenting the first case to (from left) Drs. Weikert, Cionni, and Han.*

If a vitreous strand is incarcerated in the side port incision following IOL implantation, this can cause pupil ovalization; more importantly, it can lead to chronic inflammation of the eye. Therefore, the link between the anterior and posterior segments should be disconnected. In my experience, 2 procedures have been very successful: 1) The vitreous strand to the side port can be cut with a YAG laser after maximal miosis has been achieved pharmacologically. If the laser can cut the strand, vitreous from the area close to the implant will revert behind the lens. This approach avoids a second intraocular procedure. 2) If this procedure is not successful, a limbal anterior vitrectomy allows complete and easy removal of the vitreous strand. Just sweeping the vitreous may not be successful, and snipping with microscissors may leave some vitreous in the wound; therefore, if a sterile intervention is performed, limbal anterior vitrectomy would be the preferred technique. A pars plana approach is usually not necessary for a simple vitreous strand. In summary, regardless of the preferred approach, a vitreous strand to the side port incision should be disconnected or removed to avoid long-term complications.

Q7.4 If a cataract patient hates glasses and is a good candidate for a presbyopia-correcting IOL, I most commonly recommend:

- Standard diffractive multifocal IOL (+3) 18.5%
- Low-add diffractive multifocal IOL (+2.5) 24.6%
- Diffractive EDOF IOL 26.2%
- Monofocal monovision 20.8%
- Other refractive IOL 0.8%
- Refer 9.2%

Eric Donnenfeld Most of the audience has voted for one of the following 4 ways to manage a patient who is a good candidate for a presbyopia-correcting IOL and does not want to wear glasses: a standard diffractive multifocal IOL, a low-add diffractive multifocal IOL, a diffractive EDOF IOL, and monofocal monovision. In my opinion, all 4 choices are correct. When we have this many viable options it overwhelmingly means one thing: No choice is perfect, and each has advantages and disadvantages. The lenses with the least glare and halo (EDOF and low add) have the fewest side effects and provide good intermediate vision, but they often do not provide complete spectacle independence at near. The high-add multifocal IOLs have more spectacle independence but more glare and halo, while monovision results in a loss of stereopsis and depth perception. The correct answer for an individual patient is found in his or her willingness to accept glare and halo and lack of stereopsis in pursuit of spectacle independence.

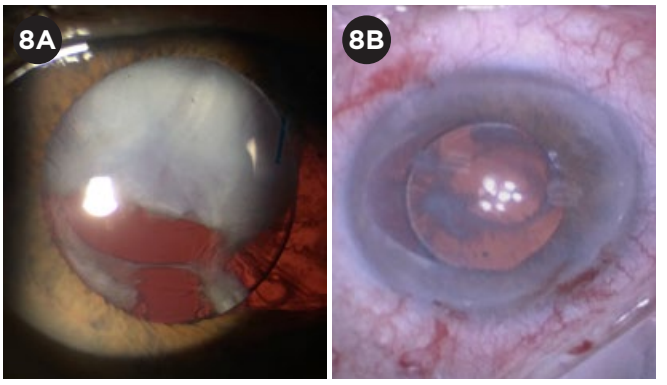
Case 8: Iris Prolapse

This 71-year-old patient had complications from cataract surgery that was done 6 weeks prior. She has chronic narrow angles despite a YAG iridotomy and a small pupil, iris prolapse, posterior pressure, and an AC tear that extended into the posterior capsule. The prolapsed iris that could not be reposited was excised; cortex was left behind due to the posterior pressure. Her vision is now 20/200.

Q8.1 If iris prolapse occurs in association with increased posterior pressure, what would you generally do to remove the remaining cortex?

- Perform cortical I/A via a separate new incision..18.1%
- Reduce the posterior pressure with a pars plana vitreous tap.....65.0%
- Stop surgery and resume after waiting for an hour 8.8%
- Excise the prolapsed iris and abort the surgery...5.0%
- Abort surgery, and leave any prolapsed iris alone.....2.5%

Bob Osher The first maneuver should be to reposit the iris by lowering the IOP. Often the eye can be overfilled with OVD, which can be aspirated. Rather than push the iris back through the incision, which never works very well, a second stab incision can be made through which a dull instrument can be used to sweep the iris back through the main incision. I prefer an OVD cannula because a retentive OVD like Healon5 (AMO) can then be injected onto the iris, displacing it posteriorly. I would also hydrate the incision to retard recurrent prolapse. Once the iris is safely reposited, the surgeon must manage the increased IOP. External causes like speculum pressure against the globe or retrobulbar hemorrhage should be excluded. The patient should be asked if he or she is uncomfortable (e.g., has to urinate), as any Valsalva can raise the IOP. The most likely cause is an intraocular etiology like BSS passing through the zonules and hydrating the vitreous gel. I keep a special lens (Osher Fundus Lens, Ocular Instruments) on my back table, which allows me to quickly view the fundus through the microscope to exclude a choroidal hemorrhage or effusion. In my experience, a pars plana vitreous tap is rarely necessary. I would prefer to inflate the capsular bag with a cohesive OVD and then remove the cortex by a dry aspiration technique. I will use a curved cannula (Crestpoint and Bausch + Lomb) on a 3-cc syringe to aspirate subincisional cortex and then a straight 27-gauge cannula for the remainder of the cortex. Alternatively, I can use a bimanual technique or a coaxial I/A technique, entering the OVD without infusion. Once inside the incision, the infusion is initiated and the cortex can be safely engaged at the most anterior proximal location, then removed with slow-motion parameters. Before withdrawing the I/A tip, the infusion should be reduced or even stopped to prevent iris prolapse. The knowledgeable management of iris prolapse can result in an excellent functional and cosmetic surgical result.



CASE 8. *(8A) Slit-lamp image showing retained cortex behind the IOL and a large stromal iris defect temporally. (8B) Following removal of cortex and centration of the IOL, the temporal iris defect persists.*

Q8.2 What would you do in this eye with retained cortex and a PC tear 6 weeks following complicated cataract surgery with posterior pressure and iris prolapse (Fig. 8)?

- Continue medical treatment for longer.....0.7%
- Attempt to YAG a central optical opening in the layer of cortex 9.7%
- Surgically remove the cortex.....67.4%
- Refer to an anterior segment surgeon 8.3%
- Refer to a posterior segment surgeon..... 13.9%

Terry Kim In this patient with retained cortex 6 weeks following complicated cataract surgery, the majority of the audience voted to surgically remove the cortex from behind the IOL. The other responses are reasonable considering the potential complexity in pursuing this approach. For this specific case, I was asked to lecture on the related topic of retained lens fragments in the *anterior* chamber after cataract surgery. In this scenario, the response of surgically removing the retained lens fragment is highly recommended. In our retrospective series on this topic,[1] we found that all of the patients who were initially managed medically (usually with topical corticosteroids) failed therapy and eventually underwent surgical removal of the lens fragment. The primary reasons for removal included worsening/persistent corneal edema (63%) and worsening/persistent anterior chamber inflammation (37%). Our study also revealed that the patients' visual acuity improved after lens fragment removal and that delayed diagnosis (and delayed removal) increased the risk of prolonged and/or permanent corneal edema, with some cases requiring corneal transplantation. Management strategies for the surgical removal of a lens fragment from the anterior chamber include using an I/A handpiece to aspirate this fragment, which may require a second instrument to "crush" the fragment into the aspiration port. However, one of the problems associated with this approach includes the possibility of further fragmentation of the lens fragments into smaller pieces that can be flushed by irrigation behind the iris or somewhere in the anterior chamber where it may be difficult to visualize. Hence, an alternative approach involves using a cohesive OVD to direct the entire lens fragment to the main

corneal incision where it can then simply be burped out of the anterior chamber through this incision in 1 piece. Preoperative use of a miotic agent like pilocarpine is recommended to minimize the risk of losing any lens fragment behind the iris. When it is difficult to ascertain whether the retained material in the anterior chamber is actually lens or cortex, it should be treated like lens material and removed promptly without much delay to minimize the risk of corneal decompensation.

1 Zavodni Z et al. *Am J Ophthalmol.* 2015;160(6):1171-1175.

Q8.3 How would you address the temporal iris defect?

- Leave it alone for now and try miotics or colored soft contact lens....4.8%
- Leave it alone for now—operate later if symptomatic....16.1%
- Leave it alone for now—refer later if symptomatic....10.2%
- Perform suture repair....68.8%
- Implant an artificial iris device....0.0%

Brandon Ayers In this scenario, we have a surgical complication that includes a large temporal iris defect. Most attendees indicated they would attempt primary suture repair of the iris defect during the surgery. In many cases this is possible by reapproximating the 2 ends of the iris defect with a 10-0 polypropylene suture and then tying with an intraocular knot (such as a Siepser knot). This technique can be very helpful, especially with smaller iris defects, where the 2 ends can easily be approximated with minimal stress placed on the iris root. The source of iris damage is often intraoperative iris prolapse from intraoperative floppy iris syndrome (IFIS), and often can be repaired at the time of surgery. Caution should be taken in cases of intraoperative iris damage when the anterior segment is unstable due to posterior pressure or violation of the posterior capsule. In this situation the IOL or anterior chamber may not be stable, and attempting iris repair may jeopardize the success of the surgery. Secondary repair is a better option. Time gives the eye the ability to heal, reduces inflammation, and allows the capsule to fibrose, holding the IOL more securely. Miotics or prosthetic iris contact lenses can be tried to see if glare is reduced. If nonsurgical techniques work well, repair may not be needed. In some cases, the iris damage can be severe enough that primary repair is not possible. In cases where repair is not an option, prosthetic contact lenses may be the best choice. Currently, no FDA-approved devices are available for iris replacement in the United States. Multiple iris prosthesis FDA trials are ongoing; the hope is that a device will be approved in the near future.

Q8.4 If operating on this patient's 2nd eye, I would . . .

- Employ iris retractors early on....12.8%
- Employ a pupil expansion ring early on....25.5%
- Perform a pars plana vitreous tap....20.2%
- Use mannitol or other strategy....37.2%
- Refer the patient elsewhere....4.3%

Dick Lindstrom The audience recommendations are all reasonable, and the use of a combination of them makes sense to me. I would approach a patient with a shallow anterior chamber, poorly dilating pupil, and dense cataract who had a complex course in the first eye—with intraoperative iris prolapse, positive posterior pressure, a capsular tear, and retained cortex—with several strategies. First, I would utilize a peribulbar block of combined lidocaine and Marcaine (bupivacaine hydrochloride and epinephrine) followed by digital and balloon compression to soften the eye. I no longer use intravenous mannitol, but it is a reasonable option as recommended by many in the audience. I would be prepared with a Malyugin ring or similar pupil expansion device as well as iris and capsule retractors. Following preparation of the primary incisions, I would inject nonpreserved lidocaine with epinephrine diluted 5:1. I usually prefer 4-5 iris retractors over a pupil expansion device, which requires 4-5 small paracenteses. I would also use Omidria (Omeros) in the BSS infusion bottle. A high viscosity cohesive viscoelastic such as Healon GV or Healon5 can also be helpful in creating an adequate anterior chamber and initiating viscomydriasis. If the anterior chamber was difficult to form, I would not hesitate to perform a limited vitreous aspiration using a vitrector through the pars plana. No infusion is required, and I turn the cutting port posteriorly to avoid any chance of opening the posterior capsule. This always results in a deep anterior chamber. I rarely use a femtosecond laser these days, but I have found that the Mynosys (Zepto) device creates an excellent round and strong anterior capsulotomy. If it is available, I would employ it in a case such as this patient. I also like the MiLoop (Iantech), which would be useful in cutting this dense nucleus into 4-6 pieces following hydrodissection. I would inject some dispersive viscoelastic to subluxate the nuclear pieces anteriorly and further protect the posterior capsule prior to phacoemulsification. A phacoemulsification machine with forced infusion would enhance anterior chamber stability. Cortical cleanup should be routine, but I would be prepared to do biaxial I/A. A standard 1-piece aspheric hydrophobic acrylic IOL would be implanted in the capsular bag. I would have a 3-piece IOL available, and if a PC tear occurred, my plan would include sulcus placement of the haptics and posterior optic capture in the 5.2-mm Zepto capsulorrhexis. With Healon GV and Healon5, I am very compulsive about removing viscoelastic to reduce the risk of an IOP spike. I would utilize intracameral carbachol and also inject a combination of intracameral moxifloxacin/dexamethasone/ketorolac (Imprimis). I would have ReSure wound sealant (Ocular Therapeutix) available if hydration did not result in watertight wounds. If possible, this patient might benefit from a same-day postoperative visit with an IOP pressure check. My postoperative regimen in this complex case would include a topical steroid and a nonsteroidal anti-inflammatory drug (NSAID), preferably in a combination drop to enhance compliance.

EXTRA **MORE ONLINE.** For additional images relevant to Case 4, view this article online at aao.org/eyenet.

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