

# Cataract Surgery in an Eye With a Small Pupil

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## *How do you manage a small pupil during cataract surgery?*

—Topic prepared by Alan N. Carlson, MD

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### **JAMES C. LODEN, MD**

A small pupil during cataract surgery may be encountered with intraoperative floppy iris syndrome (IFIS), which is associated with the use of  $\alpha$ 1-antagonist agents such as tamsulosin (Flomax; Boehringer Ingelheim Pharmaceuticals, Inc.) or from the use of pilocarpine, chronic inflammation, posterior synechiae, pseudoexfoliation syndrome, and atonic pupils in elderly patients. Small pupils not due to IFIS are easily managed through mechanical pupillary stretching. First, I place a paracentesis port and irrigate the anterior chamber with 1% nonpreserved lidocaine with epinephrine. Next, I fill the anterior chamber with viscoelastic. In my experience, both cohesive and dispersive agents may be used with success. After making the clear corneal incision, I place a Bechert Nucleus Rotator (Crestpoint Management Ltd.) through the paracentesis port and insert a Kuglan Hook (Bausch + Lomb) through the main incision. Next, I perform bimanual mechanical pupillary stretching in two directions approximately 180° apart followed by viscodilation. In most circumstances, I can complete the case using a standard phaco technique without iris expansion devices.

IFIS cases must be approached differently, because mechanical pupillary stretching is seldom helpful. First, I create a paracentesis port with a more anterior corneal entry into the anterior chamber. A floppy iris (which is challenging enough) can be aggravated by a posterior corneal entry that facilitates prolapse. Next, I slowly irrigate the anterior chamber with 1% nonpreserved lidocaine with epinephrine. The combination of lidocaine and epinephrine can work wonders in some cases but may have no effect in others. I instill viscoelastic

through the paracentesis port and take care not to overfill the anterior chamber, because the iris can prolapse immediately upon creation of the clear corneal incision.

My preferred approach is a soft-shell technique using Healon5 and Healon (both from Abbott Medical Optics Inc.). I create a temporal clear corneal incision, and I am careful to make a long corneal tunnel to prevent early entry into the anterior chamber and subsequent prolapse of the iris. If the pupil will not enlarge with intracameral lidocaine and viscodilation, I immediately insert a Malyugin Ring (Microsurgical Technology). Although this device adds to the expense of the procedure, there is nothing more expensive than an unhappy patient postoperatively with a macerated iris, corneal edema, and some lenticular material in the vitreous.

Care should be taken to perform gentle hydrodissection in all cases with and without iris expansion devices. Throughout the case avoid large pressure gradients that facilitate iris prolapse. Vigorous hydrodissection may result in sudden iris prolapse even in the presence of iris expansion devices. If the iris prolapses, I reposition it through the paracentesis port with Healon5. Throughout the case, I slowly remove the phaco and I/A handpieces to allow the internal and external pressure to equalize.

During my worst IFIS case, the keratome entered the anterior chamber early, followed by immediate and severe iris prolapse. None of the tricks I described worked. Finally, I had to remove the excess viscoelastic with a bimanual I/A technique and then reposition the iris with Healon5 through the paracentesis port. I placed 10–0 nylon sutures in the clear corneal incision and created a second incision with a more anterior entry 60° away. I immediately inserted a Malyugin Ring, and the case continued without further excitement.

**JOHNNY L. GAYTON, MD**

I have the misfortune of regularly dealing with patients who have miotic pupils and need cataract surgery. Middle Georgia has a large glaucoma population. The main reason for miosis in my practice, however, is IFIS. Because urologists, internists, and family practitioners are prescribing tamsulosin like it is Chicklets, not a surgical day goes by that I do not see several patients with IFIS.

My colleagues and I have increased how successfully we deal with miosis, especially that caused by IFIS. Starting topical atropine drops several days before surgery may facilitate dilation in some cases, but this can result in urinary retention, which is why the patient was taking tamsulosin in the first place. Consequently, I only give patients atropine immediately before surgery. I also administer Paremyd (Akorn, Inc.), which contains 0.25% tropicamide and 1% hydroxyamphetamine. Hydroxyamphetamine is not a direct-acting sympathomimetic like phenylephrine. Hydroxyamphetamine's sympathomimetic action is unique, because it causes the presynaptic neuron to release endogenous norepinephrine into the synaptic cleft, which causes neuronally stimulated contraction of the iris radial muscles. The 0.25% tropicamide is a rapid short-acting drug, which, like atropine, addresses the iris sphincter muscle. I also instill a drop of neosynephrine and a topical nonsteroidal anti-inflammatory drug, which decreases intraoperative miosis. My preference is bromfenac sodium ophthalmic solution 0.09% (Bromday; Ista Pharmaceuticals), because it is potent and inhibits cyclooxygenase (Cox-1 and Cox-2) enzymes. I have a low threshold for administering preoperative intravenous mannitol to patients with nanophthalmic eyes and elevated IOP.

Before the first incision, I make sure that everything needed for the operation is ready. I have found that, the quicker the procedure progresses, the less likely I am to have to use a pupillary expansion device. My goal is to perform an excellent procedure in 5 minutes or less if possible. I create the primary incision with a long tunnel so that the iris is less likely to prolapse. I then instill DiscoVisc (Alcon Laboratories, Inc.), because I find that it viscodilates and maintains the pupil almost as well as Healon5 but with fewer postoperative spikes in IOP. I angle the secondary incision toward the primary one so that I can easily sweep the iris back into the eye if the iris prolapses. It is much easier to pull than to push a rope; the same holds true with the iris. If the pupil does not enlarge to 5 mm or greater, I will usually insert a Malyugin Ring. I prefer this device over hooks or other devices due to its ease of insertion and removal as well as the excellent stability that it restores to the iris.

After I create the capsulorhexis, I perform gentle hydrodissection with 1% lidocaine on a Chang Hydrodissection Cannula (Katena Products, Inc.). Next, I complete viscodissection, as described by Richard Mackool, MD.<sup>1</sup> In eyes with shallow anterior chambers or severe IFIS, I debulk the nucleus prior to hydrodissection. As I remove nuclear material, I am careful to avoid the iris, for what has been touched cannot be untouched. After I remove the nucleus, I perform subincisional hydrodissection of retained nuclear, epinuclear, and cortical material with a J cannula. I have been performing this technique for more than 20 years and have found it particularly helpful in eyes with small pupils. After I insert the lens, I ensure that both haptics are completely in the bag. Some of the worst cases of chronic inflammation and pigment dispersion that I have seen have occurred in eyes that had one haptic in the bag and one in the sulcus. Patients are commonly referred to me for this reason.

Technology presents cataract surgeons with a new dilemma. Laser cataract surgery cannot be performed if the pupil is not adequately dilated, but I question whether the procedure is a good idea at all for these eyes, especially those with severe IFIS. I have observed that many of these patients have some miosis after the laser portion of the procedure. Time then elapses as the patient is moved from the laser and prepared for the intraocular portion of the procedure. For now, I am only using the femtosecond laser in eyes with IFIS and/or miotic pupils when they dilate well. If significant miosis develops intraoperatively in the first eye, I switch to traditional cataract surgery for the second eye.

I have not mentioned Shugarcaine (4% unpreserved lidocaine diluted 1:3 with BSS Plus [Alcon Laboratories, Inc.]) in my comments. Unfortunately, the government, in its zeal to make medical care "safer," has made the solution impractical to use in Middle Georgia. It would have to be mixed in a compounding pharmacy every 4 hours, and the closest facility is at least 35 minutes away.

**MICHAEL E. SNYDER, MD**

When I encounter a small pupil during cataract surgery, my decision of which techniques to use not only depends on the diameter of the pharmacologically dilated pupil, but also on the pathophysiology underlying the pupil's limited dilation and on the other surgical maneuvers that may be required.

For pupils smaller than 3.5 mm, I uniformly select some method of augmenting dilation. For pupils between 3.5 and 5 mm, I use an additional technique if the patient has any one of the following factors:

- a history of systemic  $\alpha$  receptor antagonist use
- a history of IFIS in the fellow eye

- a light blue iris
- a toric IOL (a view of the periphery of the optic is mandatory)
- zonulopathy (a capsular tension ring [CTR] may be required)

Although viscomydriasis can be useful for dilating the pupil for the capsulorhexis, its utility is transient, and phacoemulsification either lessens or eliminates the effect, which compromises my view of the anterior segment during the most challenging part of the procedure. Similarly, I do not rely heavily on intracameral mydriatics, as their longevity of action during the case is not always adequate.

I prefer to use either flexible iris retractors or Malyugin Rings when augmented dilation is required. The latter is my “go to” device because of its ease and efficiency of insertion and removal. Moreover, it creates an octagonal aperture that maximizes surgical access while minimizing stretching of the sphincter muscle compared with the use of four or five flexible retractors. I prefer the 6.25-mm version of the Malyugin Ring, because its aperture is more than ample for the desired maneuvers for standard phacoemulsification. I also find the 6.25-mm device easier to disengage at the end of the procedure than its 7-mm cousin.

Some surgeons find it challenging to remove the Malyugin Ring. In my experience, a facile approach is to disengage the proximal scroll; to sweep the “spoon” of the insertion device under it; to draw the device slowly into the barrel; before bringing the two lateral scrolls fully into the tube, to pull the inserter/remover unit into the corneal tunnel; and then to complete the retraction into the barrel. This method prevents the scrolls from catching on the roof of the inserter tube during removal, which can cause the device to buckle and twist.

Flexible retractors can also be very useful and may be preferable in certain cases. For example, in an eye with significant zonulopathy in which a CTR or sutured CTR may be required, the retractors provide a “stenting” of the iris to the limbus rather than just stenting of the pupil to itself. When such additional hardware may be placed within the anterior segment, this additional support is helpful. Further, if extra support of the capsular bag is required, the same retractors can be placed around both the iris and the margin of the capsule. Similarly, in megalo-anterior segment cases, a Malyugin Ring alone will cause notable movement of the ring and adjacent iris diaphragm as fluid flows within the anterior segment, whereas retractors will stabilize the margin of the iris and the limbus. When I use these retractors, I like to make the openings in the posterior

limbus with an S-14 spatulated needle (Ethicon, Inc.). I enter just over the insertion of the iris to avoid tearing the iris forward during the procedure.

If the fellow eye has significant IFIS, yet the pupil dilates widely, retractors can be effectively placed at the beginning of the procedure for the second eye to prevent intraoperative constriction. Dilating rings are particularly ineffective, and in fact deleterious, at preventing constriction when the pupillary aperture is larger than the ring’s diameter.

In cases of iridocorneal endothelial syndrome or iris neovascularization, flexible hooks may be preferable to rings, because the tension can be slowly titrated to what the stroma will bear without tearing. Many kinds of disposable and reusable iris rings and retractors are available.

### ROBIN R. VANN, MD

I find a systematic approach helpful for managing a small pupil during cataract surgery. At the preoperative evaluation, I measure the size of the pupil when it is dilated and note in the record any synechiae, trauma with iridocorneal adhesions, or pseudoexfoliation of the lens capsule. I also note if the patient has a history of diabetes or has taken tamsulosin. For borderline pupils (5-6 mm), I use a buffered 1:4,000 epinephrine/1% lidocaine mixture to help maintain or slightly enlarge the pupil during the case. For pupils under 5 mm or with posterior synechiae, I use mechanical devices such as iris hooks or a Malyugin Ring—my preferred mechanical device—to obtain and maintain appropriate dilation throughout the surgery.

When the pupil constricts intraoperatively, I change my approach slightly and adjust it according to the situation. In patients with diabetes or those who take tamsulosin and have borderline pupils, I have found that Healon5 enlarges the pupil 1 to 2 mm and immobilizes it during the lens-disassembly portion of the operation. I am then, however, required to modify the flow rates during phacoemulsification to under 25 mL/min to avoid prematurely removing the ophthalmic viscosurgical device. If I do not feel comfortable modifying my settings and I have already performed the capsulorhexis, then I will place iris hooks instead of a Malyugin Ring to mechanically dilate the pupil. By using iris hooks at this stage, I avoid the potential problem of engaging the Malyugin Ring with the capsulorhexis rather than the margin of the pupil. If I am surprised by a progressive constriction of the pupil during phacoemulsification, I will often change my second instrument to a push-pull instrument to manipulate the iris and improve my visualization of the quadrant of the lens capsule on which I am working.

**ALAN N. CARLSON, MD**

This month, several remarkably contributors who are known for their surgical skills as well as their teaching ability have shared their wisdom, experience, and technical expertise in managing a small, poorly dilating pupil. There is overlap and consistency among the contributors' methods for this complication. It is important to recognize this problem before surgery begins by noting poor pupillary dilation in the clinic or perhaps during previous surgery on the other eye. Cataract surgeons also need to recognize predisposing factors such as the use of tamsulosin or pseudoexfoliation. Intraoperative epi-Shugarcaine is helpful in mild cases but produces inconsistent results in patients who have long used tamsulosin. With regard to pupillary stretching in non-IFIS cases like uveitis, less is more—meaning that it is easy to overstretch the pupil. Surgeons can do more if necessary, but I teach trainees to stretch about half what they think is needed and to use viscomydriasis for the rest. In contrast to my cocontributors this month, I am probably less likely to use a mechanical pupillary expander. I do, however, think these devices can be beneficial, and I make sure my trainees are well versed in these options.

If the pupil is between 3.5 and 5.5 mm, I will modify my technique as follows:

1. I ensure that the patient has had additional time to achieve dilation in the preoperative holding area.
2. I use a 2.2-mm keratome to make a single-plane incision parallel to the iris. I often do not go in all the way and make the incision between 2 and 2.2 mm in length. By creating this incision horizontal or parallel to the iris, I achieve a consistent length.
3. I inject viscoelastic, usually Healon GV (Abbott Medical Optics Inc.) in typical cases. I use Healon5 in more severe cases.
4. I make the paracentesis incision after the primary incision to be sure that there is an optimal and ergonomic relationship between the two. I also make this incision parallel to the iris (1-mm wide) to avoid constructing a wound that contributes to the prolapse of the iris.
5. I initiate the capsulorhexis centrally and spiral it out to the maximum that can be visualized. I will often allow it to go past the border of the pupil when I can no longer visualize it directly if I feel comfortable with the configuration of the tear and when "the Force" is with me.
6. Cortical cleaving hydrodissection is critical but must not lead to turbulence or a gradient that causes the iris to prolapse. I try to place the can-

nula under the capsule as close to the wound as possible. The wave then propagates posteriorly away from the wound. This is a brisk injection of a very small quantity of BSS (0.5-1.5 mL; Alcon Laboratories, Inc.). If I successfully created a capsulorhexis close to 4 mm and the iris does not tend to prolapse, I will often initiate a second wave that becomes the hydroexpressive wave for a pop and chop procedure. I find that this strategy works incredibly well in complex cases.

7. I initiate phacoemulsification using a one-handed, low-flow, low-turbulence technique. I use a second instrument as needed, but I am careful not to allow it to cause leakage and turbulence. Low energy and patience also reduce the risk of burning the incision (low flow) or injuring the iris. No single technique works best. Therefore, I often improvise based on how the procedure is progressing. The principles remain consistent with regard to reducing turbulence: maintain occlusion with the lens nucleus to reduce the risk of injuring the iris, but do not "lollipop" the nucleus.
8. Cortical removal is best initiated in the subincisional location, where it can be the most difficult and can be further complicated by a small pupil. The remaining cortex expands the bag, making subincisional cortical removal easier.
9. I instill viscoelastic and gently retract the iris in all four quadrants to make sure that all of the lenticular material is removed.
10. After the IOL is inserted, additional patience is needed to remove the viscoelastic, because it is more likely to remain trapped behind the IOL in combination with a small capsulorhexis and pupil.
11. Iris injury is fortunately not common using my technique. Should it occur, I instill Miostat (Alcon Laboratories, Inc.) at the end of the procedure to facilitate the pupil's return to a more normal size.
12. I monitor IOP in the early postoperative period more closely in patients with small pupils who undergo cataract surgery.

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A demonstration of these techniques can be viewed at <http://www.alancarolsonmd.com/cataract-surgery-pearls-for-treating-the-patient-with-small-poorly-dilating-pupils>. In closing, I would like to emphasize the importance of counseling patients with small pupils prior to surgery. It is important that they understand that their surgery can be far from routine and that they may require a longer postoperative recovery than in uneventful cases. ■

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