

I-Ring offers new strategy for intraoperative small pupil management

Physicians demonstrate application of this device in various small pupil situations.

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Adequate visualization of the cataractous lens is essential for safe phacoemulsification and IOL implantation. A compromised lens view due to partial iris coverage, in cases of a pupil smaller than 5 mm, can pose several challenges to the cataract surgeon and result in potential intraoperative complications including iris tissue damage with secondary bleeding and miosis, pupillary sphincter tear, posterior capsular tear, dropped nucleus, and vitreous loss with possible secondary retinal complications. Surgical difficulty with a small pupil can be further compounded by the presence of zonular weakness, capsular inadequacy, a shallow anterior chamber and a brunescant complete cataract. Further, normal iris resting position in a well-dilated state is usually optimal for safe phacoemulsification.

When the iris tissue is floppy, it escalates the difficulty of modern-day cataract surgery. To optimize pupillary size and manage floppy iris tissue, in addition to ophthalmic viscosurgical devices, various pharmacological agents may be used preoperatively. These include parasympathetic antagonists such as tropicamide 0.5%, cyclopentolate 1% or 2%, and homatropine 2% or 5%; sympathetic agonists such as phenylephrine hydrochloride 2.5% or 10%; along with possible intraoperative use of bisulfate-free epinephrine, intraocular lidocaine, lidocaine plus epinephrine, intracameral phenylephrine 1.5%, or phenylephrine plus lidocaine.

Mechanical instrumentations for pupil optimization include iris hooks, the Malyugin ring (MicroSurgical Technology), the Morcher pupil dilator (FCI Ophthalmics), the Graether pupil expander (Eagle Vision), the APX pupil-expanding devices (APX Ophthalmology), the Beehler pupil dilators (Moria) and the Perfect Pupil expansion ring (Milvella).

In this column, Drs. Kenyon and Pineda describe the surgical application of the Visitec I-Ring pupil expander in the intraoperative management of a small pupil so the surgeon can perform a safe phacoemulsification and IOL implantation.



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During the past decade, increasing use of Flomax (tamsulosin, Boehringer Ingelheim) and other alpha-1-adrenergic antagonist medications with the consequences of intraoperative floppy iris syndrome, including an inadequate pupil aperture of less than 5 mm, has become an ever more common cataract surgical challenge. Moreover, multiple other intrinsic or acquired conditions also pose risk factors for surgically insufficient pupils, including diabetes, pseudoexfoliation, surgical or accidental trauma, posterior synechiae, miotic therapy and prior laser photocoagulation.

To further complicate matters, both pseudoexfoliation and trauma can also compromise lens zonule competence, thereby posing either acute intraoperative or delayed postoperative lens, IOL and/or lens capsule dislocation issues. Pseudoexfoliation in particular has been associated with late IOL and capsule dislocation.

To manage such perplexing pupils, both pharmacologic and mechanical surgical strategies have been devised. The former include high molecular weight viscoelastics such as Healon5 (sodium hyaluronate 2.3%, Abbott Medical Optics), intracameral mydriatics such as preservative-free phenylephrine 1.5% or epinephrine 0.025%, and an irrigant additive mydriatic plus NSAID such as Omidria (phenylephrine 1% and ketorolac injection 0.3%, Omeros). Mechanical devices comprise simple iris hook retractors or pupillary expansion rings such as the Malyugin ring (Microsurgical Technology) and Perfect Pupil (Milvella).

Although such strategies can be tailored to specific surgical situations, the problems of currently available pupil expanders, specifically their variability of insertion/removal plus potential for iris and other ocular tissue damage, nonetheless deserved improvement. To solve these problems, the Visitec I-Ring pupil expander was devised by Beaver-Visitec International (Figure 1); it is FDA Class 1 Exempt as well as CE marked. This single-use device is composed of polyurethane and sterilely housed with its injector and extractor instrument. The polyurethane material is especially pliable and gentle on the iris tissue, and elicits no intraoperative patient discomfort even with only topical anesthesia. The I-Ring's channels embrace the pupil margin for 360°, and the four positioning holes are safely isolated from the iris. The ring is injected through a 2.4-mm incision, and when engaged utilizing a Sinsky

hook, it sustains a circular pupil of diameter 7 mm or greater. Here we present the initial experiences of the I-Ring Study Group for various applications of this device.



Figure 1. I-Ring schematic demonstrates positioning holes isolated from the channels and living hinges to facilitate removal.

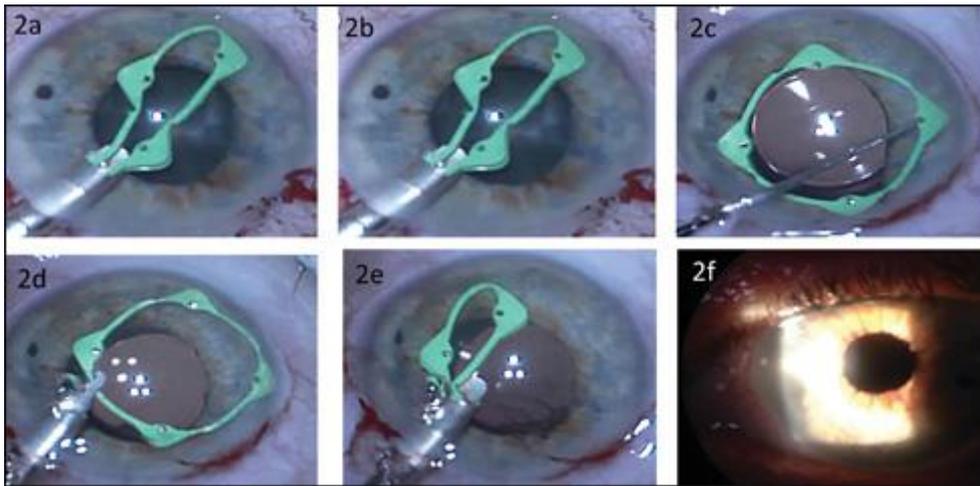


Figure 2. Small pupil cataract surgery. I-Ring injection into the anterior chamber (a). Sinskey hook guides channels to engage the pupillary margin (b). Following completion of phacoemulsification and IOL insertion, the Sinskey hook disengages the I-Ring from the iris (c). The forked tip of the manipulator spans a living hinge (d). The I-Ring is withdrawn into the tube of the insertion device (e). On postoperative day 1, the pupil is round, central and constricted (f).

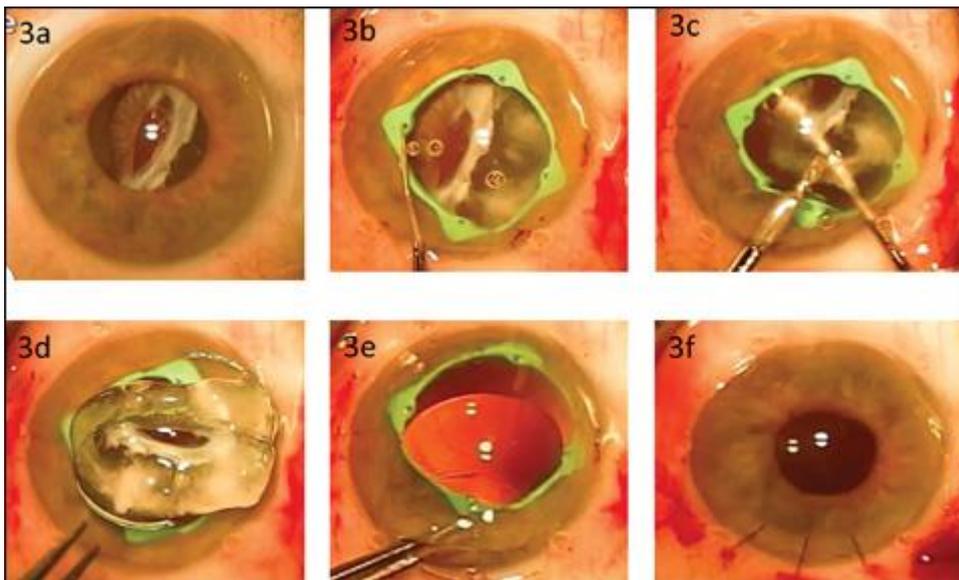


Figure 3. IOL/capsule dislocation secondary to pseudoexfoliation. The entire IOL and lens capsule complex is subluxated, and the pupil does not pharmacologically dilate (a). I-Ring engagement with the Sinskey hook creates a 7-mm pupil and stabilizes the iris diaphragm to prohibit iris and vitreous prolapse (b). The IOL/capsule is elevated with a cyclodialysis spatula (right) and grasped with retinal forceps (left) (c). Completed extraction of the entire IOL/capsule through the I-Ring aperture. Despite its large size, the I-Ring remains in position and no vitreous prolapses (d). The 7-mm diameter PMMA IOL is inserted through the I-Ring following transscleral placement of 10-0 polypropylene sutures (e). At the completion of surgery, the incision is secure, the IOL is central and stable, and the pupil is restored to preoperative size and configuration (f).

Primary phacoemulsification with miotic pupil (Figure 2)

When an inadequately sized pupil is encountered at the outset of surgery, the I-Ring is inserted through the primary incision into the viscoelastic-filled anterior chamber. A Sinsky hook retracts the ring at each of the four positioning holes to engage the adjacent iris quadrant. As the channel supports the entire circumference of the pupil, the iris diaphragm remains stable throughout phacoemulsification, irrigation/aspiration and IOL implantation. The Sinsky hook is again utilized to disengage the channels, and the forked end of the manipulator engages the ring at one of the four living hinge points. The ring invariably remains undistorted in the pupillary plane when withdrawn into the injector tube, thereby posing no risk of damage to the iris, corneal endothelium or incision.

IOL exchange in pseudoexfoliation-related IOL and lens capsule dislocation (Figure 3)

In cases of spontaneous late onset dislocation of the entire IOL and lens capsule as a consequence of pseudoexfoliation, not only must the non-dilating pupil be adequately enlarged to permit safe IOL/capsule retrieval, but also the iris diaphragm must be stabilized to discourage vitreous prolapse and the pupil must be maintained to accommodate insertion and fixation of the replacement posterior chamber IOL. Here the I-Ring is again inserted in standard fashion. The limbal incision is enlarged to 7 mm, and retinal forceps are used to grasp and extract the entire IOL/capsule complex. With the I-Ring and viscoelastic support, no vitreous prolapse occurs during passage of the scleral sutures (CIF-4 10-0 Prolene), insertion of a 7-mm diameter PMMA IOL (CZ70BD, Alcon Surgical), I-Ring disinsertion and limbal incision closure.

Although numerous pharmacologic and mechanical strategies for small pupil management have merit and applicability, the I-Ring presents the next generation of pupil expansion devices with advances in safety, reliability and consistency. Neither problems nor complications have been encountered in hundreds of uses, even by less experienced resident surgeons. Such encouraging uses of the I-Ring in routine small pupil cataract surgery as well as in complex scenarios such as IOL dislocation requiring both pupil enlargement and stabilization verify its utility and adaptability for meeting the challenges of these and potentially other anterior segment surgical themes and variations.

- **References:**

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