

SURGEON'S CORNER

Capsule Membrane Suture Fixation of Decentered Sulcus Intraocular Lenses

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Different surgical methods are used to fixate the subluxated sulcus intraocular lens (IOL) in the absence of in-bag fixation, ranging from iris and scleral suturing to optic capture of the IOL. A new technique, which we have termed *capsule membrane suture fixation*, provides an additional method for securing a subluxated or decentered sulcus-based IOL to the remnant capsule or a capsular membrane. This method can also be used in secondary surgery for fixation, repositioning, or removal and replacement of IOLs. In this technique, the IOL haptics are sutured to the fibrotic elements of the capsular membrane to center and secure the IOL to the capsular membrane and prevent complications associated with uveal touch.

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The desired outcome of intraocular lens (IOL) implantation is a well-centered and stable lens that enhances vision while avoiding corneal and uveal touch.¹ In the absence of in-bag fixation, this outcome can be achieved with optic capture by an anterior, posterior, or combined anterior and posterior continuous curvilinear capsulorrhexis. These methods have been previously described in the literature.¹ We describe an additional method to secure a sulcus-based IOL to the remnant capsule or a capsular membrane. This surgical technique, which we termed *capsule membrane suture (CMS) fixation*, involves suturing the IOL haptics to the remnant capsule to achieve capsule membrane fixation of the IOL. It extends the advantages of capsular IOL fixation when otherwise in-bag fixation is compromised and membrane optic capture is impossible.

(Marcaine; AstraZeneca, Wilmington, Delaware) drops were instilled in the eye. Any posterior displacement of the IOL, indicative of zonular laxity, was noted. The white-to-white corneal diameter was measured using calipers. Seven limbal paracenteses were made at the 1-, 3-, 4:30-, 6-, 7:30-, 9-, and 11-o'clock positions using a Grieshaber blade (Alcon Laboratories, Inc, Fort Worth, Texas).

Intracameral anesthesia was obtained with approximately 0.5 mL of preservative-free lidocaine, 1%, at which point the IOL was noted to move (Figure, B). Five Grieshaber iris hooks were placed through the paracenteses sites to engage the edge of the iris and fully expand the pupil in a pentagonal configuration (Figure, C). A 3-mm clear corneal incision was fashioned inferotemporally at the 5-o'clock position using a diamond keratome blade. Using a Sinsky hook, the decentered sulcus IOL was centered on the pupil over the capsule membrane. A viscoelastic product (Healon5; Abbott Medical Optics, Santa Ana, California) was instilled into the anterior chamber, and Grieshaber scissors were used to cut the posterior synechia superotemporally. A 10-0 Prolene suture (Ethilon 7889; Ethicon, Inc, Somerville, New Jersey) on a taper-cut, 13-mm needle (Ethilon CIF-4; Ethicon, Inc) was passed

SURGICAL TECHNIQUES

After preparation and draping were performed in the usual, sterile manner (Figure, A), proparacaine hydrochloride and then bupivacaine hydrochloride

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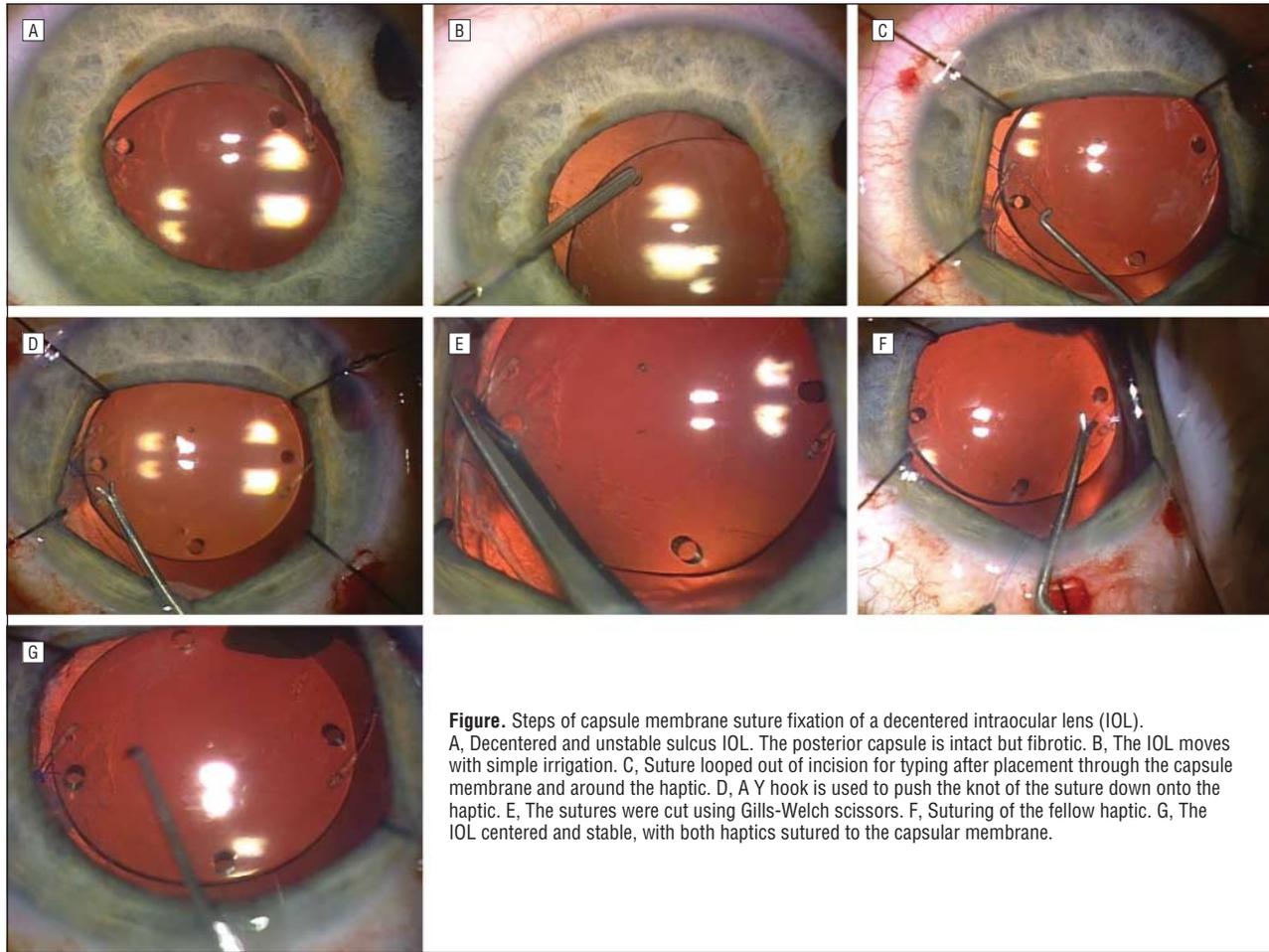


Figure. Steps of capsule membrane suture fixation of a decentered intraocular lens (IOL). A, Decentered and unstable sulcus IOL. The posterior capsule is intact but fibrotic. B, The IOL moves with simple irrigation. C, Suture looped out of incision for tying after placement through the capsule membrane and around the haptic. D, A Y hook is used to push the knot of the suture down onto the haptic. E, The sutures were cut using Gills-Welch scissors. F, Suturing of the fellow haptic. G, The IOL centered and stable, with both haptics sutured to the capsular membrane.

through the paracentesis at the 3-o'clock position, the capsular membrane posterior to the inferonasal haptic, and then finally out at the paracentesis at the 7:30-o'clock position using a 26-gauge cannula to guide it. The needle was cut and removed from the 10-0 Prolene suture. Both ends of the suture were drawn out through the main incision using a cyclodialysis spatula and a Sinsky hook, and a tie was formed outside of the incision.

Using a Y hook, the first half hitch of the tie was slid carefully until it was snug against the capsular membrane (Figure, D). Care was taken to exert the least amount of tangential traction when tying the sutures to avoid tearing the capsular membrane. Three additional ties were applied using the same technique to secure the knot. The knot, in this case, was not tied using the Siepser technique² because the IOL haptics could be sutured onto the capsular membrane using the previously placed clear corneal incision, without the

need for a new paracentesis incision. Healon5 was instilled as necessary to maintain the anterior chamber. The suture tails were cut using Gills-Welch scissors (Figure, E). The suture, thus, effectively tied the haptic of the IOL to the capsular membrane. The same technique was used to secure the superotemporal haptic to the capsular membrane (Figure, F). Stable fixation of the IOL to the capsular membrane was confirmed by gently tapping the lens with a Sinsky hook (Figure, G).

At the end of the case, Healon5 was replaced with balanced salt solution, and preservative-free vancomycin (1 mg in 0.1 mL of balanced salt solution) was instilled behind the lens. After stromal hydration, the wounds were watertight, requiring no sutures. Drops of apraclonidine hydrochloride (Iopidine, 0.5%; Alcon Laboratories, Inc) and tobramycin and dexamethasone (TobraDex, 0.3%; Alcon Laboratories, Inc) were given, and the eye was covered with a clear eye shield. The pro-

cedure was well tolerated, and there were no intraoperative complications. This technique was used in eye 1 (**Table 1**). A similar technique was used for the remaining 2 eyes. Key steps of the procedure are shown in the Figure and are also available on video.³

RESULTS

Between September 1, 2006, and November 30, 2006, CMS fixation was successfully applied to 3 eyes of 2 patients where membrane optic capture was impossible. Informed consent for participation was obtained from both patients. Clinical data are summarized in Table 1, and preoperative data are summarized in **Table 2**. All the eyes had comprehensive preoperative and postoperative assessments, which included testing of uncorrected and best-corrected distance visual acuity, manifest refraction by autorefractometry (model RK-F1; Canon USA,

Table 1. Clinical Data for the 3 Study Eyes

Eye No./ Sex/Age, y	Eye	Ocular History	Chief Concern
1/M/60	Left	Traumatic ECCE at age 34 y Secondary sulcus IOL at age 36 y	Monocular diplopia
2/M/66	Right	Pediatric ECCE without IOL at age 7 y	Contact lens intolerance (aphakic)
3/M/66	Left	Pediatric ECCE without IOL at age 7 y Secondary sulcus IOL at age 49 y Scleral buckle for macula-on RRD at age 50 y	Monocular diplopia

Abbreviations: ECCE, extracapsular cataract extraction; IOL, intraocular lens; RRD, rhegmatogenous retinal detachment.

Table 2. Preoperative Findings

Eye No.	AC Reaction	IOL Position	Pseudophacodonesis	Other Findings
1	Trace cells	IOL subluxated and displaced inferiorly	Yes	Corneal endothelial pigment, peripheral inferior iris TIDs, and superior surgical peripheral iridectomy
2	No	Aphakic Large central opening of capsule (6 × 8 mm)	Aphakic	Vitreous noted at the inferior pupillary margin and Soemmering ring thickening superotemporally and inferonasally
3	No	IOL subluxated and displaced inferonasally	Yes	Corneal endothelial pigment, corectopia with posterior synechiae, midperipheral iris TIDs, and narrow crescents of fibrotic capsule remnants

Abbreviations: AC, anterior chamber; IOL, intraocular lens; TID, transillumination defect.

Table 3. Preoperative and Postoperative Data

Eye No.	Preoperative			Postoperative				
	UCVA	BCVA	IOP, mm Hg	UCVA	BCVA	IOP, mm Hg	IOL Position	Surgery
1	1.00	0.00	15	0.17	0.00	13	Centered and stable at 24 mo	CMS fixation of decentered IOL
2	2.00 ^a	0.00	15	0.30	0.00	16	Centered and stable at 45 mo	IOL implantation CMS fixation of new IOL
3	0.30	0.10	16	0.17	0.10	15	Centered and stable at 44 mo	CMS fixation of decentered IOL
Mean	1.10	0.03	15.3	0.21	0.03	14.7	NA	NA

Abbreviations: BCVA, best-corrected distance visual acuity; CMS, capsule membrane suture; IOL, intraocular lens; IOP, intraocular pressure; NA, not applicable; UCVA, uncorrected visual acuity.

^aCounting fingers at 2 feet (aphakic).

Inc, Lake Success, New York), detailed slitlamp examination and funduscopy, measurement of IOP by Goldmann applanation, anterior chamber depth and keratometry measurements using an optical path difference scanning system (OPD-Scan II ARK-10000; Nidek, Inc, Fremont, California) and a multi-dimensional diagnostic system (Orb-scan IIz; Bausch & Lomb, Rochester, New York), and ultrasound biomicroscopy (Sonomed, Inc, New Hyde Park, New York). Careful attention was given to the evaluation of zonular support by noting the presence of phacodonesis or iridodonesis preoperatively. In the case of aphakia requiring CMS fixation of a new IOL to the capsular remnant, axial

length measurements were obtained by IOLMaster v5 (Carl Zeiss Meditec, Inc, Dublin, California), and the IOL power was calculated using 4 formulas (Haigis, Holladay II, Hoffer Q, and SRK/T) targeted for plano. The highest IOL power closest to emmetropia was chosen.

All the eyes achieved excellent centration and stability of the IOL at 6 months, and there were no intraoperative or postoperative complications. In all the cases, patients reported subjective improvement in the quality of their vision, and there was no change in the best-corrected distance visual acuity postoperatively. The IOP remained within the reference range postoperatively in all 3 eyes (**Table 3**). The

anterior segment was quiet in all 3 eyes within 1 month of surgery, and there were no signs of uveitis-glaucoma-hyphema syndrome at 6 months.

COMMENT

The integrity of the capsular bag can be unexpectedly compromised at any stage of primary cataract surgery, and it is almost expected to occur in secondary IOL surgery, such as that to reposition subluxated IOLs or to remove and replace in-bag IOLs.⁴⁻⁶ Lack of in-bag fixation may be expected with secondary IOL placement after previous extracapsular cataract extraction in which the patient is left aphakic. This situa-

tion typically occurs after cataract surgery in very young children and, not uncommonly, with lensectomy after penetrating ocular trauma when it is not safe to implant an IOL at the time of the primary surgery. In addition to these cases of severely damaged capsular bags, a continuous curvilinear capsulorhexis that is too large for optic capture poses another challenge for capsular bag fixation of the IOL. These situations lend themselves to the new technique of CMS fixation, and they are discussed in more detail later herein.

If a defective or pitted IOL optic can be removed through the original capsular opening, the lens haptics may be removed from a fused capsular bag by sliding them out of the membrane. If this is impossible because of bends or loops on the haptic, they may be amputated from the optic and left in the membrane. A similar removal technique may be used for an eccentric IOL with only one loop in the bag. Undersized sulcus-based IOLs with neither haptic in the capsular bag may be mobile, leading to uveitis-glaucoma-hyphema syndrome and requiring surgical intervention.^{7,8} In these cases, either capsular membrane optic capture or the new technique described herein of suturing the IOL haptics to the membrane may be used to ensure adequate fixation of the IOL.

Aphakia is seen less frequently now than in the past, but it may manifest in patients who had pediatric cataract surgery without an IOL, trauma, or as a result of a complication during previous cataract surgery.^{9,10} Several options have been discussed in the literature to secure secondary IOLs in this context,¹¹ including anterior chamber IOLs,¹² iris-sutured posterior chamber IOLs,¹³⁻¹⁵ scleral-sutured posterior chamber IOLs,¹⁴⁻¹⁶ and IOLs with haptics tunneled within the sclera.¹⁷ Ideally, if the capsule is well supported by zonules, the IOL should be fixed in the capsule or to the capsular membrane if not within the capsular bag. This type of fixation has the obvious advantage of stability, excellent optic centration, and fewer possible complications compared with other procedures.

The CMS fixation of the haptics to the capsular membrane can also be considered when the capsule membrane opening is too large to allow for optic capture but peripheral capsular membrane remnants are still present. The peripheral fibrotic membrane makes this possible and avoids many of the complications of other techniques. Unlike the anterior chamber IOL, the membrane-sutured lens does not require a normal anterior chamber angle and also avoids the potential of endothelial decompensation and pigment dispersion glaucoma.¹²

Compared with scleral fixation of IOLs, CMS fixation is simpler and easier to perform. The IOL haptics are sutured to the capsule, minimizing decentration and tilt, suture erosion through the sclera, and the risk of intraocular hemorrhage.¹⁸⁻²¹ Fixating the lens to the capsule also prevents the possible adverse effects of a sulcus-placed lenslike iris chafing causing iris transillumination defects, uveitis-glaucoma-hyphema syndrome, or sunset syndrome.^{7,8} Most important, the sutures are safer and simpler to perform because they are entirely intraocular, and they are placed in avascular tissue. This reduces the possibility of infection, erosion, or granuloma formation compared with a scleral-fixated lens.

The importance of adequate zonular support cannot be overemphasized because CMS fixation relies on an intact zonular apparatus. The presence of phacodonesis, iridodonesis, or IOL tilt must be carefully noted preoperatively and at the time of surgery. If capsular/zonular support is compromised, the surgeon must be prepared to consider other options, including IOL exchange with an anterior chamber IOL or an iris or scleral-sutured IOL. Similarly, the possibility of intraoperative cheese wiring of the capsule may persuade the surgeon to abandon CMS fixation in favor of other IOL fixating techniques. Follow-up in this small case series was limited to 6 months, and further studies that evaluate long-term outcomes of this technique should be conducted. These issues should be addressed preoperatively with the pa-

tient as part of the informed consent process.

Although intraoperative cheese wiring of the suture is a possibility, this was not seen in any of the present patients. We believe that should this occur, the area of capsule adjacent to the fibrosis is more likely to tear than the actual fibrosis itself. The least amount of tangential tension should be used in securing and centering the IOL. Similarly, postoperative cheese wiring of the capsule by the 10-0 Prolene suture is a potential risk. Nevertheless, this risk is likely minimal given that postoperative capsular remodeling and fibrosis may serve to keep the attachment firm and secure. In addition, the fact that the IOL is directly attached to the capsular bag and not to adjacent structures, such as the iris or sclera, poses a decreased risk of late IOL subluxation or dislocation due to ocular movement and tissue erosion. This is because in CMS fixation, the zonular apparatus, rather than the suture itself, is chiefly responsible for IOL centration and stability.

In conclusion, this new surgical technique of CMS fixation of IOLs provides an alternative to simple sulcus IOL placement, anterior chamber placement, iris suture fixation, and scleral-sutured or glued sulcus placement. By considering CMS fixation in addition to membrane optic capture fixation, the surgeon extends the advantages of capsular fixation of the IOL to not only primary but also secondary surgical scenarios.

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