

Peer-Reviewed Literature:

IOL Implantation Without Capsular Support



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The endocapsular placement of an IOL is undoubtedly anatomically preferable following successful cataract extraction. However the presence of an unstable capsule-zonule complex or its absence, as with a dislocated lens or pseudoexfoliation syndrome, preempts the endocapsular fixation of the IOL. A similar predicament arises if an eye has been left aphakic or the IOL-capsule complex has subluxated, which usually occurs secondary to pseudoexfoliation. In such a situation, the surgeon has four options: (1) to leave the eye aphakic; (2) to implant an ACIOL; (3) to fixate a PCIOL in the iris; or (4) to fixate a PCIOL in the sclera. The potential issues of anisometropia, optical aberrations, and contact lens intolerance make aphakia a less-than-optimal solution in all but a few patients. This article therefore focuses on the other three options. The following articles were reviewed:

1. Por YM, Lavin MJ. *Techniques of intraocular lens suspension in the absence of capsular/zonular support*. *Surv Ophthalmol*. 2005;50:429-462.
2. Dick HB, Augustin AJ. *Lens implant selection with absence of capsular support*. *Curr Opin Ophthalmol*. 2001;12:47-57.
3. Goldsmith JA, Li Y, Chalita MR, et al. *Anterior chamber width measurement by high-speed optical coherence tomography*. *Ophthalmology*. 2005;112:238-244.
4. Apple DJ, Brems RN, Park RB, et al. *Anterior chamber lenses. Part I: complications and pathology and a review of designs*. *J Cataract Refract Surg*. 1987;13:157-174.
5. Wagoner MD, Cox TA, Ariyasu RG, et al. *Intraocular lens implantation in the absence of capsular support. A report by the American Academy of Ophthalmology*. *Ophthalmology*. 2003;110:840-859.
6. Hennig A, Johnson GJ, Evans JR, et al. *Long-term clinical outcome of a randomised controlled trial of anterior chamber lenses after high volume intracapsular cataract surgery*. *Br J Ophthalmol*. 2001;85:11-17.
7. Malbran ES, Malbran E Jr, Negri I. *Lens guide suture for transport and fixation in secondary IOL implantation after intracapsular extraction*. *Int Ophthalmol*. 1986;9:151-160.
8. Manabe S-i, Oh H, Amino K, et al. *Ultrasound biomicroscopic analysis of posterior chamber intraocular lenses with transscleral sulcus suture*. *Ophthalmology*. 2000;107:2172-2178.
9. Condon GP, Ahmed IK, Masket S, et al. *Small-incision iris fixation of foldable intraocular lenses in the absence of capsule support*. *Ophthalmology*. *In press*.

ACIOL

Following the implantation of the first ACIOL in 1952 by Baron,¹ multitudes of this lens type were developed. However, by the 1980s, it was apparent that rigid, closed-loop ACIOLs were associated with an unacceptable rate of complications—irreversible endothelial loss leading to pseudophakic bullous keratopathy, intractable inflammation, cystoid macular edema (CME), structural change to the angle leading to glaucoma, and hyphema.²

Modern ACIOLs bear no resemblance to their predecessors except in the anatomic site of their implantation.² The optic is anteriorly vaulted just enough to minimize IOL-iris touch and iris chafing while the flexible open-loop haptics resist increased vaulting under high compression, which prevents endothelial damage.¹ Rounded, highly polished edges—particularly at the optic-haptic junction—minimize trauma to the iris if the IOL inadvertently contacts the iris. The haptics are designed to provide three- or four-point fixation, instead of continuous apposition, that minimizes the area of contact with the outflow structures within the angle. Each point of fixation features a highly polished footplate that prevents erosion into the angle structures and minimizes fibrous overgrowth of the haptic.¹

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Prerequisites for an ACIOL's implantation are the presence of an anatomically normal anterior chamber and accurate sizing of its horizontal diameter. Classically, surgeons have used a horizontal white-to-white measurement plus 1mm as a guide for sizing, but optical coherence tomography of the anterior chamber has shown this method to be inaccurate.³ An oversized lens will result in greater-than-desired anterior vaulting, potentiating



Figure 1. During iris-fixation of a foldable PCIOL, the optic is captured by the iris to provide stable fixation during suturing. Although the haptics remain in the sulcus, the impression of the haptics against the iris provide a visual landmark to place the sutures. When placed in the midperipheral iris, the sutures have a minimal impact on the physiologic function of the iris.

endothelial damage and loss. An undersized lens will result in excessive movement of the IOL, which will potentially cause increased iris chafing and inflammation.¹ However, even with a perfectly implanted ACIOL, Apple et al⁴ postulated that subclinical uveitis secondary to lens-tissue contact creates inflammatory products that could be directly toxic to the endothelium and angle and could also result in CME. The rate of CME associated with ACIOL implantation has been reported at 1% to 10%.¹ The rates of additional adverse outcomes associated with ACIOL implantation are 1% to 7.8% for corneal decompensation,² 0 to 15% for glaucoma,⁵ and 0 to 4% for retinal detachment.⁵ The frequency of endophthalmitis was reported to be 0.2%.⁵ However, a large-scale (2,000 patients), randomized, controlled trial comparing ACIOL implantation versus aphakia following intracapsular cataract extraction found no significant difference between groups for any of the aforementioned parameters.⁶

SCLERAL FIXATION

Recognition of the high rate of adverse events associated with closed-loop ACIOLs in the 1980s prompted the development of novel techniques for fixating an IOL in the aphakic eye. In 1986, Malbran et al⁷ were the first to

describe transsulcus fixation of PCIOLs (Figure 1). Currently, scleral fixation has been described using a rigid PMMA lens with eyelets and foldable three-piece acrylic lenses. The placement of sutures involves either an ab interno or ab externo technique; the former is technically easier, whereas the latter facilitates the increased accuracy of suture placement.¹ Further variations in technique differ in the method of securing the haptic with the fixation suture, the number of points of PCIOL fixation, and the method by which to avoid erosion of the suture/knot.¹

Scleral fixation has an advantage in that it may be performed in the presence of significant structural abnormalities of the anterior chamber and that it mitigates many of the adverse outcomes associated with ACIOLs, particularly the older closed-loop designs. However, the attempted placement of the haptics in the ciliary sulcus with scleral suturing is not precise. Using ultrasound biomicroscopy (UBM) to assess the haptic's location following scleral fixation, Manabe et al⁸ reported that only 38% of haptics were in the ciliary sulcus, whereas the others were behind it. The posterior placement of haptics increases the risk of IOL instability and tilt.⁸ Significant tilt (ie, greater than 10°) has been reported in 11.4% to 16.7% of eyes.¹ Posterior tilting of one haptic results in the anterior tilting of the other and could cause localized pushing of the iris, which would result in segmental angle closure and UGH syndrome.⁸ Placing the suture through the pars plicata results in not only unstable fixation but also an increased risk of inflammation due to irritation of the ocular tissues.⁸ Vitreous incarceration is also associated with, but not limited to, the posterior suturing of haptics despite the undertaking of a vitrectomy. This incarceration can result in vitreoretinal pathology such as macular holes, retinal tears, and subsequent retinal detachments in up to 4.9% of eyes.²

Another major concern with scleral fixation is the longevity of the sutures. Haptics correctly placed in the sulcus will likely achieve stable fixation and potentially fibrose to the surrounding structures. However, posteriorly placed haptics (62% of haptics) rely solely on the sutures for support.⁸ A suture's failure is likely to be secondary to biodegradation and mechanical stresses placed on it from eye rubbing and blinking. Typically, the suture of choice has been 10–0 polypropylene, but some surgeons recently have advocated the use of 9–0 polypropylene or 9–0 Gore-Tex (W.L. Gore & Associates, Newark, DE).² Suture erosion is also a serious complication as it creates a potential communication between intra- and extraocular environments that could lead to endophthalmitis. When tied on the conjunctiva alone, sutures can erode in up to 24% of eyes; the incidence is only 15% of cases when scleral flaps are utilized.¹ The rate of endophthalmitis following suture erosion has not been reported.

IRIS-FIXATED PCIOL

The sole requirement for the iris fixation of a PCIOL is sufficient iris tissue to support the lens (Figure 1). Most concerns regarding iris fixation have focused on the potentially deleterious consequences of IOL-iris interaction—namely, CME, prolonged iritis, and pigment dispersion. Surgeons have also questioned the impact of an iris-fixated PCIOL on the physiologic function of the iris as well as the long-term viability of the suture. In a 2003 ophthalmic technology assessment of the AAO, Wagoner et al⁵ concluded that the literature, at that time, equally supported the safe and effective use of open-loop ACIOLs, iris-sutured PCIOLs, and sclerally sutured PCIOLs. However, the majority of the literature evaluating the iris fixation of a PCIOL was in the context of an open-sky technique with concurrent penetrating keratoplasty. The two studies that evaluated iris fixation in the context of cataract surgery with a rigid lens inserted through a limbal incision.

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More recently, Condon et al⁹ reported on a retrospective series of 46 consecutive patients undergoing primary implantation of a foldable acrylic lens in the absence of zonular support. IOL powers were calculated for in-the-bag placement, and the lenses were delivered through 3.5-mm incisions. The IOL was folded in a “moustache” configuration and unfolded in the anterior chamber to achieve iris capture of the IOL. Each haptic was then fixated to the peripheral iris using a 10–0 polypropylene suture (PC-7 [Alcon Laboratories, Inc., Fort Worth, TX] or CIF-4 [Ethicon Inc., Somerville, NJ]) passed through a paracentesis and then tied using a modified Siepser sliding knot.

There was a significant improvement in BCVA and reduction in refractive error, thereby supporting the IOL power calculations. More importantly, the aforementioned concerns about the iris fixation of PCIOLs did not manifest during a mean follow-up period of 18.6 months. Specifically, three patients had prolonged iritis that resolved after appropriate steroid therapy. Three other patients exhibited pigment dispersion, but only one had an elevated IOP. Also, only two patients had CME, but the pathology was present prior to surgery. There were two IOL dislocations; one of these was secondary to hap-

tic-optic disinsertion, and the second was thought to be the result of a loose suture.

The investigators⁹ postulated that, compared with scleral fixation, there was a smaller chance of suture breakage with iris fixation; the mechanical stresses placed on the suture from the movement of the iris are significantly less than those placed on the sclera by eyelid rubbing and lid movement. Furthermore, the posterior angulation of the haptics decreases the contact of the peripheral iris with the distal ends of the haptics, thus minimizing pigment dispersion. Finally, the smaller incisions potentially confer a lower risk of postoperative endophthalmitis.

BOTTOM LINE

A review of the literature suggests ACIOLs, iris-fixed PCIOLs, or sclerally fixated PCIOLs are safe and effective options in the absence of capsular support, as proposed by Wagoner et al.⁵ In many scenarios, individual surgeons' comfort in performing various procedures and specific circumstances may dictate the approach used. In the presence of significant anterior segment anomalies, including a gross absence or instability of the iris, scleral fixation effectively would be the only option. In an older patient with no history of glaucoma who had a normal anterior segment with a healthy endothelium, an ACIOL might be best. Iris fixation may be preferred in all other patients, particularly younger ones in whom the complications may arise with an ACIOL or suture breakage and endophthalmitis in the context of a scleral-fixed PCIOL. ■

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