DAVID F. CHANG, MD

The 2013 Cataract Spotlight Session presented a full range of challenging cases, from surprising instrument snafus to torn capsules with vitreous loss.

Cataract Complications

This past November, the 12th annual Spotlight on Cataract Surgery Symposium at the Academy's Annual Meeting was entitled "M&M Rounds: Learning From My Mistakes." Cochaired by William Fishkind, MD, and myself, this four-hour case-based video symposium was focused on cataract surgical complications.

Every cataract surgeon makes mistakes and suffers complications, but it is how and what we learn from them that makes us better ophthalmologists. During the symposium, 18 cataract experts each presented a video case in which something went wrong, and a complication occurred that taught them valuable lessons. At critical decision points during the case, the video was paused and the attendees were then asked to make clinical decisions using electronic audience response pads. Next, two discussants (who had not viewed the case) were asked to make their own management recommendation and to comment on the audience responses before the video of the outcome was shown. The audience also voted on the best teaching cases and selected those surgeons who demonstrated the most courage—both in the OR and on the podium.

The 18 video case presentations covered the full spectrum of surgical complications, from the common to the rare—and from the spectacular save to the demoralizing outcome. The complications included anterior capsular tears (both with and without the femtosecond laser); instrument snafus (jammed forceps and projectile cannulas); entanglement with capsule retractors, capsular tension rings (CTRs), and Malyugin rings; suprachoroidal effusion; descending nuclei and intraocular lenses (IOLs); IOL exchange complications; and capsules or zonules ruptured at virtually every stage of surgery. Even those attendees who thought that they had "seen it all" were shaking their heads at some of these cases. The entire symposium with videos can be seen if you purchase AAO Meetings on Demand (go to www.aao.org/2013 and click "AAO Meetings on Demand").

Samuel Masket, MD, concluded the symposium by delivering the ninth annual AAO Charles Kelman Lecture. Dr. Masket's presentation, "25 Years of the *JCRS* Consultation Section," highlighted surgical solutions to complicated cataract or IOL cases that had been featured in his long-running column in the *Journal of Cataract and Refractive Surgery.*

This *EyeNet* article reports the results of the audience response questions, along with written commentary from presenters and panelists. Because of the anonymous nature of this polling method, the audience opinions are always interesting and were discussed in real time during the symposium by our panelists. Finally, I want to especially thank our 18 audacious video presenters. It is much easier to present your best cases instead of your complications in front of several thousand attendees. We all appreciate their humility, courage, and generosity in sharing these cases with us so that we might all improve our surgical judgment and skills.

—David F. Chang, MD
Cataract Spotlight Program Cochairman

CASE 1 FROM CHAMPAGNE TO LEMONADE

A Miotic Pupil With an Anterior Capsular Tear

Roger Steinert's patient had a small pupil, and a fibrotic pigmented membrane was peeled from the pupil edge. After a pupil expansion ring was implanted, a defect was noted in the anterior capsule. The defect might have been caused by the pupil instrumentation.

Q At this point, with an anterior capsular tear/defect and a moderately firm nucleus, what would be your strategy?

- No change; continue with slow intracapsular phaco 43%
- Add relaxing continuous curvilinear capsulorrhexis (CCC) cuts and then continue intracapsular phaco 17%
- Convert to can-opener capsulotomy, then continue intracapsular phaco 3%
- Prolapse the nucleus for supracapsular phaco. 23%
- Convert to manual extracapsular cataract extraction (ECCE). 14%

Roger Steinert This case began with an unexpected problem in the anterior capsule, disclosed by the gape seen when staining with trypan blue revealed a midperipheral anterior capsular defect. Interestingly, the video does not give any clue when or how this defect occurred. What became clear, however, is that the defect could not be included in the capsulorrhexis. Given the advanced state of the cataract, perhaps the positive pressure inside the lens was the reason the defect extended far enough to the periphery that it could not be included in the circular tear capsulotomy (a mini-"Argentinean flag" sign). Now confronted with a single defect in the capsulorrhexis, the surgeon had to decide how to minimize the potential for an extension wraparound tear. Gentle and low-force techniques would certainly be appropriate.

My personal choice was to add three more defects in the capsulorrhexis, at 3, 6, and 9 o'clock relative to the incision. In doing so, I referenced a lesson learned from can-opener capsulotomy in ECCE—in these cases, we never saw wraparound tears when we expressed the intact large nucleus through the capsulotomy. (That is, multiple weak areas will allow an enlargement that does not extend beyond the lens equator.) In this case, by adding three more defects in the capsulorrhexis, I was able to relieve all of the stress from the single defect and reduce the pressures on that area that might extend into a wraparound tear.

Audrey Talley Rostov An anterior capsular tear always presents a management challenge. Care must be taken to minimize adverse sequelae, including further extension of the tear and vitreous loss. The majority of the respondents voted to continue with slow, careful intracapsular phaco. This is a reasonable option if one takes great care to avoid excessive manipulation of the bag and uses an ophthalmic viscosurgical device (OVD) generously to avoid catching the edge of the capsule in the phaco tip, thereby increasing the likelihood of the extension of the capsular tear.

The audience's second choice—prolapsing the nucleus for supracapsular phaco—would be my preferred approach for this situation. After injecting cohesive OVD beneath the nucleus and dispersive OVD above the nucleus to protect the corneal endothelium, the surgeon can then perform phaco carefully in a "soft shell" fashion, thus avoiding the capsular tear and iris while protecting the corneal endothelium. Consideration can also be given to utilizing trypan blue to stain the capsule and provide some capsular stiffening while also creating better visualization so that one can avoid catching it in the phaco or irrigation and aspiration (I&A) tip.

The audience's third choice (and the method used here), the creation of relaxing incisions in the capsulorrhexis, provides a great surgical pearl for releasing stress on the capsule and allowing a safe phacoemulsification to continue.

CASE 2 CONUNDRUM

A Wraparound Tear in a Multifocal IOL Patient

Stephen Lane's patient had a femtosecond laser capsulotomy. Following cortical cleanup, a wraparound posterior capsular tear, presumably from a femtosecond tag, was noted. A multifocal IOL had been planned.

Q How would you proceed with this wraparound posterior capsular tear?

- No vitrectomy, but implant a posterior chamber IOL (PCIOL) in the sulcus. 67%
- Perform limbal vitrectomy prior to sulcus PCIOL implantation 21%
- Perform pars plana anterior vitrectomy prior to sulcus PCIOL implantation 7%
- Perform a manual posterior capsulorrhexis (with or without a vitrectomy). 5%
- Perform a femtosecond laser posterior capsulorrhexis (with or without a vitrectomy) 0%

Q Following a partial posterior curvilinear capsulotomy with a radial anterior/posterior capsular tear, I'd implant a:

- One-piece monofocal IOL in the bag. 14%

One-piece multifocal IOL in the bag. 7%
Three-piece monofocal IOL in the sulcus 45%
Three-piece multifocal IOL in the sulcus (unsutured) 34%
Three-piece multifocal IOL in the sulcus (sutured) 0%

Stephen Lane A wraparound capsular tear is most commonly a result of an anterior capsular rim discontinuity that tears out to the zonules or beyond to the posterior capsule. Frequently, this discontinuity is so small that the surgeon is not aware that it exists.

The unique feature of this case is that the anterior capsulorrhexis created by the femtosecond laser appeared completely intact at the conclusion of nuclear and cortical removal. However, the positive pressure created upon decompression of the anterior chamber with removal of the irrigation cannula at the conclusion of I&A was enough to cause a wraparound tear. The lesson to be learned is to never allow decompression of the anterior chamber if there is any concern about an anterior capsular discontinuity. Instead, instill OVD before removing the irrigation cannula to maintain an adequate intraocular pressure (IOP) to keep the anterior segment inflated.

In this case, there was never any evidence of vitreous loss, so a vitrectomy was not necessary. After instilling OVD to tamponade the vitreous face, I converted the posterior capsular tear to a posterior rhexis with a "keyhole" in the anterior capsule. This was done in order to prevent further extension of the capsular opening posteriorly. With this reassurance, a single-piece multifocal IOL was placed in the capsular bag. I took care with the orientation of the haptics, positioning them 90 degrees away from the keyhole in the anterior capsule. Although a multipiece multifocal IOL could have been placed in the sulcus (with or without optic capture), the stability of the IOL in the capsule was felt to be superior, given the circumstances discussed above. Indeed, the IOL has remained stable with a good visual result with one year of follow-up.

Robert Cionni Although a radial anterior capsular tear might seem nonthreatening, it really needs to be treated as a significant potential threat! Even in skilled hands, 40 percent of anterior capsular tears will wrap around to involve the posterior capsule, and 20 percent will develop vitreous prolapse, requiring a vitrectomy.[1] Therefore, all anterior capsular extensions should be managed as carefully as posterior capsular tears.

I agree with the majority of the polled audience that proceeding with gentle removal of the nucleus and cortex is the correct approach. The key to preventing a wraparound tear to the posterior capsule and ensuing vitreous prolapse is to avoid anterior chamber collapse while limiting forces at the anterior capsular edge as well as avoiding overexpansion of the capsular bag. A single-piece acrylic PCIOL, carefully placed into the capsular bag with the haptics oriented away from the area of the anterior capsular extension, should result in a stable/centered IOL in the long term.

If a posterior capsular tear occurs following a radial anterior capsular extension and a posterior CCC is achieved, either a single-piece IOL in the bag or a three-piece IOL in the sulcus is appropriate for long-term stability, unless the posterior CCC is too large to ensure in-the-bag stability. In the latter instance, sulcus placement of a three-piece IOL is indicated. In either case, there is no need to avoid placement of a multifocal IOL.

1 Marques F et al. *J Cataract Refract Surg.* 2006:32(10);1638-1642.

CASE 3 KILLING ME SOFTLY

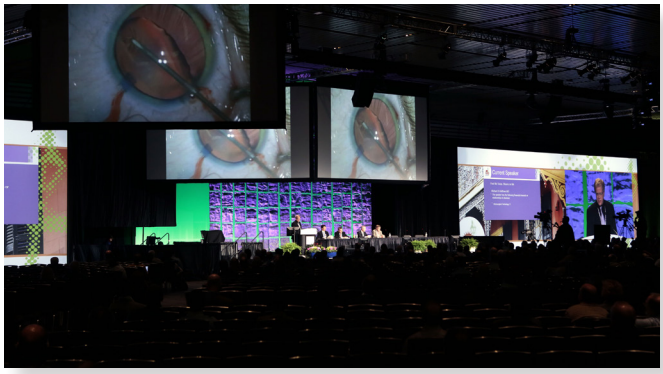
A Soft Nucleus With Posterior Capsular Rupture

Brock Bakewell's case involved a soft nucleus that did not rotate. As phaco proceeded, a tear in the posterior capsule occurred, and vitreous prolapse ensued.

Q Soft nucleus won't rotate. Now what?

Continue cautious phaco. 4%
Stop; hydrodissect again. 29%
Stop; viscodissect 46%
Use an OVD and mechanically maneuver (e.g., spatula). 14%
Switch to I&A. 7%

Brock Bakewell Even though the patient ended up with a sulcus-fixated IOL captured by the anterior capsulorrhexis and a 20/20 outcome without any retinal tears, the case could have been handled differently. The complication could have been prevented if a more thorough hydrodissection had been performed from the outset. As a rule of thumb, a surgeon should never proceed with phacoemulsification until it is possible to freely rotate the nucleus, no



CLINICAL DILEMMAS. Audience members gave immediate feedback via electronic response pads.

matter how soft it is. Injecting balanced salt solution (BSS) through a Binkhorst cannula works well to free up the nucleus subincisionally.

In this case, once the posterior capsular tear happened, a dispersive OVD should have been injected into the rent prior to removal of the phaco needle. Even though vitreous did not present immediately, a dispersive OVD can sometimes prevent vitreous prolapse during I&A of the residual paranuclear material and cortex. When the vitreous did present, triamcinolone could have been used to identify it, making bimanual vitrectomy through paracentesis incisions easier and potentially less traumatic.

Ehud Assia This case illustrates the importance of effective hydrodissection in eyes with a soft nucleus. In these eyes, mechanical separation of lens material using a spatula or other instrument may be even more difficult than it is in eyes with harder nuclei, as the instrument may penetrate through the lens material during mechanical manipulation rather than separate it from the lens capsule. If lens material does not rotate during surgery, hydrodissection or viscodissection should be performed again.

Most of the audience favored viscodissection; however, this maneuver should be done very cautiously. Fluid will always find its way out. In contrast, if the flow of a viscoelastic substance is blocked, it may accumulate and eventually explode the posterior capsule. Studies have shown that OVD is more efficient in maintaining a space between the lens material and the capsule after it was first separated by fluid.

Another significant point is the adjustment of the phaco parameters to the hardness of the cataract. Many surgeons have a favored setting that they use in most of their cases; however, there is no "one program fits all." Soft lenses do not require burst mode, and the aspiration rate should be lowered to prevent a fast and uncontrolled aspiration of the epinucleus and cortical fibers along with the posterior capsule. Although switching to I&A may work well, hydrodissection should be done prior to lens aspiration. In any case, failure to rotate the lens material should not be ignored, and any attempt to separate the lens material from the capsule should be done prior to its removal.

CASE 1 TO 3

The "CPR Award" voted for the surgeon whose case demonstrated the best save (successful rescue from impending disaster):

- Roger Steinert: Miotic pupil 44%
- Stephen Lane: Femtosecond laser/ multifocal IOL 41%
- Brock Bakewell: Soft nucleus 15%

CASE 4 THE DONNENFELD SNAP TECHNIQUE

Enlarging a Small Capsulorrhexis

Eric Donnenfeld presented a case in which he manually enlarged a contracted capsulorrhexis in the setting of unexpected zonular weakness.

Q An anterior capsule flap overlying the IOL optic is noted. What would you do next?

- Stop–you've done enough 36%
- Leave it, but inject Miochol-E 4%
- Trim the capsule flap with intraocular microscissors 29%
- Excise the capsule flap with bimanual vitrectomy instrumentation 25%
- Manually complete the tear ("snap" maneuver) 7%

Eric Donnenfeld This patient had intractable dysphotopsia following cataract surgery and was quite miserable with her quality of vision. The anterior capsule—the presumed cause of her dysphotopsia—was overriding the IOL in one quadrant. Treatment options included implanting a plano piggyback IOL, vaulting the IOL in front of the anterior capsule, and trimming the quadrant of capsule.

The surgeon attempted to manually tear the anterior capsule, which resulted in vitreous loss. During the bimanual vitrectomy, the surgeon was able to trim the aberrant capsule with I&A vitrectomy mode.

This resulted in resolution of the patient's symptoms, which confirmed that the anterior capsule override was the cause of her dysphotopsia.

In retrospect, removing the capsule was the right decision, and using a manual tear was the wrong technique. Using the vitrector to trim the capsule or employing microscissors would have been less traumatic and equally effective.

Skip Nichamin The audience's leading response was to stop and do nothing. In cases of weakened zonules with a tenuous capsular bag/IOL complex, this can, at times, be an acceptable option. The cause of the zonular weakness—for example, a progressive degenerative condition versus a nonprogressive traumatic etiology—along with the particular anatomy of the case will help the surgeon determine the best strategy.

I personally would lean toward a bimanual technique, using intraocular microscissors to enlarge the opening, along with using microforceps in the opposite hand to stabilize structures and provide countertraction to the force of the cutting scissors. Both instruments would be placed through watertight paracentesis incisions. Generous use of a cohesive OVD to maintain space and a dispersive agent to tamponade the area of exposed hyaloid would also be key considerations.

CASE 5 OPEN OR CLOSED?

A Posterior Polar Cataract

Sonia Yoo presented a posterior polar cataract patient. Because of a capsular defect, the posterior capsule tore when the anterior chamber suddenly shallowed after the I&A tip was withdrawn.

Q **For a posterior polar cataract, I would:**

- Hydrodissect and hydrodelineate 10%
- Viscodissect and hydrodelineate 14%
- Hydrodelineate only 67%
- Skip all hydrosteps 7%
- Refer these cases 2%

Q **In this case with posterior capsular rupture successfully managed, I would:**

- Immediately inform the patient of the complication 52%
- Wait until later to discuss the complication 30%
- Not discuss any complication unless other problems arose 17%
- Tell the patient, "Good news; we've avoided the inconvenience of a later Nd:YAG capsulotomy" . . 2%

Bonnie Henderson Management of posterior polar cataracts can be tricky. The polar cataract is a discoid opaque area of the posterior lens composed of malformed lens fibers. The polar cataract can be adherent to the posterior capsule—and, in turn, the central capsular area can be weak. Not all cases will result in a capsular tear; therefore, it can take a surgeon by surprise if she is not prepared.

The first question refers to the single most important change that a surgeon can make when operating on a posterior polar cataract. Hydrodissection should be avoided to prevent additional pressure in the weakened posterior capsular area. Even gentle hydrodissection or viscodissection between the capsule and lens can cause a cleavage of the posterior capsule. Therefore, it is often considered a safer approach to hydrodelineate the nucleus to separate the inner harder core from the softer epinucleus. The inner core can then be removed while leaving the epinucleus as a protective shell. The epinucleus is subsequently removed cautiously to evaluate for any opening of the posterior capsule.

If there is a hole in the capsule, as in this case, it is paramount to stabilize the anterior chamber with viscoelastic solution before removing any instruments. The capsular defect should be managed like any other posterior capsular defect by minimizing chamber fluctuations, lowering fluidics, and cutting vitreous strands that migrate anteriorly.

When a complication occurs, even if it is managed appropriately and without incident, I believe that it is best to inform the patient. Every surgeon has and will have complications. This is the nature of surgery. Therefore, the patient should be informed of significant problems that occur. Additionally, when this is the case, it is essential to make the patient aware of any signs and symptoms of potential postoperative complications. This discussion is best held on either the day of or the day after surgery.

CASE 6 COMPLEX CASES GONE WILD

A Dense Traumatic Cataract

Ike Ahmed's case was a dense traumatic cataract. After a CTR was placed, phaco was complicated by a posterior capsular tear. This posed the question of whether to attempt a posterior capsulorrhexis—or to simply place an IOL in the ciliary sulcus.

Q **A posterior capsular tear is noted with a CTR already inserted into the capsular bag. What now?**

- Posterior capsulorrhexis and implant a nontoric single-piece acrylic IOL 7%
- Posterior capsulorrhexis and implant a toric IOL . . 22%
- Implant a three-piece IOL in the ciliary sulcus. . . . 22%
- Implant a three-piece IOL in the sulcus and capsulorrhexis capture 41%
- Implant a three-piece IOL in the sulcus and suture fixation 7%

Ike Ahmed This was a complex case with 180 degrees of zonular dialysis present. Plans were made to use a sutured capsular tension segment (CTS) and a CTR to provide adequate capsular bag centration and support. These were placed early in the case, but the presence of a posterior capsular rent—which occurred during the removal of the last nuclear fragment—increased the risk of peripheral extension. As soon as the tear was noted, prevention of anterior chamber shallowing was critical to prevent extension. Thus, the anterior chamber was filled with OVD prior to removal of the phaco handpiece.

At this point, one has to consider where IOL fixation will be attempted and plan accordingly. The plurality of the audience voted to place a three-piece PCIOL in the sulcus with optic capture. However, the presence of the CTS, with its central eyelet around the capsulorrhexis, would cause excessive optic tilt; thus, I believe that this strategy is not advisable. (If only the CTR was in the bag, then optic capture would be quite reasonable.) Almost a quarter of the audience elected to place a three-piece PCIOL in the sulcus;

without adequate zonular support, this would increase the risk of IOL decentration. (If both the CTR and CTS could be retained and sutured, then this would be a viable option.) As one can see, the presence of the large zonular dialysis and CTS/CTR in the bag creates additional issues in the presence of a posterior chamber rent.

At this point, I elected to attempt a posterior CCC to prevent the tear from extending further into the periphery during cortical removal and IOL insertion—which is a major risk with the CTR in place—as well as to retain the advantages of in-the-bag placement of the capsular tension devices and the PCIOL. A pars plana incision was made at this point to manage vitreous prolapse and decompress behind the posterior chamber to prevent further extension. This was a critical decision that I believe made performing the rhexis more manageable.

Dispersive OVD was injected posterior to the tear, and microscissors were used to cut and create a flap in the posterior chamber just beyond the central tear. Microforceps were used to continue the tear in a circular fashion. Tips for performing a posterior CCC include 1) balancing pressure anterior and posterior to the posterior chamber (OVD should be injected behind and in front to sandwich the posterior chamber, but not to the point of overfilling); and 2) grasping and regrasping often, using both standard shearing as well as stretching techniques for continuing the tear. Careful focusing and managing vector forces are important during the creation of the rhexis. In this case, a 4-mm posterior CCC was performed. It is important to keep the rhexis from being too large.

Once the posterior CCC was created, cortical removal was performed, and 7-0 Gore-Tex suture was used to suture the CTS to the sclera in the area of dialysis. A single-piece toric PCIOL was then placed in the bag and positioned carefully. The presence of a pars plana incision aided in removal of the OVD behind the toric IOL with the use of the vitrector.

Alan Crandall This case is very interesting as well as complex. The original plan was to place a single-piece toric IOL within the bag. Due to zonular weakness, a CTS and CTR were implanted. However, the posterior capsule was torn later during surgery.

It is critical to understand the problems that the tear created. In a case such as this one, the first step is to not come out of the eye until an OVD is placed to prevent vitreous from coming forward. (A dispersive OVD can be used to hold the vitreous face back.) Once the chamber is stabilized, then one can decide how to approach the situation. A CTR will place centrifugal force symmetrically on the bag—and because the tear did not extend, it would make sense to attempt a posterior rhexis. However, it is important to avoid overfilling the bag, as that could lead to an extension of the tear and make the rhexis attempt difficult. A single-piece IOL cannot be placed into the sulcus, as it will likely cause pigment dispersion and secondary glaucoma, but it can be placed if the posterior rhexis is completed.

The audience response seems to indicate that most surgeons are not comfortable with a posterior rhexis in this setting. If one is not comfortable with a posterior rhexis, then this would not be a good case in which to attempt it, and the fourth answer would make good sense. Rotation of a toric lens into the correct position would have to be carefully performed in this case given the zonular issue; a bimanual rotation with minimal force on the complex could be used. Removal of the OVD must also be done carefully to make sure that the lens does not rotate and no further forces destabilize the IOL/bag complex.

Overall, this was beautiful surgery; it shows that it's critical to have multiple game plans with well-thought-out approaches.

CASE 4 TO 6

The "Grand Rounds" Award voted for the surgeon who presented the best teaching case:

Ike Ahmed: Dense traumatic cataract 73%
Sonia Yoo: Posterior polar cataract 24%
Eric Donnenfeld: An errant anterior capsular tear 3%

CASE 7 FOOL ME TWICE, SHAME ON ME

Ectopia Lentis

Rich Hoffman presented a case of ectopia lentis with severe subluxation of the crystalline lens. Iris hooks were used as capsule retractors during the anterior capsulotomy, but this resulted in a radial tear of the anterior capsule. This tear subsequently extended into the posterior capsule.

Q With this defect in the anterior and posterior capsules, I'd implant:

A one-piece monofocal in the bag 0%
A three-piece in the ciliary sulcus 4%
A three-piece in the sulcus (iris suture fixation) . . . 14%
A three-piece in the sulcus (scleral suture fixation) . .39%
An ACIOL 43%

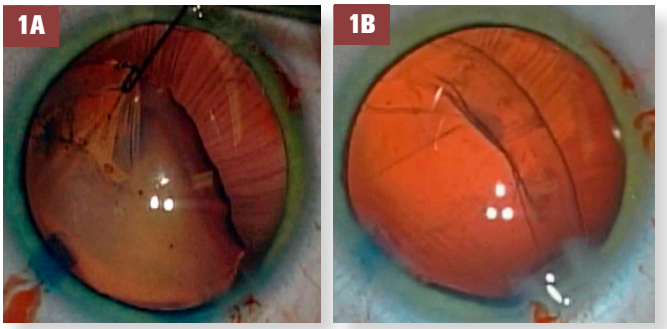
Rich Hoffman This was a case of a 24-year-old female with Marfan syndrome who requested lens extraction of her moderately subluxed crystalline lenses. During creation of the capsulorrhexis, iris hooks were placed on the capsulorrhexis margin to help support the lens and assist in countertraction during propagation of the capsulorrhexis. The mistake made in this case was placing the iris hook on the rhexis margin too close to the leading edge of the capsulor-

rhexis (Fig. 1A). In addition, excessive tension was placed on the hook due to the surgeon's delusion that lens centration could be improved if enough tension was placed with the hook. The result was a peripheral tear toward the bag equator that was successfully rescued by loosening the iris hook and redirecting the tear centrally with a microincision capsulorrhexis forceps. Once the leading edge of the rhexis was 3 clock-hours from the hook location, retightening the hook did not place any significant forces on the leading edge of the rhexis.

The surgeon did not learn from his first mistake and placed a second hook to aid in bag support. Unfortunately, he also positioned this hook too close to the rhexis leading edge and placed excessive tension. The radial tear that resulted was not salvageable, and the capsulorrhexis needed to be completed by starting a new edge perpendicular to the radial tear. After removal of the lens with I&A handpieces, a large opening in the posterior capsule, distant from the anterior radial tear, presented the intraoperative dilemma of an incompetent anterior capsulorrhexis and a significant posterior capsular opening (Fig. 1B), both of which made placement of a Cionni-style CTR or an Ahmed ring segment unsafe.

Although an ACIOL was an option in this young patient with high clinical expectations, the surgeon decided to use a PCIOL. Placement of a PCIOL in the sulcus, without some form of fixation, would eventually lead to IOL subluxation, as the IOL haptic would likely work its way through the compromised zonules. Iris fixation, utilizing a Siepser slip-knot technique, was performed under very low microscope illumination in order to avoid retinal phototoxicity.

There were several lessons from this case. First, avoid iris hooks for capsular support unless they are absolutely needed. If they are utilized, avoid excessive tension and ensure that the leading edge of the capsulorrhexis is at least 3 clock-hours from the point of the iris hook placement. And, finally, make sure you have a backup plan that includes knowledge of iris fixation and scleral fixation and, if all else fails, an appropriately sized ACIOL.



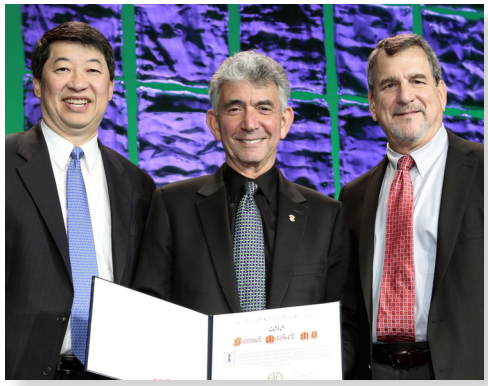
CASE 7. (1A) Capsulorrhexis extension toward the equator due to iris hook being placed on the rhexis margin too close to the leading edge with excessive tension. (1B) Appearance of capsular bag following removal of all cortical material with radial tear of the anterior capsule at the 5 o'clock position and significant opening of the posterior capsule emanating from the 9 o'clock position.

Michael Snyder Dr. Hoffman's case demonstrates one of the challenges of using iris retractors on the capsule margin. Because the retractor holds the capsulorrhexis at a single point along its contour, and the tips of the retractors are not always rounded, applying tension to the hooks can cause the capsulorrhexis to split. Accordingly, in these loose lens cases, it is safer for the capsulorrhexis if you use the iris retractors to stabilize—but not fully recenter—the lens. Also, the more retractors used, the less tension applied to the CCC at any given fixation point, so once the pack is open, use them liberally!

When a CCC split does occur, especially in these loose, small bags, there is a higher likelihood that the split will extend to the posterior capsule as well, as there are no intact equatorial zonules in that meridian to stop the propagation of the tear. Fixation of the bag with a Cionni-style CTR is not possible in the absence of an intact CCC, making successful placement of an in-the-bag IOL unlikely.

Capsule retractors, which have a broader, rounded end, are designed to support the equator of the bag and thus do not put tension on the capsulorrhexis. They also distribute the tension that is applied to a broader component of the capsule, thereby decreasing the likelihood of inducing a tear at a given amount of stress. As a result, capsule retractors can be tightened more, and the bag can be fully recentered. However, in the small crystalline lenses that are common to ectopia lentis, the capsule retractor may occupy too much physical space on the bag center and can impede surgical maneuvers during phaco.

It is interesting that a plurality of the audience would prefer an ACIOL, even in this young patient. Their votes may reflect the technical challenges and steep learning curve presented by PCIOL suture-fixation techniques. The 4 percent who would have opted for passive sulcus placement of a three-piece PCIOL in the setting of a torn bag with zonulopathy would undoubtedly have gotten a "second bite at the apple" to determine how best to fixate an IOL in this setting, as I am convinced that a passively placed sulcus IOL would soon migrate either off center or into the vitreous.



NINTH ANNUAL KELMAN LECTURE. After presenting his Kelman Lecture, Dr. Masket (center) receives the Kelman Award from the symposium cochairmen, Dr. Chang (left) and Dr. Fishkind (right).

(1A, 1B) RICHARD S. HOFFMAN, MD

CASE 8 THREADING A NEEDLE

Zonular Weakness

Terry Kim presented a case of severe zonular weakness. MST capsule retractors were placed followed by insertion of a CTR. As the double-stranded capsule retractors were removed, it was discovered that the CTR had passed through the loop of one of the capsule retractors.

Q **Extremely weak zonules are unexpectedly noted during phaco. What next?**

Carefully continue to phaco	5%
Place a CTR prior to continuing phaco	50%
Place a Henderson CTR prior to continuing phaco	3%
Place capsule retractors prior to continuing phaco	15%
Place capsule retractors plus a CTR	23%
Convert to manual ECCE	5%

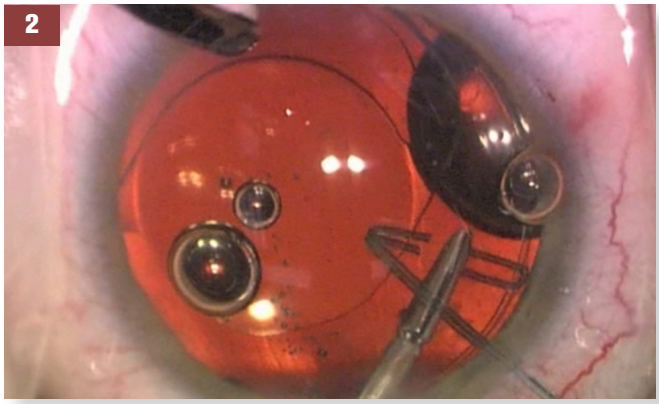
Q **The CTR and capsule retractor are entangled. What now?**

Dial the CTR free	4%
Cut and remove the CTR	4%
Pry apart the MST retractor	4%
Cut the MST retractor	88%
Refer the case	0%

Terry Kim This 61-year-old healthy female presented with chronic progressive bilateral vision loss. Her slit-lamp examination revealed bilateral nuclear sclerotic and posterior subcapsular cataracts that were contributing to her visual symptoms. Of note, both eyes also exhibited mild superior lens subluxation and inferior zonular deficiency (approximately 4 clock-hours) on dilated examination with no phacodonesis. On further questioning and examination, I could elicit no history or evidence of ocular trauma, previous eye surgery, or known causes of lens subluxation, such as Marfan syndrome, homocystinuria, and pseudoexfoliation (PXF).

I considered the host of capsular support and capsular ring devices available to supplement her phacoemulsification procedure and IOL implantation. Based on her finding of isolated zonular weakness in the inferior quadrant (of presumably a nonprogressive nature), I opted to use two MST capsule retractors (MicroSurgical Technology) and a CTR (Alcon ReFORM).

I performed a paracentesis incision through which I injected a dispersive OVD directly into the inferior quadrant of missing zonules to tamponade any potential vitreous and then filled the anterior chamber. After completion of a CCC through a 2.2-mm temporal clear corneal incision, two MST capsule retractors were placed through two 1-mm paracentesis incisions in the inferior quadrant about 2 clock-hours apart to support the inferior capsule. After uneventful phacoemulsification of the lens and aspiration of all cortical material, a CTR was inserted into the capsular bag with a Geuder injector without incident. A single-piece acrylic IOL was then implanted into the capsular bag.



CASE 8. Vannas scissors were used to cut the loop portion of the MST retractor, and both segments were removed from the eye.

At this point, I was quite pleased (and relieved) that the case had gone so well without any complications. I thought I was done and home free. However, after uneventful removal of the first MST capsule retractor, I encountered a lot of resistance when trying to remove the second MST capsule retractor. Upon closer inspection, I realized that the CTR had somehow threaded through the loop of the second MST capsule retractor!

After recovering from the shock of this unlikely phenomenon, I contemplated various approaches to free the MST retractor from the CTR while minimizing trauma to the capsule and remaining zonules. I ultimately decided to use Vannas scissors through the main temporal corneal incision to cut the loop portion of the MST retractor and remove both segments from the eye (Fig. 2). Fortunately, this maneuver proved successful without any adverse events. Postoperatively, the patient did very well and was very happy with her 20/25 uncorrected vision and a well-centered PCIOL in a stable capsular bag.

After trying to re-create this phenomenon using a Miyake view in a laboratory setting—courtesy of Dr. Alan Crandall, who told me that it took him 45 minutes after multiple attempts—I learned this complication is most likely going to be very rare. However, some potential strategies to help prevent this from occurring again include tightening the tension of the capsule retractor(s) prior to CTR insertion, directing the CTR away from the MST retractor(s) during insertion, or using other capsule retractors that have no loop, such as Mackool hooks. In any case, this rare complication shows how we can continue to learn from our mistakes even as our cataract surgery techniques and technologies continue to advance and evolve.

Walter Stark Preoperative anticipation of weak zonules is important, as one should suspect this with PXF material on the pupillary border and/or lens capsule or a history of significant ocular trauma. Occasionally, these patients have

TERRY KIM, MD

an extremely shallow anterior chamber even with a normal axial length, which indicates loss of zonular support. This can be obvious with the anterior capsulotomy in that the lens will move with the initial cut of the capsule.

In these cases, I will try to perform a large enough capsulotomy so that I can get good hydrodissection, which will result in minimal traction on the remaining zonules as the nucleus is being emulsified. A larger capsulotomy also reduces the later chances of phimosis of the anterior capsule. If one can obtain good hydrodissection, the nucleus can be safely emulsified at the iris plane. Iris retractors can be used on the edge of the capsule to support the capsular bag as the cataract is being removed. Instead of using CTRs, I prefer to use a three-piece 13.5-mm MA50BM acrylic IOL (Alcon). The optic on this lens is 6.5 mm in diameter, which is 18 percent larger than that of a 6-mm optic lens. The haptics of this lens will serve as a CTR and can be sutured to the sclera or peripheral iris using 10-0 Prolene sutures with a CIF 4 or CTC 6 needle (Ethicon).

Fifty percent of the audience indicated that they would use a CTR prior to continuing phacoemulsification. One must have good hydrodissection to have enough space to place the CTR. Also, I suspect that placement of the ring could lead to further weakness of the zonules. Fifteen percent of the audience would place capsule retractors, and 23 percent would place capsule retractors plus a CTR. I agree with the use of capsule retractors to help stabilize the capsule.

In this case with an open posterior capsule, I would place the IOL in the sulcus. If the IOL is not stable, one could suture fixate it to the iris. This is accomplished by obtaining pupillary capture of the IOL and suturing the IOL loops to the iris with 10-0 Prolene sutures.

With regard to the entanglement of the capsule retractors and CTR in this case, I agree with the audience (88 percent) to cut the MST retractors. I have not seen this complication happen, as I rarely use CTRs. In addition, it should be noted that CTRs do not prevent later subluxation or dislocation of the capsular bag and IOL. To prevent late subluxation of the IOL, one must suture the CTR to the sclera. When I do suture fixation to the sclera or iris I use 10-0 Prolene suture tied around the loop of the lens or the CTR. Although 10-0 Prolene is not biodegradable, it can be cut over time if it is placed through the eyelets or positioning holes in the haptics or optic of the IOL. If the lens is to be placed in the sulcus, one should avoid a single-piece acrylic lens, which can cause UGH (uveitis-glaucoma-hyphema) syndrome.

CASE 9 WHEN MDS NEED MORE SUPPORT

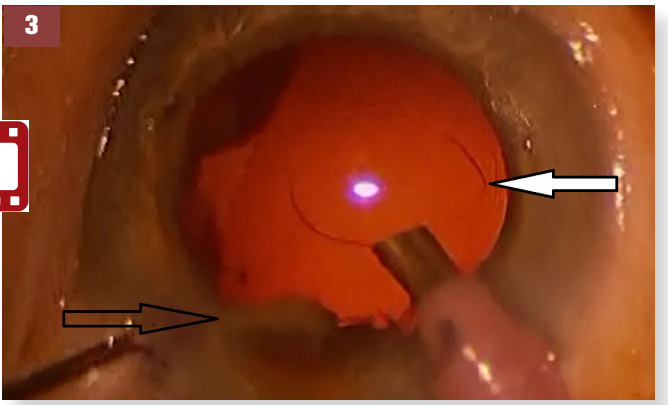
PC Rupture

In Tom Oetting's case, a central rent developed in the posterior capsule prior to removal of the final fragment of nucleus. The surgeon had trouble controlling the anterior chamber, and the phaco needle directly struck the posterior capsule (Fig. 3).

Q How would you approach this remaining lens material in the presence of a posterior capsular rent?

- Phaco after walling off the rent/vitreous with OVD . . 20%
- Phaco after inserting an IOL as a scaffold. 65%
- Phaco after inserting a Sheets glide as a scaffold . . 9%
- Convert to manual ECCE. 4%
- Leave lens material and refer to vitreoretinal surgeon 2%

Tom Oetting Before removing the phaco needle, we placed a dispersive OVD to maintain the chamber to help avoid vitreous prolapse. The dispersive OVD was also used to sequester the residual nuclear material across from the wound over the iris. A dry technique was used to remove any vitreous down to the plane of the posterior capsule. In this technique, the chamber was supported with OVD, as the typical two-handed technique with irrigation of BSS would have made it hard to control the residual nuclear material. Following the anterior vitrectomy, a three-piece acrylic optic IOL was placed into the sulcus to act as a scaffold for the residual nuclear material.[1] The residual nuclear material was removed with a slow-motion technique involving low vacuum and low bottle height.[2] The entire video can be viewed online at www.eyenet org.



CASE 9. The phaco needle directly struck the posterior capsule, leaving a round hole (white arrow) with residual lens material (black arrow).

1 Narang P et al. *Ophthalmology.* 2013;120(12):2442-2448.
2 Osher RH. *J Cataract Refract Surg.* 1993;19(5):667.

Steve Dewey This case highlights the difficulties of dealing with that last segment of nuclear material in the presence of apparent chamber instability. While the goal is to avoid interaction of the posterior capsule with the phaco needle, it is sometimes unattainable. The cause may be relatively simple, such as leakage through the side port and main incisions. If

THOMAS A. OETTING, MD

the surgeon uses a blunt side port instrument, this can be placed behind the fragment as a barrier. Obviously, a sharp chopper is of little use for this. A safer phaco needle with rounded edges will reduce the likelihood of damage should the capsule become engaged. Finally, as the fragment is typically accessible and mobile, reducing vacuum and flow while maintaining irrigation will decrease postocclusion surge for this last fragment.

In this case, prevention was not successful, and the capsule integrity was compromised with nuclear material remaining in the anterior chamber. The first step in this situation is to avoid the sudden "what-just-happened" urge to withdraw the phaco needle. Instead, the surgeon should maintain irrigation, exchange the side port instrument for a viscoelastic cannula, and introduce the most available viscoelastic to tamponade the rent in the capsule. While a dispersive OVD is preferred, at this point the goal is to isolate the vitreous posteriorly and maintain the fragment in the anterior chamber by pinning it in the angle as quickly and as efficiently as possible. The irrigation is discontinued as the viscoelastic fills the eye, and the needle can be removed.

The stability of the operative field will determine how best to proceed. If the problem has arisen as a result of patient movement, or if the operative field is challenging (due to such issues as a small lid fissure or a prominent brow or cheek), then additional sedation and a slight enlargement of the incision may be the best next step. I typically go for about 3 mm, as this will still be sutureless but will improve access considerably. Depending on the size of the fragment versus the tear, this incision enlargement may allow for simple viscoexpression. If the tear is substantial but the capsular support is adequate, placing the IOL in the sulcus provides a well-described barrier effect to allow removal of the fragment on top of the IOL with phacoemulsification. Kenalog staining will determine whether an anterior vitrectomy is needed.

A three-piece IOL is the best choice, but the situation may dictate temporary placement of a single-piece lens for the purposes of expediency. If possible, the single-piece IOL should be placed in the bag; if not, it should be exchanged for a three-piece IOL in the sulcus with available optic capture.

CASE 7 TO 9

"Meet Me in Vegas Award" for the surgeon who had the luckiest outcome:

Terry Kim: Zonular weakness 45%
Rich Hoffman: Ectopia lentis 44%
Tom Oetting: PC rupture 10%

CASE 10 BLAME THE HORSE

Traumatic Zonular Dialysis

Lisa Arbisser presented a case that involved a traumatic subluxated dense cataract (the patient had previously been kicked by a horse) with a large zonular dialysis. There was free vitreous in the anterior chamber for nearly 180 degrees. As the case progressed, it became apparent that the pars plana anterior vitrectomy may have torn the posterior capsule, leading to a dropped nucleus.

Q For a traumatic cataract with vitreous prolapse noted preoperatively, I would:

Perform a limbal anterior vitrectomy and then phaco 9%
Perform a pars plana anterior vitrectomy and then phaco 34%
Partition the vitreous with OVD and then phaco . . . 6%
Plan a manual ECCE 13%
Refer the patient elsewhere 38%

Q With a large zonular dialysis and dropped lens material, what IOL would you implant?

Sulcus PCIOL with no suture fixation 25%
Sulcus PCIOL with suture fixation 25%
Sulcus PCIOL (glued/scleral tunnel) 3%
ACIOL 33%
Leave aphakic 14%

Lisa Arbisser I always plan a bag-sparing procedure with a modified CTR when possible with a lens in the bag. I compartmentalize herniated vitreous with dispersive OVD, pushing the knuckle behind the ruptured zonular network, and follow that with cohesive OVD to prevent phacoemulsification in the presence of vitreous.

This case was more extreme, with free vitreous in the anterior chamber. I placed a pars plana 23-gauge trocar system vitrector in a sutureless manner prior to opening the eye. After particulate identification with triamcinolone, I amputated anterior-posterior attachments and "called home" the free vitreous to the posterior segment with biaxial vitrectomy (irrigation through the side port anteriorly and the vitrector through the trocar cannula). An anterior approach is less likely to clear vitreous and can result in further unzipping of the zonular network.

Conscious of the need to aim for the center of the vitreous cavity and of having my vitrectomy port sideways rather than upward—as one would for a dry vitreous tap in a crowded chamber—I cleared prolapsed vitreous and proceeded to make a continuous rhexis, apply capsular suspension hooks, use careful multidirectional hydrodissection, and begin phaco. To my dismay, moments after the second vertical chop, the nucleus dislocated posteriorly. I presume that, despite my conscious efforts, I had broken the

posterior capsule, with the vitrector causing this calamity. I learned the lesson that instead of aiming for 3.5 mm from the limbus (as I always have with a direct MVR blade sclerotomy), 4 mm might have been more appropriate with the trocar in the phakic eye. This would have allowed my angle of attack to be sufficiently steep, especially since I was pushing the lens posteriorly with the anterior infusion.

If the nucleus falls into the posterior segment, I discipline myself to leave it, clear the anterior segment of lens debris and vitreous, place an implant, and refer for a three-port vitrectomy and fragmentation by my vitreoretinal colleagues.

If an implant is placed, it must be stable and not make the subsequent surgery more difficult. In this case—given the posterior capsular rupture, profound zonular incompetence precluding the use of a ring, glaucoma, and iris pathology—no IOL would be ideal at this juncture. A one-piece IOL in the bag was out of the question. Despite the intact rhexis, there was no way to capture a three-piece lens or depend on the sulcus. Iris fixation, an ACIOL, sulcus fixation, or a glued IOL require pupilloplasty, rendering the subsequent vitrectomy more difficult. I was loath to make a large incision, destroy conjunctiva, or suture the blown pupil with a definitive surgery still to come. My choice was to leave the patient aphakic.

The patient had an uneventful vitrectomy-lensectomy, and the patient and retina surgeon chose to leave her aphakic, although I would have chosen a glued sulcus-fixated IOL and pupilloplasty at the time of the second surgery, had I been given a vote. Her glaucoma remains controlled, and her eye is quiet. She is currently wearing a contact lens and has 20/30 best-corrected visual acuity and mild commotio retinae findings. The patient is satisfied, as is the referring ophthalmologist, who continues to refer.

Tim Murray In this case, the traumatic subluxated lens presented with large zonular dialysis associated with vitreous prolapse anterior to the lens. This case is ideally managed from a combined posterior and anterior approach. In the setting of preexisting vitreous prolapse, placement of transconjunctival trocars (either 25 or 23 gauge) should be performed through the pars plana 3.5 mm posterior to the limbus. Often the lens is shifted posteriorly, and attention to the lens relationship to the vitrectomy probe is critical. The initial pars plana vitrectomy should be focused on removing the anteriorly displaced vitreous and can be enhanced with triamcinolone staining of the vitreous gel. Current pars plana vitrectomy techniques—including valved cannulas, high-speed cutting, and advanced probe technology—minimize transvitreal tractional forces and decrease the potential for retinal complications.

At this point in this case, standard clear corneal phacoemulsification could be performed through a large central capsulorrhexis. Minimizing any additional strain on the residual zonules is key, and maintaining stability of the anterior chamber fluidics will minimize the potential for additional vitreous prolapse. Removal of residual cortex, followed by placement of a sulcus IOL with bag capture of the optic, enables excellent IOL stabilization and enhances rapidity of visual recovery. Closure of the clear corneal wound with 10-0 nylon facilitates fluidic stability while the pars plana vitrectomy is completed. Visualization of the retinal periphery is critical to assure that there is no unrecognized pathology (retinal tear, dialysis, or detachment). Injection of off-label intravitreal triamcinolone is worth considering, as it reduces the incidence of postsurgical/posttraumatic cystoid macular edema.

In this case, the pars plana vitrectomy was complicated by early compromise of the posterior lens capsule, a complication much more frequently seen after prior trauma or previous vitreoretinal surgery. This case emphasizes the importance of recognizing the relationships between the lens and the pars plana in eyes that have experienced significant trauma. After recognizing the dislocated lenticular fragments, the surgeon completed the case with stabilization of the anterior segment, the eye was left aphakic, and the patient was referred for secondary surgical management. If a vitreoretinal surgeon had been available, immediate retrieval of the dislocated nuclear and cortical fragments could have been performed in a single surgical procedure.

CASE 11 THE 100-YEAR-OLD LENS

Brunescent Cataract

In Kevin Miller's case, there was a brunescent, rock-hard nucleus in a 99½-year-old woman with a small pupil. After the pupil was expanded with a Malyugin ring, phaco resulted in a zonular dehiscence. The conversion to a manual ECCE was complicated by the lens loop being caught within the ring.

Q Faced with a rock-hard lens, how would you handle this small pupil?

- Nothing extra besides viscomydriasis 7%
- Instill intracameral epinephrine or phenylephrine . . . 5%
- Pupil mechanical stretching, with or without sphincterotomies. 11%
- Iris retractors 25%
- Malyugin or other ring. 52%

Q What is your personal experience and comfort level with manual large-incision ECCE?

- Very experienced 55%
- Some experience (and comfortable with) 17%
- Some experience (not that comfortable with) 17%
- Very limited (or no) experience 8%
- Also comfortable with sutureless manual ECCE . . . 3%

Kevin M. Miller My 99½-year-old patient (with a 100-plus-year-old lens) had a densely brunescent cataract, a poorly dilating pupil, and moderate zonular laxity (Fig. 4A). Given her age, I wanted to spare her a 12- or 13-mm ECCE incision, and I figured I could always convert from phaco to ECCE if necessary. If I could debulk her lens even a little with phaco, she would end up with a smaller overall incision. Intracameral epinephrine and highly cohesive OVD failed to dilate her pupil, so I placed a 6.25-mm Malyugin ring.

The phaco was slow and difficult, and I eventually decided to convert when zonular laxity became excessive. I extended the 2.4-mm phaco incision to a 7- to 8-mm mini-ECCE incision. The mistake I made was inserting an irrigating lens loop through the Malyugin ring. I should have removed the ring first. I inadvertently dislocated the ring from the pupil while passing the lens loop through it. When I tried to pull the nuclear fragment from the eye, the Malyugin ring trapped me inside (Fig. 4B)!

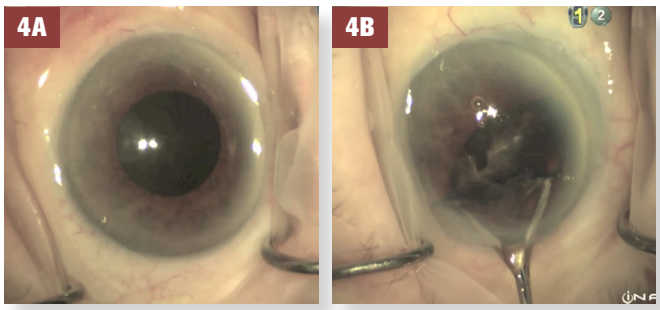
After several minutes of fiddling, totally trapped by the lens loop–nucleus–Malyugin ring complex, I finally resolved the problem by pulling the ring out with Colibri forceps. Thereafter, I was able to withdraw the lens loop and nucleus. The lesson I learned is, always remove the Malyugin ring before inserting an irrigating lens loop.

Boris Malyugin In cases involving a small pupil, I personally prefer the stepwise approach. First, intracameral epinephrine is injected (this is an off-label use and is not available in all countries). This is followed by posterior synechiolysis with the spatula or a Bechert nucleus rotator, a forklike instrument, inserted through the main or side port incisions. A highly viscous OVD will be helpful for deepening the anterior chamber and expanding the pupil. Such OVDs facilitate anterior capsulorrhexis, although the pupil dilation effect does not last long because of washout from the anterior chamber. Repeated OVD reinjections might be necessary throughout the procedure.

In most of these cases, my preference is definitely the Malyugin ring. When the pupil is too small, usually it is not possible to engage the iris simultaneously with both lateral scrolls after first catching it with the distal scroll. That is why stretching of the fibrotic 2.0- to 2.5-mm pupil helps prepare the eye for the ring implantation.

In this case, the surgeon decided to use the lens loop to extract the rock-hard lens with the Malyugin ring in place. Given the size of the lens, with its diameter of approximately 11 mm, even with the biggest ring size (7 mm) it will not be technically possible to pass the cataract through the pupil. One option would be to leave the ring in place and cut one side of it with the Vannas scissors. Medium-sized nucleus can then be extracted through the pupil with the ring in place. But in this instance, ring removal before nucleus extraction with the loop definitely will be the best option.

Conversion from phaco to the manual small-incision cataract procedure is the other challenge of this case. Small-incision cataract surgery (SICS) is actually a dying art in most developed countries, and residents rarely can see it performed, let alone practice it. The small tunnel created for phaco is usually located more centrally and is longer than required for the SICS incision. This makes nucleus extraction more difficult. Reshaping the phaco tunnel into the bigger valve incision usually results in the wound having an irregular internal aspect. Subsequent wound suturing creates a significant amount of surgically induced astigmatism, delaying visual recovery.



CASE 11. (4A) The appearance of the pupil at the start of surgery. (4B) After conversion from phaco to ECCE, the irrigating lens loop and remaining nucleus were trapped inside the eye by the dislocated Malyugin ring.

Using the lens loop for nucleus delivery is also a challenge by itself. The surgeon should be careful to avoid catching the iris and/or lens capsule. I like to always have a vitrectomy probe and triamcinolone at hand in case the integrity of the capsular bag is compromised. A backup IOL is another possibility, in case sulcus or iris fixation is necessary.

In summary, if preoperative examination reveals a small pupil with a brown nucleus and raises the suspicion of weak zonules, the surgeon must anticipate possible surgical scenarios and prepare the appropriate tools.

Randall Olson A 100-year-old lens can be very hard. Sadly, hardness combined with a small pupil is not too unusual. For those experienced in sutureless small-incision ECCE, this is a perfect case, and it avoids any issue with nuclear hardness or pupillary concerns. For much of the world, this case would not be unusual. In the hands of an expert, it takes minutes and has impressive results. The training necessary to be good at this usually requires experience in the developing world—and the effort to learn is worth it. It would be a better way to go than a manual large-incision ECCE.

For a small pupil, the audience clearly prefers a Malyugin ring, and I heartily concur. It is easy to insert and can make a tough case routine. If I were to attempt phaco, I would make a deep pit in the center of the nucleus and use vertical chop with the tip buried deep in the nucleus to try and break off small pieces. Sometimes horizontal chop can take a partial chop and break through the posterior nuclear bowl. I would not hesitate to convert to an ECCE if progress is worrisome—I have seen the zonules go next!—and would have my sutureless scleral incision already in place so that the conversion is easy. Oh, yes, take out the Malyugin ring first.

KEVIN M. MILLER, MD

What Can Go Wrong, Will

Amar Agarwal presented a complex case that involved posterior capsular rupture with an anterior vitrectomy and an attempt to implant a glued IOL, which was hampered by multiple snafus with instruments and the IOL haptics. The case required use of the IOL scaffold technique and fixation of the IOL in the sulcus, which then led to a glued IOL.

Q Absent capsular support, I'd choose (for myself):

An ACIOL or iris-claw IOL 38%
An iris-sutured IOL 18%
A scleral-sutured IOL 21%
A glued IOL 18%
An aphakic contact lens 5%

Q Phaco over IOL (or glide) scaffold?

Have tried–my preference 21%
Have tried–bad idea/not comfortable 2%
Have never tried–would consider trying 69%
Have never tried–wouldn't do 9%

Amar Agarwal The audience was asked which IOL they would like in their own eye, and 38 percent said ACIOL and 18 percent glued IOL. The worst part of an ACIOL is its unpredictable nature. Some cases go well, whereas some land up with serious problems. The bigger problem seen with an ACIOL is that its unpredictable nature increases with time. In other words, as the patient ages, the lens can create more problems for the patient. In addition, a sutured IOL has pseudophacodonesis, so I would always prefer a glued IOL in my own eye if needed.

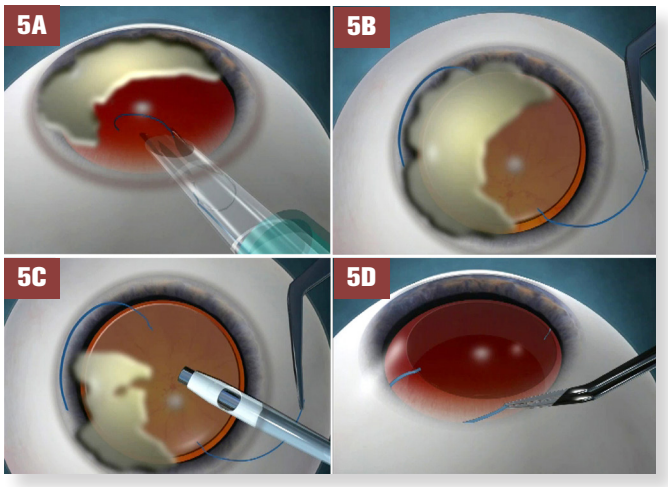
This case had a posterior capsular rupture. The nucleus was sinking into the anterior vitreous. After fixing an infusion cannula (I like fluid in the eye when operating on such complications), I used the posterior assisted levitation (PAL) technique to bring the nucleus anteriorly above the iris. After a necessary anterior vitrectomy, I implanted a three-piece IOL under the nucleus (Figs. 5A to 5D) to create an IOL scaffold. This way, I could emulsify the nucleus comfortably without the fear of the nucleus falling into the vitreous cavity.

Once that was done, I thought my problem was solved, as I only had to put the IOL into the sulcus. The first problem came in the form of a jammed forceps, which broke one haptic. When I tried to cut the optic, the other haptic broke. With great difficulty, I then explanted the damaged optic of the IOL. During all these maneuvers, the anterior capsule also got removed, so I had no choice but to go for a glued IOL. The next problem? My scleral flaps were not 180 degrees apart, so the IOL was not centered. I made a fresh sclerotomy under the scleral flap to ensure that the two sclerotomies—where the haptics are externalized—were 180 degrees apart. I then re-externalized the haptics, tucked them in the Scharioth intrascleral pockets, and finally glued the haptics in place with fibrin glue. Thus concluded my personal Longest Day.

After my presentation, the attendees were asked about their perception of the IOL scaffold technique. I was happy to note that 69 percent would try the technique in cases of posterior capsular rupture with a nucleus still in the eye. I agree, as it is quite easy and safe to perform. One caution I have is that if the cataract is black or hard brown, then extend the scleral incision and remove the nucleus. Another tip: If you are doing an IOL scaffold, don't use iris hooks. Instead, once the nucleus is emulsified, use iris hooks to assess the capsule and then decide whether to put the IOL in the sulcus or do a glued IOL.

Randall Olson There are a lot of good answers for a case with no capsular support. The majority of the audience preferred an ACIOL, and there is nothing wrong with a good ACIOL. While some prefer a sutured or glued IOL, surgeons will get the best result with the technique with which they are most experienced. I tend to scleral suture these IOLs, but I am impressed with the appearance of glued IOLs. Of course, the best approach is to do everything possible to maintain some level of capsular support in a complicated case.

When the capsule is broken, placing an IOL to serve as a barrier to keep nuclear fragments in the anterior chamber is a slick technique. A Sheets glide can provide some protection, but not as much as an IOL will. However, the IOL will



CASE 12. IOL scaffold technique in a case of posterior capsular rupture. (5A) Nucleus is brought anteriorly to the iris. (5B) A three-piece IOL is injected after anterior vitrectomy under the nucleus. (5C) The IOL now acts as a scaffold (temporary platform) so that one can emulsify the nucleus above the IOL without the nucleus falling down. (5D) The IOL is then placed into the sulcus if the capsule is present or glued into place if there is no capsular support.

AMAR AGARWAL, MD

make cortex removal more difficult, so I like to remove all I safely can with the nucleus trapped out of the way anteriorly and to the side as well as to block the posterior break with an OVD. Also, if the view is not clear and you truly cannot see where the IOL is going, do not insert it. Having an IOL, cortex, and nucleus all deep-sized in the vitreous is more variety than I like!

CASE 10 TO 12

"Morphine Drip Award" voted for the surgeon who endured the most pain during his or her case:

Amar Agarwal: The longest day 64%
Kevin Miller: Brunescent cataract 26%
Lisa Arbisser: Traumatic zonular dialysis. 9%

CASE 13 HIGH PRESSURE COMES IN SMALL PACKAGES

Nanophthalmos

Doug Koch presented a case of nanophthalmos with a 16-mm axial length eye. Sudden shallowing of the anterior chamber with increased posterior pressure developed, due to a choroidal effusion.

Q **Sudden chamber shallowing occurs in a nanophthalmic eye due to increased posterior pressure. Now what?**

Carefully continue phaco after deepening the anterior chamber (e.g., OVD, mannitol) 5%
Perform a limited pars plana vitreous tap/vitrectomy 66%
Make a scleral window 12%
Abort the surgery and return to the OR in one to two hours. 2%
Abort the surgery and discharge the patient 15%

Doug Koch This 42-year-old patient had chronic angle crowding due to a shallow anterior chamber. The axial length was 16.14 mm. Argon laser iridoplasty was unsuccessful in reducing iridocorneal touch, so lens extraction was recommended. IOL power for emmetropia was 54 D, and piggyback IOL implantation was planned.

From the outset, surgery was challenging due to the shallow anterior chamber. However, all steps proceeded smoothly until IOL insertion: The pressure in the eye increased such that no OVD could be retained in the anterior chamber, there was iris prolapse, and the posterior capsule nearly abutted the corneal endothelium.

The differential diagnosis of this is either choroidal effusion (or even hemorrhage) or increased vitreous pressure. Indirect ophthalmoscopy showed no clear evidence of choroidals, but I made this diagnosis based on the magnitude of the pressure rise and its occurrence in the latter stages of surgery. Also, I felt that there was potentially greater downside to managing this as "increased vitreous pressure" alone. The typical treatment for increased vitreous pressure is a limited anterior pars plans vitrectomy, and this could actually facilitate expansion of a choroidal effusion by reducing vitreous volume. On the other hand, the treatment for a choroidal effusion is either deferring surgery (to later in the day or even a few days later) or scleral cutdown. Neither of these options would worsen the condition if the etiology was in fact increased vitreous pressure.

A scleral cutdown was performed by my colleague Peter Chang, MD. Using a 54 Beaver blade, he made a radial incision in the sclera beginning 1 mm behind the limbus and extending around 2 mm posteriorly. When the surgeon entered the supraciliary space, fluid did indeed present. A scleral window was made with a Kelly punch. Unfortunately, the pressure in the eye, although improved, was still too high. A second scleral window was made in an adjacent quadrant. More fluid was drained, allowing completion of the surgery with insertion of a 40-D IOL in the capsular bag and a 14-D IOL in the ciliary sulcus. One caveat on the insertion of the second IOL: It is not advisable if the anterior chamber is still crowded. It was not in this case, and the patient has done well with three years of follow-up.

Tom Samuelson Nanophthalmic eyes are among the most challenging cases encountered by anterior segment surgeons. The anterior chamber is often profoundly shallow, and the lens is often very large in proportion to the remainder of the anterior segment. It is critical to differentiate cases in which the anterior chamber is extremely shallow preoperatively prior to entering the eye from cases such as this one, in which the anterior chamber suddenly became more shallow during surgery. The management of these distinctly dissimilar clinical situations is quite different.

Interestingly, the majority of the audience recommended pars plana aspiration. However, I would strongly caution against passing instruments through the pars plana in this clinical scenario. While a limited pars plana vitrectomy is often useful at the start of cases in which the preoperative anterior chamber depth precludes safely performing capsulorrhexis and prephaco manipulations, such a maneuver can be very dangerous in the setting of a choroidal effusion or hemorrhage. A suprachoroidal process is high on the differential diagnosis in Dr. Koch's case. Passing a needle through the pars plana in the setting of evolving choroidal hemorrhage or effusion could create a retinal tear or worse.

In this case, the anterior chamber depth suddenly became more shallow intraoperatively, and the globe became firm. This is a suprachoroidal effusion or hemorrhage until proven otherwise. The proper management would include either temporarily delaying the case while waiting for the effusion to resorb or performing scleral windows. The latter

can be both diagnostic and therapeutic. I would recommend examining the eye with indirect ophthalmoscopy. If a large and localized suprachoroidal process is identified, I would close the eye and come back a week or two later to complete the case. If there is no obvious focal process, the differential includes diffuse choroidal expansion or misdirection of the irrigating fluid. The former process can be diagnosed by creating a scleral window. If considerable nonhemorrhagic suprachoroidal fluid is encountered and drained, the eye is often adequately softened to finish the case. Intravenous osmotic agents such as mannitol can be used to shrink the vitreous and facilitate the process. Another viable option is to abort and complete the case at a later time once the suprachoroidal expansion resolves and the effusion is reabsorbed.

CASE 14 DON'T CRY FOR ME, ARGENTINA

White Cataract

In Geoff Tabin's case of a white mature cataract, the dye-stained anterior capsule split in both directions (Argentinean flag sign).

Q What is your usual technique for performing the capsulotomy with a white lens?

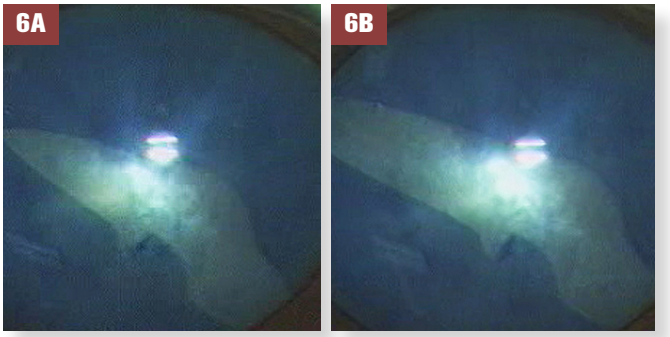
OVD plus forceps	44%
Irrigating cystotome	2%
First aspirate cortex with a needle	46%
Femtosecond laser capsulotomy	8%
Would refer	0%

Q Argentinean flag sign! Now what?

Enlarge capsulotomy—phaco in bag	22%
Prolapse the nucleus and phaco it in the anterior chamber	18%
Convert to large-incision ECCE	52%
Convert to sutureless small-incision ECCE	6%
Abort and refer	2%

Geoff Tabin My patient was a 67-year-old woman with a white cataract and light-perception vision. Because the patient did not speak English and it was possible that the case would be a long one, I elected to use a peribulbar block. I began by constructing a 2.4-mm temporal clear corneal incision. I injected a small air bubble through a side port incision and then painted the anterior capsule with trypan blue. Next, I injected a space-retaining OVD to fill the anterior chamber. I began my capsulotomy with a bent 27-gauge needle connected to a syringe. Upon puncturing the anterior capsule, I pulled back on the syringe to aspirate as much liquefied cortex as possible. Despite these precautions, as soon as I began to tear my capsulorrhexis, the opening extended in both directions 180 degrees across the capsule, giving the classic Argentinean flag sign (Figs. 6A and 6B).

Possible explanations for the uncontrolled splitting of the capsule are a combination of remaining liquefied cortex on the posterior aspect of the lens, posterior pressure from the peribulbar block, or my having aspirated viscoelastic with my needle when trying to remove the liquefied cortex. I cleared the remaining lens milk and refilled with viscoelastic. I now found that I had a very hard, large, and



Case 14. These images of the Argentinean flag sign show the radial tear extending out in both directions.

dark-brown nucleus in a classic morgagnian cataract. I did not feel it would be safe to attempt to chop and emulsify the nucleus in the bag, with the danger of the tear extending. My choice was either to elevate the nucleus out of the bag and continue phacoemulsification in the anterior chamber or to convert to SICS. Because of the density of the nucleus, I elected to convert and remove the nucleus in order to minimize endothelial damage.

I abandoned my clear corneal incision and moved 45 degrees superiorly. I performed a peritomy followed by a half-thickness scleral groove of approximately 6.5 mm in length starting 1.5 mm posterior to the limbus. I then created a scleral tunnel incision that extended 1.5 mm into clear cornea, widening as it entered the cornea. I entered at the corneal edge of the incision, retaining a good self-sealing internal lip to the wound. Next, I attempted to hydrodissect the nucleus out of the bag. The nucleus remained in the capsular bag. I then attempted to elevate it out of the bag with viscoelastic, but it remained adherent to the posterior capsule. Gentle manipulation revealed significant zonular laxity, as is often the case with morgagnian cataracts.

One option at this point would have been to convert to an intracapsular extraction and then place a secondary IOL. However, I was able to save the case using a trick that I learned from Sanduk Ruit, MD, who is from Kathmandu, Nepal. I tilted up the proximal pole of the nucleus with viscoelastic and placed a one-piece PMMA lens (Alcon CZ70BD) under the nucleus and into the capsular bag with the optics oriented 90 degrees away from the split. The IOL safely dissected the nucleus from the posterior capsule and served as a stable capsular tension device in the bag. The nucleus then easily came forward and was hydroexpressed through the wound, revealing a perfectly centered IOL in the capsule with a clear visual axis and a stable watertight

GEOFFREY C. TABIN, MD

wound that did not require sutures. The conjunctiva was closed with cautery forceps. On postop day one, the patient had 20/30 uncorrected acuity with a clear cornea.

Rudy Nuijts This was an example of a hard cataract where opening the bag resulted in huge tearing of the rhexis. The tearing could not be controlled by micropuncturing, which sometimes is helpful in softer white cataracts to prevent progression of the tear to the periphery. ECCE with an envelope capsulotomy technique and a large incision can still be an excellent solution in these cases to prevent a posterior capsule rupture or, even worse, a dropped nucleus. A phaco in the bag is not recommended in these cases because of the high density of the particular nucleus and the subsequent zonular stress that may occur. Similarly, phaco in the anterior chamber of a prolapsed very hard nucleus may compromise the endothelium and is not recommended.

CASE 15 UNHAPPY MULTIFOCAL PATIENT; UNHAPPY SURGEON!

Multifocal IOL Exchange

Matteo Piovella presented a case in which a large posterior capsular rent was noted following multifocal IOL implantation. Because of posterior IOL subluxation, a vitrectomy and IOL exchange were performed one week later. This was complicated by significant hemorrhage, and the eye was left aphakic. One month later, a monofocal PCIOL was implanted into the ciliary sulcus; this lens subsequently subluxated. When scleral suture fixation of the subluxated sulcus IOL was attempted, there was significant bleeding and iris incarceration by one of the scleral sutures. Moreover, prolonged corneal edema occurred; this eventually cleared without a corneal transplant.

Q What is your time limit for performing a multifocal IOL exchange?

- Up to three months 17%
- Up to six months. 50%
- Up to one year. 0%
- No time limit 17%
- Would refer 17%

Q What has been your personal experience with multifocal IOL explantation?

- I don't use multifocal IOLs 44%
- I use them but have never explanted one 27%
- I have limited experience (<3 cases). 13%
- I have performed ≥3 cases and have never had a major complication. 14%
- I have performed ≥3 cases and have had major complications 3%

Bruce Wallace Patient expectations remain high in the relatively new era of refractive cataract surgery and multifocal IOLs. Dr. Piovella reminds us that, as seen in his case, these procedures may not go as planned. During preoperative counseling, surgeons and their staff should warn patients and their family members that there are no guarantees of spectacle independence, even with multifocal IOLs. Unlike monofocal IOLs, angle-supported multifocal IOLs are not available, so contingency plans during unexpected surgical events are few. Because of the myriad important steps to success with multifocal IOL use, the surprising audience response of 44 percent choosing not to implant them may not be so surprising after all.

CASE 13 TO 15

"Purple Heart Award" presented to the surgeon who attempted the most courageous intraoperative maneuvers:

- Doug Koch: Nanophthalmos 52%
- Matteo Piovella: Unhappy multifocal patient. 25%
- Geoff Tabin: White cataract 24%

CASE 16 A HAPTIC, A HAPTIC, MY KINGDOM FOR A HAPTIC!

Subluxated IOL

In Dick Mackool's unusual case, a single-piece hydrophobic acrylic PCIOL was partially in the capsular bag—and missing one haptic. There was a posterior capsular rent, which was causing pigment dispersion and iris chafing due to movement within the sulcus.

Q How would you address this subluxating IOL?

- Suture the IOL into position 0%
- Move IOL into the ciliary sulcus and leave it there . . 0%
- Move IOL into the ciliary sulcus and suture it 0%
- IOL exchange (ACIOL) 31%
- IOL exchange (PCIOL) 69%

Dick Mackool The audience has it right, although I didn't do what they advised. This case is an example of the unique nature of each eye with a subluxated IOL. Variables are numerous, including the status of both capsules, the lens zonules, and IOL type/position/status, etc. Thoughtful preoperative planning, including contingency plans, is advisable.

In this patient, a unique approach was taken, enlarging

the preexisting capsulorrhexis before incising the periphery of the optic in such a manner as to create a protuberance (i.e., a haptic-like appendage). The presence of this then permitted the optic to be captured in the capsulorrhexis.

Nick Mamalis This is an interesting case of a single-piece with haptic, hydrophobic acrylic PCIOL. The IOL had one intact haptic and was missing the opposite haptic. The haptic/optic on this side was sharp and irregular and located in front of the capsular bag. It is unclear what happened to the missing haptic and why the original implanting surgeon did not recognize the complication and remove the IOL at the time of the original surgery.

It is reassuring that none of the audience members recommended moving the IOL into the ciliary sulcus or trying to suture it into position. These particular types of PCIOLs can cause problems with potential pigment dispersion and iris chafing due to their relatively thick, sharp haptics. These lenses are designed to go into the capsular bag and should not be placed in the ciliary sulcus.

Dr. Mackool chose a unique method of solving this problem by making a small cut in the area of the haptic/optic junction where the haptic had been torn loose from the IOL during the original insertion. This allowed for fixation of the IOL within the capsular bag with a small notch to hold it into position. Time will tell whether this modification will allow adequate centration and fixation of the implant within the capsular bag and resolve the issues of pigment dispersion and iris chafing.

CASE 17 A BLOODY WORRY

Chamber Shallowing

Brian Little presented a case in which the iris prolapsed with a shallow chamber in a very firm eye.

Q **Faced with iris prolapse, a flat chamber, and a firm eye, what now?**

- Deepen AC (OVD, mannitol) and attempt phaco . . . 43%
- Pars plana vitreous tap/vitrectomy, then phaco . . . 35%
- Reposit iris and abort case . . . 8%
- Excise iris and abort case . . . 3%
- Stop and return to OR after an hour . . . 13%

Kirk Packo Sudden shallowing of the anterior chamber remains one of the most classic intraoperative adverse events that eventually befalls all cataract surgeons at some point. Its occurrence is one that requires an almost brainstem reaction and differential diagnosis development by the surgeon. Maintaining an organized approach and looking for other key elements help establish the correct diagnosis and action.

The surgeon must look to "the company that the shallow chamber keeps" for the answer. Some issues to consider are as follows: 1) Did the block go smoothly, and could this be a retrobulbar hemorrhage compressing the eye posteriorly (proptotic eye, chemosis, ecchymosis)? 2) Is the lid speculum pressing on the eye (tight orbit, prominent orbital brow)? 3) Is the red reflex lost or asymmetrically lost, with an irregularly shallowed chamber (choroidal hemorrhage)? 4) Is the red reflex preserved with an evenly shallowed chamber (posterior fluid misdirection)?

It is the full set of physical findings that directs the surgeon to the etiology and thus to the treatment. The main goal of managing the suddenly shallow anterior chamber is to prevent loss of intraocular contents as much as possible. Closing the eye, maintaining the integrity of the fluids, and normalizing IOP are the first priorities. A surgeon can never be faulted for stopping after accomplishing these steps. It is only when surgeons stray out of their comfort zone, especially when they are unsure of the exact diagnosis, that indefensible harm may occur. Performing a limited pars plana vitrectomy in an eye with an evolving choroidal hemorrhage, for example, is a sure way to create significant retinal damage. Maintaining an organized assessment and a conservative reaction is the key to managing this clinical dilemma.

CASE 18 A FLYING CANNULA

Pithing the Eye

Bob Osher presented a case where a cannula suddenly shot into the anterior chamber angle while he was injecting BSS into the eye. This caused bleeding from the angle.

Q **Have you ever personally experienced a projectile cannula?**

- Never. . . . 55%
- Once, without posterior capsule rupture . . . 29%
- Once, with posterior capsule rupture . . . 5%
- Two or more times, but never had posterior capsule rupture . . . 7%
- Two or more times, and have had posterior capsule rupture . . . 5%

Robert Osher The potential for a flying cannula is present any time there is a forceful intracameral injection. Severe damage to intraocular structures has been reported.

I strongly recommend educating all scrub techs about

this serious complication so that they will use Luer-Lok syringes and perform a security check before handing the syringe to the surgeon. Then, the surgeon should pinch the hub between his or her index finger and thumb so a loose or detaching cannula will be caught. Finally, during hydration of the incision at the end of the case, when the injection is most forceful, the tip of the cannula should be directed perpendicular to the lateral wall of the incision, so that an abrupt detachment of the cannula is less likely to enter the eye. This complication, which occurs far more often than is discussed, can usually be avoided by these precautions.

Richard Lindstrom Release of a cannula into the eye while fluid is being injected can result in severe complications. The worst complication I have observed in a referred patient was expression through a capsule and into the retina, resulting in a vitreous hemorrhage and retinal tear.

Prevention includes training the surgical assistant to tighten the cannula and using Luer-Loks on syringes. In addition, I always tighten all cannulas when they are handed to me. (Even with a Luer-Lok, if the cannula is not tightened carefully, it can still be ejected off of the syringe tip.) I also always hold the hub of the needle when I am injecting, especially if I am using a viscous fluid while hydrating a wound and applying significant pressure. I have had a few cases in which the cannula has come loose but the needle was not injected into the eye, and only a little fluid was lost as the syringe loosened from the needle. The bottom line: Ejection of a needle into the eye is an avoidable complication—and the surgeon will be held responsible if it occurs. ■

CASE 16 TO 18

"Witness Protection Program Award" for the surgeon who displayed the most courage by his willingness to present his complication in public:

Dick Mackool: Subluxated IOL 45%
Brian Little: Chamber shallowing. 32%
Bob Osher: Pithing the eye. 23%

FINANCIAL DISCLOSURES

Financial interests are designated by C, E, L, O, P, or S:

C = CONSULTANT/ADVISOR
E = EMPLOYEE
L = LECTURE FEES
O = EQUITY OWNER
P = PATENTS/ROYALTY
S = GRANT SUPPORT

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