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

CASE STUDIES IN PUPIL DILATION

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

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.
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.
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°.

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**MANAGING SMALL PUPILS**

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...
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.

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**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.
Instead, I began by placing a Lester hook and an Osher Y-hook on opposite pupillary margins to gently stretch the pupil, causing a small tear in the pupillary margin.

Instead, I began by placing a Lester hook and an Osher Y-hook on opposite pupillary margins to gently stretch the pupil, causing a small tear in the pupillary margin (Figure 10). Although this action caused a small tear in the pupillary margin, 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.

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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.

**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

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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.

**IOL IMPLANTATION**

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