CASE STUDIES IN PUPIL DILATION

A VARIETY OF TECHNIQUES AND DEVICES ARE AVAILABLE TO FACILITATE CATARACT SURGERY IN EYES WITH A SMALL PUPIL.

BY ERIC D. DONNENFELD, MD; CRISTOS IFANTIDES, MD, MBA; CATHLEEN M. MCCABE, MD; AND MICHAEL PATTERSON, DO

ERIC D. DONNENFELD, MD

Cataract Surgery in an Eye With a History of Trauma and Floppy Eyelid Syndrome

A patient with a history of trauma and floppy eyelid syndrome presented for cataract surgery. Although the patient's pupil was not that small, I decided to place an I-Ring pupil expansion device (Beaver Visitec International) given the patient's history of ocular trauma.

I use phenylephrine and ketorolac intraocular solution 1%/0.3% (Omidria, Omeros) for all of my patients whose insurance covers it, but especially if they have a history of ocular trauma, small pupils, intraoperative floppy iris syndrome (IFIS), or pseudoexfoliation. This strategy has dramatically reduced my need for pupil expansion devices.

SURGICAL STEPS

Inserting the pupil expansion device. To begin the case, I inserted the I-Ring through a 2.2-mm incision to expand the pupil to 6.8 mm. I then positioned the device by adjusting its four positioning holes until the channels overlapped the iris, holding the pupil in place (Figure 1). The I-Ring offers many benefits during surgery; two that I particularly appreciate are that it doesn't distort the iris and that it rarely causes iris sphincter tears compared with other pupil expansion devices. With the I-Ring inserted, I was able to perform the cataract surgery in a controlled manner.

Capsulorhexis, phacoemulsification, and IOL insertion. I created the capsulorhexis and performed phacoemulsification using a slow-motion technique and low energy. I encountered a tear in the anterior capsule from previous trauma, so I inserted a three-piece IOL. I rotated the IOL into position and placed it in the sulcus.

Removing the expansion device. In my experience, removing the I-Ring is simple. The positioning holes are engaged in order to move the device inferiorly. It is frequently challenging to maneuver the device in the areas close to the wound, but the device's soft material allowed easy manipulation in this case (Figure 2).

All four positioning holes must be removed before the I-Ring can be removed from the eye. I used the insertion device to capture the I-Ring, close it, and pull it out through the incision.

OUTCOME

The patient's postoperative recovery has been uneventful. The pupil is a normal size without distortion.

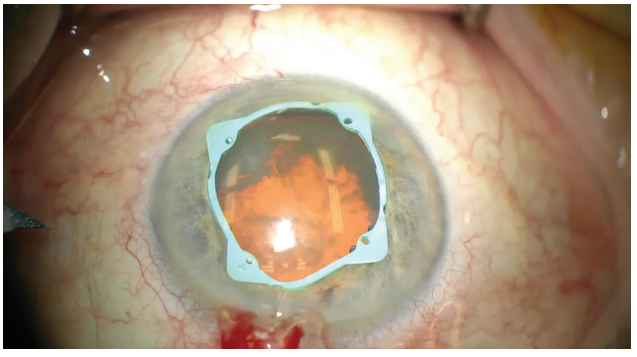


Figure 1. The I-Ring is placed by adjusting its four positioning holes until the channels overlap the iris to hold the pupil in place.

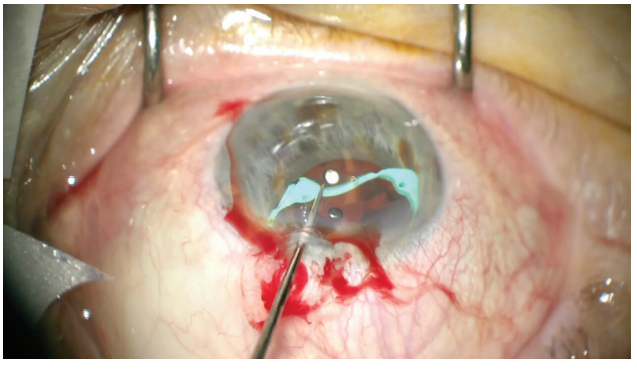


Figure 2. The I-Ring's soft material allows easy manipulation intraoperatively.

Figures 1 and 2 courtesy of Eric D. Donnenfeld, MD

CRISTOS IFANTIDES, MD, MBA

Subluxated Traumatic Cataract

A 58-year-old man presented with a traumatic cataract in his right eye caused by a punch to the face several decades earlier. On presentation, the patient's left eye had counting fingers visual acuity secondary to an ischemic central retinal vein occlusion. In the right eye with traumatic cataract, visual acuity was 20/70 with image distortion.

ZEPTO CAPSULOTOMY

The lens was shifted superonasally with poor dilation in the area of the iris above the lens, so I began the case by placing iris retractor hooks to expose the area of interest on the cataract surface. I then made a 2.4-mm wound and inserted the Zepto Capsulotomy System (Centricity Vision). Before use of this device, I always check to ensure that the rod is engaging the nitinol ring so that the device folds properly. A subluxated crystalline lens is decentered, so finding the center of the lens can be tricky business. I try to find clues that will tell me where the anatomic center of the lens is. In this case, the traumatic cataract had a stellate pattern by which I could center the capsulotomy.

After engaging the capsule with handpiece suction, I waited to allow plenty of vacuum force to build up to ensure a good seal around the entire ring. Once I reached maximum vacuum, I instructed the OR staff to release the energy pulse on the console, thus creating the capsulotomy (Figure 3). After releasing the vacuum and withdrawing the device, I checked the resulting piece of capsulotomy tissue under the microscope to look for any irregular borders or tags. I then placed capsulotomy hooks (MicroSurgical Technology) into two other paracenteses that I had made earlier. This allowed me to shift the lens-bag complex back into the ideal physiologic position.

I then carefully disassembled the cataract using a vertical chop technique, taking care to minimize stress on the capsular bag. After removing the nucleus and epinucleus, I used triamcinolone to stain for vitreous and removed any that I detected using an anterior vitrectomy setup.

CAPSULAR TENSION RING

It's critical to keep the anterior segment pressurized in loose lens cases to prevent vitreous from prolapsing forward. I refilled the anterior segment with an OVD, removed the irrigator, and placed a capsular tension ring (CTR) in the bag for added support.

I prefer to use a right CTR, but I flip it upside down so that it exits the inserter toward the left; this allows me to control and direct the leading aperture with a Sinskey hook, minimizing the chance of bag rupture (Figure 4). Also, using a right CTR allows better visualization of the trailing aperture because the finger on the CTR inserter is pointing up, allowing better control of the placement and of the timing of release of the CTR.

AHMED SEGMENT

After inserting a Tecnis ZA9003 three-piece IOL (Johnson & Johnson Vision), I removed the capsular hooks. I created a peritomy and coagulated the vessels on the sclera above the area of zonular loss to prevent excessive bleeding during sclerotomy creation. I then measured about 2.5 mm back from the limbus and marked two entry wounds 2.5 mm apart. I used a 1-mm blade to enter through the first sclerotomy.

I threaded a PTFE (Gore-Tex, W.L. Gore Medical) suture through the first peritomy, pulled it out of the eye using forceps, and then threaded it through the aperture of an Ahmed segment (FCI Ophthalmics). I used intraocular forceps to go through the second sclerotomy to internalize the PTFE suture into the eye, then externalized it through the sclerotomy.

Figures 3 and 4 courtesy of Cristos Ifantides, MD, MBA

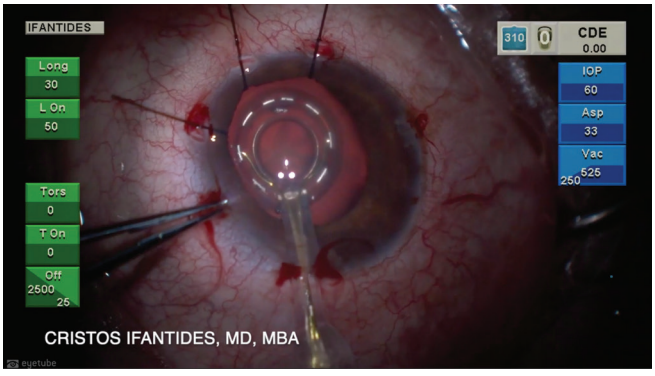


Figure 3. The capsulotomy is created using the Zepto Capsulotomy System.

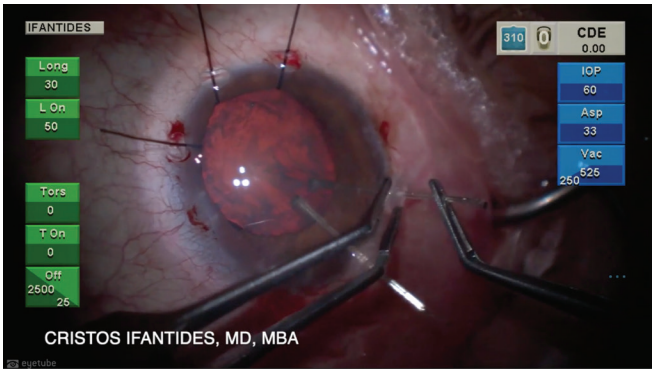


Figure 4. A right CTR is placed.

I placed the Ahmed segment into the capsular bag. After the segment was in the bag, I tightened the two arms of the suture until the bag was fixed in the proper physiologic position.

To wrap up the case, I carefully tied off the suture in a 3-1-1 knot and buried the knot using a Sinskey hook. I placed a 10-0 nylon suture at the main wound and an 8-0 polyglactin (Vicryl, Ethicon) suture at the sclerotomies, closed the peritomy with an 8-0 polyglactin suture, and removed the iris hooks. After removing the OVD, I took care to hydrate as many of the wounds as possible before removing the irrigator to keep the anterior segment pressurized and prevent vitreous from prolapsing forward.

OUTCOME

On postoperative day 1, the patient's visual acuity was 20/70 with a clear cornea and excellent IOL centration. By postoperative week 1, the patient's UCVA was 20/30, and BCVA was 20/25 with refraction of -0.25 +0.50 x 175°.

CATHLEEN M. MCCABE, MD

Small Pupil Cataract Surgery Managed With an Iris Speculum

We encounter small pupils in cataract surgery for a variety of reasons. Causes can include pseudoexfoliation, posterior synechia, the patient's exposure to medications that induce IFIS, fibrotic membranes at the pupil margin, and intraocular manipulation or trauma to the iris.

When we are performing laser cataract surgery, a small pupil makes it difficult to create a properly sized capsulotomy with the laser. Toric IOL placement is also challenging if the pupil is small due to difficulty visualizing the orientation marks on the lens for proper positioning. The following case illustrates the management of a small pupil during cataract surgery and placement of a toric IOL.

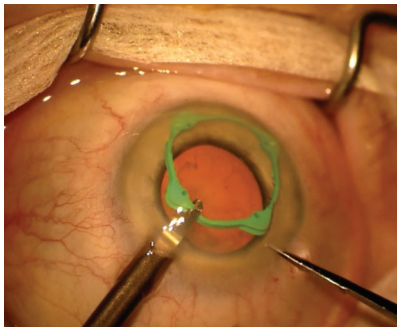
CASE PRESENTATION

A 65-year-old man with a history of primary open-angle glaucoma presented with a nuclear sclerotic cataract and complaints of blurry vision and glare causing difficulty driving at night. His BCVA was 20/40 OU with a manifest refraction of +5.00 -0.75 x 065 OD and +5.00 -1.75 x 115 OS. Visual acuity decreased to 20/80 OD and 20/100 OS with glare testing. IOP was 16 mm Hg OD and 18 mm Hg OS with timolol b.i.d. OU. A visually significant nuclear sclerotic cataract was present in each eye. OCT imaging showed progressive thinning of the retinal nerve fiber layer in each eye with corresponding visual field defects on Humphrey visual field testing. After discussing the risks and benefits of various treatment approaches, we

WATCH IT NOW

A 78-year-old woman presented for a consultation. The patient stated that a "film" had developed over her right eye approximately a year earlier and said that she was no longer able to read. She reported increasing photophobia and glare in the eye. Her history was significant for retinitis pigmentosa and associated neurosensory hearing loss.

BCVA was hand motion OD and 20/100 OS. A slit-lamp examination revealed mild blepharitis in both eyes, clear corneas without guttata, and small pupils (dilated to 5.5 mm OU). The right eye had a 3+ brunescent nuclear sclerotic cataract and a 3+ posterior subcapsular cataract. The left eye had a 3+ brunescent nuclear sclerotic cataract and a less central 2+ posterior subcapsular cataract. A fundus examination of each eye found optic nerve pallor, significant vessel attenuation, and 360° bone-spicule pigmentation. The anterior chamber of each eye was shallow (2.5 mm), and axial length was 21 mm OU. See how Roberto Pineda, MD, managed the case: bit.ly/0820CRSTPineda.



BIT.LY/0820CRSTPINEDA

Figures 5–8 courtesy of Cathleen M. McCabe, MD

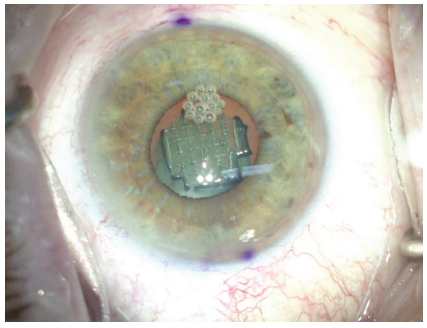


Figure 5. After femtosecond laser nuclear fragmentation, a small pupil (< 4.2 mm) is noted.

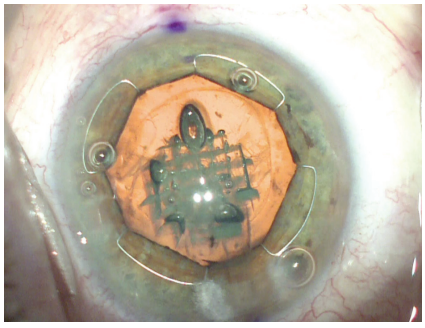


Figure 6. The XpandNT iris speculum pupil-expanding device enlarges the pupil diameter to 6.7 mm.

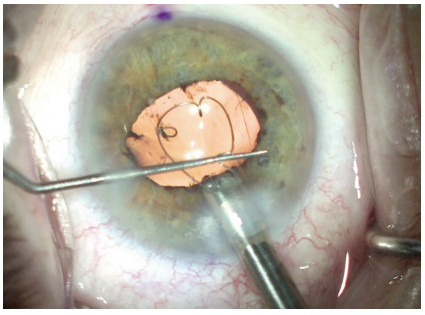


Figure 7. The iris speculum is removed using the inserter and viscodilation of the Sclemm canal and collecting channels is performed using the Omni surgical system.

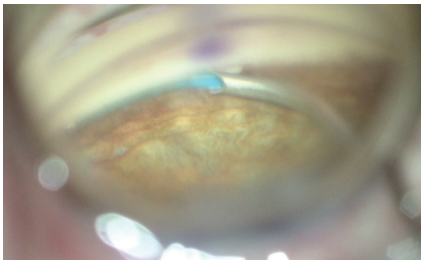


Figure 8. The Hydrus Microstent in place.

decided to proceed with cataract surgery with astigmatism correction and combined MIGS procedures in both eyes.

SURGICAL PROCEDURE

A small pupil (< 4.2 mm) was noted in the right eye at the start of surgery despite repeated application of topical dilating medications (Figure 5). Ink dots were placed at the limbus using a cystotome needle, and the slit beam was oriented at the appropriate axis before the patient was taken to the femtosecond laser room, where corneal incisions were made and nuclear fragmentation was performed with the laser. I did not use the laser to create the capsulorhexis because the pupil was too small.

In the OR, an iris speculum (XpandNT, Diamatrix) was inserted into the anterior chamber (Figure 6) after the anterior chamber was filled with a dispersive OVD (Viscoat, Alcon). The four pockets of the flexible nitinol ring were positioned so that the edge of the pupil was gently cradled and stretched, enlarging the pupil diameter to 6.7 mm. If zonular laxity is present, this iris speculum device can also be used to capture the capsule edge and can act as a secure capsular support.

Phacoemulsification and removal of the cataract proceeded as in a normal case, with no movement of the iris and a safe and secure pupil margin, preventing trauma during phacoemulsification and cortical removal.

Visualization of the toric orientation marks was easy with the widely dilated pupil. After rotating the lens into place, the iris speculum was gently removed using the inserter, and 180° viscodilation of Schlemm canal and the collector channels was performed superiorly using the Omni Surgical System (Sight Sciences; Figure 7). A Hydrus Microstent (Ivantis; Figure 8) was then placed into Schlemm canal superiorly through the same incision through the trabecular meshwork.

I have found that the combination of viscodilation using the Omni system and implantation of a Hydrus Microstent enhances the reduction of IOP. This finding also makes sense in theory, as the viscodilation opens Schlemm canal for a continuous 180° and expands the collector channels in that area. Once the Hydrus Microstent is in place, 90° of Schlemm canal are scaffolded open in an area that is, after viscodilation, now open for an additional 90°.

After removal of OVD from the anterior chamber, the pupil was round with no trauma or defects and the toric IOL was aligned properly.

POSTOPERATIVE OUTCOME

The second eye surgery was managed in a similar fashion. The patient's postoperative distance BCVA is 20/25+2 OU with well-controlled IOPs without topical medication.

BY MICHAEL PATTERSON, DO

Cataract Surgery in an Eye With 360° Synechiae

This case report describes a patient with glaucoma, a previous trabeculectomy, and 360° synechiae who presented for cataract surgery.

I began the procedure by placing an OVD into the eye to create a small opening in the pupillary membrane. I removed the pupillary membrane using Utrata forceps and, for especially adherent synechiae, scissors (Figure 9).

My initial plan was to use a Malyugin Ring (MicroSurgical Technology) in expectation of a floppy iris and to enhance visualization of the cataract. This is my standard plan for any patient whose pupil does not dilate to wider than 4.5 mm in clinic. Because the pupil was completely fibrotic, however, I was at first unable to insert the ring.

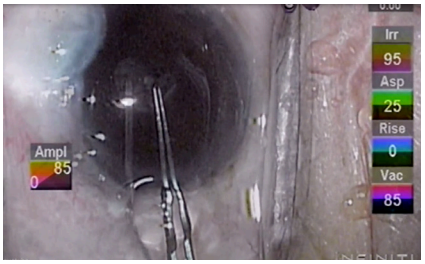


Figure 9. The pupillary membrane is removed using Utrata forceps and scissors.

Figures 9–11 courtesy of Michael Patterson, DO

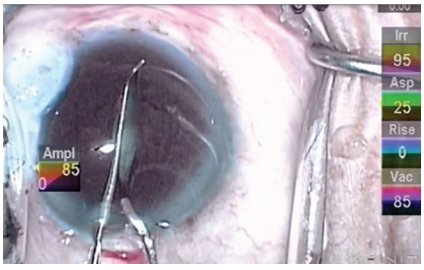


Figure 10. A Lester hook and an Osher Y-hook are placed on opposite pupillary margins to gently stretch the pupil, causing a small tear in the pupillary margin.

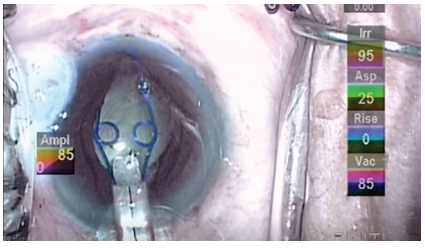


Figure 11. The Malyugin Ring is inserted.

Instead, I began by placing a Lester hook and an Osher Y-hook on opposite pupillary margins to gently stretch the pupil. Although this action caused a small tear in the pupillary margin (Figure 10), stretching the pupillary margin in this manner is my preferred method in a patient with a fibrotic iris, to sufficiently widen the pupil and allow me to safely visualize the cataract.

After stretching the pupil, I was able to insert the Malyugin Ring (Figure 11). I also used trypan blue dye to stain the anterior capsule. The dye can be extremely useful in cases such as this one, when visibility is extremely limited. Even if visibility seems good, sometimes there are other compounding factors in complex cases in which trypan blue can be your friend, so use it judiciously.

(Continued on page 44)

PREVENTING INTRAOPERATIVE MIOSIS AND ENHANCING PEACE OF MIND

By Inder Paul Singh, MD

The use of phenylephrine and ketorolac intraocular solution 1%/0.3% (Omidria, Omeros) in the infusion fluid in cataract surgery helps to maintain pupil size intraoperatively. But, importantly, it also helps to reduce surgeon stress intraoperatively and to improve patients' experiences and postoperative outcomes.[1]

To demonstrate the efficacy and benefit of using phenylephrine and ketorolac intraocular solution 1%/0.3% and the impact it can have on patient safety and outcomes, I performed a mini bilateral eye comparison trial. That is, I performed cataract surgery in both eyes of a patient, using the phenylephrine and ketorolac solution in only one.

CASE PRESENTATION

A hyperopic patient with a 3+ nuclear sclerotic cataract presented for surgery. He was taking tamsulosin (Flomax, Sanofi-Aventis), and he had a shallow anterior chamber (about 2.5 mm). As we know, patients taking tamsulosin are at heightened risk for intraoperative floppy iris syndrome (IFIS).[2]

Instead of performing phacoemulsification as I usually would in these cases, I used mostly irrigation and aspiration, guiding nuclear fragments to the phaco tip to avoid damaging the corneal endothelium. In the eye receiving phenylephrine/ketorolac, the iris and pupil were rock steady, making phacoemulsification efficient and controlled with minimal need to manipulate the iris. The removal of cortical fibers was also efficient in this eye because I could easily see the border of the capsulotomy.

In the eye with no phenylephrine/ketorolac in the irrigating solution, phacoemulsification was much more time-consuming and challenging due to the floppiness of the iris (Figure). Locating and removing cortical fibers during I/A was also more difficult in this eye. I had to use a second instrument on the iris while trying to locate the cortical fibers, to make sure that the I/A tip was under the capsule. This in turn caused further reduction in pupil size, making the case longer and more stressful.

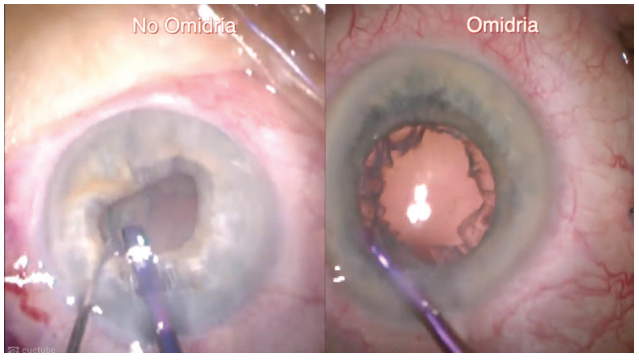


Figure. Phacoemulsification is challenging due to the floppiness of the iris in the eye with no phenylephrine/ketorolac in the irrigating solution (left).

CONCLUSION

Since making phenylephrine/ketorolac a part of my routine cataract surgery regimen, my use of pupil-expansion devices has decreased, as have patient reports of postoperative pain. A report has also associated the use of phenylephrine and ketorolac intraocular solution 1%/0.3% with decreased risk of postoperative cystoid macular edema.[3] For the sake of our peace of mind, it is worthwhile for surgeons to consider adding this solution to their irrigating fluid for cataract surgery, especially to simplify surgery for challenging eyes at risk for IFIS.

1. Hovanesian JA, Sheppard JD, Trattler WB, et al. Intracameral phenylephrine and ketorolac during cataract surgery to maintain intraoperative mydriasis and reduce postoperative ocular pain: Integrated results from 2 pivotal phase 3 studies. *J Cataract Refract Surg*. 2015;41(10):2060-2068.
2. Chang DF, Campbell JR. Intraoperative floppy iris syndrome associated with tamsulosin. *J Cataract Refract Surg*. 2005;31(4):664-673.
3. Visco D. Study to evaluate patient outcomes following cataract surgery when using Omidria with postoperative topical NSAID administration versus a standard regimen of postoperative topical NSAIDs and steroids. Paper presented at: Caribbean Eye Meeting; February 1-5, 2019; Cancún, Mexico.

(Continued from page 40)

I used a bent needle to create a flap in the anterior capsule to start the capsulorhexis and Utrata forceps to finish it. In cases such as this, in which the nucleus is often fairly dense, I prefer to make the flap slightly larger than usual—5.5 to 6.0 mm—to give myself more room to work with it.

I then proceeded with my standard cataract surgery technique using the Infiniti Vision System (Alcon). I began by sculpting with the phaco tip to ascertain the density of the nucleus and then used a standard phaco chop technique for the remainder of the nucleus removal.

Removing the remaining cortex, I used a tangential rather than a radial approach, in case of the presence of any zonulopathy that was undetected before surgery.

IOL IMPLANTATION

I implanted an AcrySof IQ one-piece acrylic IOL (Alcon) into the capsular bag and removed the Malyugin Ring. I typically take off the leading scroll of the Malyugin Ring first and reposition the ring closer to the angle. Doing so makes it easy to grasp and remove the trailing scroll.

Finally, I injected acetylcholine chloride (Miochol-E, Bausch + Lomb) to initiate miosis.

OUTCOME

This patient had moderate inflammation in the early postoperative period, as is typical with small pupil cases. This was resolved with topical antiinflammatory drops. At 1 month postoperative, his UCVA was 20/40. ■

ERIC D. DONNENFELD, MD
- Founding Partner, OCLI Vision, New York
- Professor of Ophthalmology, New York University, New York
- Trustee, Dartmouth Medical School, Hanover, New Hampshire
- *CRST* Editor Emeritus
- ericdonnenfeld@gmail.com
- Financial disclosure: Consultant (Beaver Visitec International, Omeros)

CRISTOS IFANTIDES, MD, MBA
- Assistant Professor, Ophthalmology, University of Colorado/Denver Health, Denver, Colorado
- Director, Ophthalmic Global Outreach, University of Colorado, Aurora, Colorado
- cristosmd@gmail.com
- Financial disclosure: Consultant (Centricity Vision)

CATHLEEN M. MCCABE, MD
- Cataract and Refractive Surgery Specialist and Medical Director, The Eye Associates, Bradenton and Sarasota, Florida
- Member, *CRST* Editorial Advisory Board
- cmccabe13@hotmail.com; Twitter @cathyeye
- Financial disclosure: None

MICHAEL PATTERSON, DO
- Partner, Eye Centers of Tennessee, Crossville, Tennessee
- Member, *CRST* Editorial Advisory Board
- michaelp@ecotn.com
- Financial disclosure: None