Sulcus placement of single-piece acrylic intraocular lenses

The right tool for the job.
– Norm Abram, *New Yankee Workshop*
Tim Allen, *Home Improvement*

Single-piece acrylic (SPA) intraocular lenses (IOLs) have proven to be excellent posterior chamber IOLs (PC IOLs) for placement in the lens capsular bag. However, surgical complications such as posterior capsule tear or rupture may preclude placement of an IOL in the capsular bag. When capsular bag fixation is not possible, placement of a SPA IOL in the ciliary sulcus is problematic. This raises the larger issue of which IOLs are appropriate for ciliary sulcus fixation.

Several case reports describe complications of SPA IOLs that have been placed in the ciliary sulcus; the complications include iris chafing with pigment dispersion, the uveitis–glaucoma–hyphema (UGH) syndrome, and recurrent vitreous hemorrhage.[1–4] The issue of SPA IOLs placed in the sulcus was raised during the Spotlight on Cataract Complications Symposium at the 2008 American Academy of Ophthalmology annual meeting. In an audience survey, more than 40% of the respondents said a SPA IOL could be placed in the sulcus if capsule support was adequate.

These findings prompted members of the American Society of Cataract and Refractive Surgery (ASCRS) Cataract Clinical Committee to compile their patients who had complications related to SPA IOL implantation in the ciliary sulcus. The results were incorporated into an extensive report about the complications of sulcus placement of SPA IOLs that appears in this issue (pages 1445–1458). The 6 members of the Cataract Clinical Committee contributed 30 patients to the report. In 29 patients, a single-piece AcrySof IOL (Alcon, Inc.) had been placed in the ciliary sulcus; approximately two-thirds of the cases showed signs of posterior capsule rupture at the time of the surgery. The most common complication noted was pigment dispersion with associated IOL transillumination defects. In addition, elevated intraocular pressure (IOP) and symptoms caused by the IOL edge, secondary to decentration of the IOL, were noted in many patients. Other findings such as intraocular hemorrhage and cystoid macular edema were seen much less frequently. Surgical intervention was necessary in 28 of the 30 eyes, with IOL repositioning or amputation of the offending haptic performed in 2 eyes. An IOL exchange was performed in 25 eyes; a concomitant anterior vitrectomy was performed in half the eyes.

Also in this issue (pages 1459–1463), Kohnen and Kook present 2 cases of pigment dispersion syndrome associated with sulcus implantation of an SPA IOL. Both patients were noted to have marked pigment dispersion on the iris and the trabecular meshwork with an associated elevation in IOP. In both cases, the IOL was secondarily repositioned in the capsular bag, with subsequent regression of the pigment dispersion and return of the IOP to normal limits.

Sulcus-fixation of SPA IOLs is problematic for several reasons. First, it is important to note that the package insert for the AcrySof IOL specifically states that the IOL is designed for implantation in the capsular bag. One problem associated with sulcus fixation of these IOLs is that the single-piece haptics are relatively thick and bulky, which allows contact with the posterior iris surface when the IOLs are placed in the ciliary sulcus. In addition, the optic edges are relatively square and rough, which can lead to chafing if the edge comes in contact with the posterior iris surface. These IOLs are planar. Because the haptics are not angulated posteriorly, the optic does not vault posteriorly from the iris. Another potential problem is that hydrophobic acrylic IOLs have a tacky finish rather than a smooth, slippery finish. When these IOLs are placed in the capsular bag, the sharp posterior edge of the optic and the roughened surface may diminish potential posterior capsule opacification from lens epithelial cell migration. However, when the IOLs are placed in the sulcus, the relatively sharp optic edges and the thick haptics can chafe the posterior iris pigment. This can result in the pigment dispersion syndrome, which is associated with transillumination defects in the iris and increased pigmentation on the anterior surface of the iris as well as on the trabecular meshwork and the corneal endothelial surface. Evaluation of explanted SPA IOLs reveals iris pigment granules on the anterior surface of the IOLs. The contact between the IOL and the posterior iris may also lead to breakdown of the blood–aqueous barrier with chronic inflammation as well as recurrent microhyphemas, leading to the UGH syndrome. Finally, the overall diameter from haptic to haptic of these SPA IOLs is 13.0 mm so they may be too short when placed in the ciliary sulcus. This could lead to IOL decentration, causing symptoms related to the edge of the optic and the pupillary space; the decentration may also

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accentuate the findings of scraping and pigment dispersion.

Another major issue that has been raised is which IOL is appropriate for placement in the ciliary sulcus if an SPA IOL is not. Placement of any PC IOL in the ciliary sulcus has the potential to cause complications such as pigment dispersion. However, a 3-piece PC IOL with posterior angulation of the haptics will move the optic away from the posterior pigment epithelium of the iris. In addition, a PC IOL with a relatively thin optic edge as well as small, round haptics will diminish potential problems when placed in the ciliary sulcus. If the anterior capsulorhexis is intact, the optic may be placed in the capsular bag using the optic capture technique, with the haptics in the ciliary sulcus to prevent posterior dislocation of the IOL. Placement of the optic behind an intact anterior capsulorhexis will sequester the IOL optic edge from the posterior surface of the iris.

If the PC IOL cannot be centered using optic capture with a capsulorhexis, the overall diameter of the IOL should be large enough to avoid subluxation in the ciliary sulcus. As most modern foldable IOLs are sized for placement in the capsular bag (13.0 mm or less in overall diameter), they may be too short for ciliary sulcus placement, especially in large eyes. Therefore, a 3-piece PC IOL for placement in the ciliary sulcus should have an overall diameter of at least 13.5 mm. In addition, the optic of the PC IOL should be at least 6.0 mm in diameter. Finally, the optic should be smooth and have relatively round edges.

The ASCRS Cataract Clinical Committee survey found that a silicone PC IOL manufactured by Staar Surgical Co. (AQ2010V) was the most commonly selected IOL for replacement of a sulcus-fixated IOL. This IOL has a relatively long (13.5 mm) overall diameter, as well as a relatively large (6.3 mm) optic diameter. In addition, it has a rounded anterior edge and a 10-degree haptic angulation. The optic is made of silicone, although it is unclear whether there are advantages to silicone material when placed in the ciliary sulcus.

The final issue to be addressed is ciliary sulcus fixation of new types of IOLs that are becoming available for use in ophthalmic surgery. This includes IOLs that have a negative asphericity. It has been noted that these IOLs may have decreased efficacy when they are tilted or decentered, which can occur more frequently in ciliary sulcus fixation. Other new IOL technologies such as multifocal, accommodating, or toric IOLs in the setting of inadequate capsule fixation should be addressed. These types of IOLs are often designed exclusively for capsular bag fixation and should not be placed in the ciliary sulcus. In addition, toric-designed SPA IOLs or plate-haptic silicone IOLs require capsular bag fixation and should not be placed in the ciliary sulcus. Three-piece multifocal IOLs that have adequate fixation secondary to optic capture through an intact continuous curvilinear capsulorhexis may be considered for placement in the sulcus with proper adjustments to the IOL power. New IOL designs that are made of hydrophilic acrylic materials are being evaluated for possible placement in the ciliary sulcus.

It is imperative that surgeons are aware of the potential problems that may be associated with ciliary sulcus fixation of IOLs that are designed primarily for capsular bag implantation. This is especially important for SPA IOLs as it has been well documented that problems can arise when SPA IOLs are placed in the ciliary sulcus. Hospitals and surgical centers should have IOLs designed for placement in the ciliary sulcus as a backup for cases in which complications such as posterior capsule rupture preclude placement of an IOL in the capsular bag. It is important that manufacturers continue to provide appropriate IOLs for placement in the ciliary sulcus when necessary following cataract surgery.

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