

Pupil Issues in Cataract Surgery

Mechanical expansion devices should be used when indicated in a stepwise approach to small pupils.

BY BORIS MALYUGIN, MD, PhD

A clear and unobstructed view of intraocular structures is a prerequisite for many surgical procedures. Sufficient pupil dilation not only provides the surgeon with access to the lens, but it also prevents many complications resulting from poor visualization of, and resulting trauma to, the delicate intraocular structures.

Inadequate pupil dilation can be observed in cases complicated by pseudoexfoliation syndrome, uveitis, posterior synechiae, trauma, or previous intraocular surgery. Chang and Campbell¹ described intraoperative floppy iris syndrome (IFIS) associated with systemic administration of the alpha-1 antagonist tamsulosin (Flomax; Boehringer Ingelheim Pharmaceuticals). The intraoperative diagnostic triad of this symptom is fluttering and billowing of the iris stroma, a tendency for iris prolapse through the main or sideport incisions, and progressive constriction of the pupil during surgery.

Pharmacologic therapy including the combined use of strong mydriatics such as phenylephrine 10% and tropicamide 1% together with nonsteroidal anti-inflammatory eyedrops is effective. Nevertheless, it cannot always provide a sufficient pupil aperture and sometimes leads to unwanted ocular and systemic side effects.

In small pupils, iris tissue is located closer to the high fluidic currents, which is why the iris is more likely to be aspirated into the ultrasound or I/A needles. Decreasing the flow parameters is an important factor in preventing iris damage during phacoemulsification. Reducing flow can make an appreciable difference in these cases, and central positioning and minimal movements of the handpiece are also important to prevent iris damage. Endocapsular lens nucleus fragmentation is much safer in small pupil cases because the areas of the highest fluidic currents are located inside the capsular bag, away from the corneal endothelium and iris.

Strategies for pupil enlargement depend on surgeon skill



Figure 1. The Malyugin Ring is used to expand the pupil.

and preferences as well as on the intraoperative situation.

I use a stepwise approach including the following:

- Injection of intracameral mydriatic (nonpreserved epinephrine);
- Viscomydriasis with a high-viscosity ophthalmic viscosurgical device (OVD);
- Synechiolysis and/or pupillary membranectomy with spatula and forceps;
- Pupillary stretching (if the pupil is very small); and
- Use of pupil expansion devices.

MECHANICAL PUPIL DILATION

Generally, there are four methods used for mechanical pupil dilation:

No. 1: Manual separation. In this method, the surgeon manually separates the adhesions between the iris, the lens capsule, and/or the cornea (synechiolysis).

No. 2: Mechanical stretching. Mechanical stretching of the pupil is usually effective in eyes with small pupils due to rigid iris tissue, which is usually caused by prolonged miotic use, pseudoexfoliation, or posterior synechiae. Stretching can be achieved with a spatula, Sinsky hook, or a special instrument such as a Beehler pupil dilator. Usually a pair of microhooks is introduced through two stab incisions in

the cornea to engage the iris sphincter. The hooks are then pulled in opposite directions. This maneuver creates microscopic sphincter tears that enlarge the pupil aperture. The main advantage of this procedure is that it is relatively simple and does not require any special instruments. Mechanical stretching of the pupil typically provides sufficient access to the lens and maintains the pupil diameter intraoperatively. One drawback of this technique is that it creates permanent damage to the iris sphincter. Microtears of the sphincter muscle are usually clinically asymptomatic but sometimes result in bleeding and pigment dispersion postoperatively.

No. 3: Sphincter cutting. Partial-thickness iris sphincter cuts can be made with microscissors. The cutting method is more controlled than mechanical stretching, but it requires multiple maneuvers of the scissors inside the anterior chamber, which can result in corneal endothelial damage. The disadvantages are the same as those associated with the stretching method.

No. 4: Pupil expansion devices. The fourth method, the use of pupil expansion devices, is discussed in more detail below. Suboptimal pupil dilation in response to preoperative mydriatic protocols, IFIS, and minimal efficacy of pupil stretching techniques are the most common indications for the intraoperative use of iris hooks or other mechanical pupil dilation devices.

TIPS FOR IRIS HOOK USE

Retracting the iris tissue rather than cutting it, as in a classic sector iridectomy, is much simpler and results in a significantly better postoperative pupil appearance. Richard J. Mackool, MD, was the first to describe a four-point iris retractor configuration for phacoemulsification.² The metal iris retractors connected to small blocks of titanium he developed allowed stabilization of the hooks during iris retraction. Eugene de Juan, Jr., MD, and Dyson Hickingbotham, MD, enhanced this method with the introduction of flexible iris retractors.³

Traditionally, four evenly spaced retractors are placed through limbal paracenteses 90° apart from one another. The corneal incision is centered on one of the four sides of the resulting square. A diamond configuration of iris hook placement, with one hook located subincisionally, is useful in IFIS.

While engaging the pupillary edge after the capsulorrhexis,

TAKE-HOME MESSAGE

- Sufficient pupil dilation provides access to the lens and prevents many complications.
- Strategies for pupil enlargement depend on surgeon skill and preferences and the intraoperative situation.
- In dealing with small pupils, the use of a stepwise approach is recommended.

the iris hook may catch and damage the capsule, leading to an anterior capsular tear that can extend to the periphery. To avoid this problem, a drop of OVD should be injected between the iris and the capsule before the hook is inserted. Another useful technique is to keep the hook parallel to the iris plane during insertion and tilt it slightly posterior, right near the pupillary edge, to be sure to engage only the iris.

Iris hooks can become loosened during surgery, in which case their tips may become dislocated and no longer hold the pupillary edge. This can cause problems including iris aspiration and chafing from contact with the phacoemulsification needle.

It is not recommended to stretch the pupil larger than a 5-mm square using hooks, as overstretching produces an irregular atonic pupil postoperatively.

PUPILLARY RINGS

Most of the surgical maneuvers for enlarging the pupil and preventing its intraoperative constriction are less than ideally safe. They can lead to an increased risk of iris sphincter tear, bleeding, iris damage, posterior capsular tears, and loss of the vitreous body. Potential postoperative complications include an atonic pupil of irregular shape with poor cosmetic result and photophobia. Use of pupil expansion rings rather than surgical enlargement can avoid or reduce these risks.

There are a number of pupil expansion devices currently on the market: the Graether pupil expander (Eagle Vision); the Sieser Iris Protector ring; the Perfect Pupil device (Milvella); the Morcher Pupil Dilator (Morcher GmbH); the Oasis Iris Expander (Oasis Medical, Inc.), and the Malyugin Ring (MicroSurgical Technology).

Variable pupil expansion devices differ by the easiness of intraoperative handling and surgeon's learning curve.

THE MALYUGIN RING

The Malyugin Ring is a relatively new pupil expansion device.⁴ Its one-piece design features a square shape with four equidistantly located circular loops. The loop at each angle has a gap to accommodate the iris tissue. The basic concept of this device is the coil principle of catching and holding the pupillary margin.

The Malyugin Ring System consists of a presterilized single-use holder containing the ring and an inserter,

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and the device comes in two sizes: 6.25 and 7 mm. The implantation and removal of both versions is performed with the same insertion device. For a video description of insertion, visit eyetube.net/?v=tegibe. The advantage of the smaller ring is that it is easier to insert and retract; the advantage of the 7-mm ring is that it can be used if the pupil starts off bigger or in IFIS cases.⁵ The 7-mm ring provides greater exposure of the lens nucleus and is preferable for surgeons who use the phaco flip nucleus removal technique and those who use IOLs with 6.5-mm optics. Evacuation of the cortical material with the 7-mm Malyugin Ring is also easier and safer.

DISCUSSION

Several techniques of nucleus disassembly in small-incision cataract surgery require a wide and unobstructed view of the anterior portion of the lens and of the instruments inserted into the anterior chamber. Another important factor is sufficient manipulability of the instruments, which is crucial for the successful completion of surgery. A pupil that fails to dilate makes cataract removal more difficult.⁶

In dealing with a small pupil during cataract surgery, I strongly recommend the use of a stepwise approach. Mechanical pupil expander devices should be used only in cases in which all other methods failed to provide an adequate pupil aperture. There are two main drivers for the decision to use a mechanical pupil expander device: (1) the size of the pupil and (2) the biomechanical properties of the iris tissue.

The pupil expander devices currently on the market differ with regard to ease of handling and clinical results. The Malyugin Ring is a useful tool for phacoemulsification surgery. It adequately dilates the pupil and prevents iris sphincter damage. This easy-to-insert-and-remove device expands the pupil, protects the iris sphincter during surgery, and allows the pupil to return to its normal shape, size, and function after the operation. ■

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1. Chang DF, Campbell JR. Intraoperative floppy iris syndrome associated with tamulosin. *J Cataract Refract Surg*. 2005;31(4):664-673.
2. Mackool RJ. Small pupil enlargement during cataract extraction. A new method. *J Cataract Refract Surg*. 1992;18(5):523-526.
3. de Juan E Jr, Hickingbotham D. Flexible iris retractor. *Am J Ophthalmol*. 1991;111(6):776-777.
4. Malyugin B. Small pupil phaco surgery: a new technique. *Ann Ophthalmol*. 2007;3(3):185-193.
5. Chang DF. Use of Malyugin pupil expansion device for intraoperative floppy-iris syndrome: results in 30 consecutive cases. *J Cataract Refract Surg*. 2008;34(5):835-841.
6. Malyugin B. Overview of the small pupil cataract surgery techniques. *J Intraocular Implant Refract Soc India*. 2009;5(1):40-46.

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