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New capsular tension segment with 2-point fixation for zonular weakness

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Abstract

We describe clinical applications and surgical techniques for a new type of capsular tension segment (CTS) for use during cataract surgery. The Ambati CTS is distinguished from other CTS devices by having 2 eyelets close to each other, which allows it to distribute tension to 2 points, avoiding too much stress at a single point on the anterior capsulotomy, which prevents peaking of the capsulorhexis, and potentially reducing the risk for anterior capsule tear. Two of these CTS devices could possibly be used to provide 4-point fixation of a capsular bag in eyes with near-complete zonular instability. We describe 4 cases and 2 surgical techniques for implanting the new CTS, 1 technique in an adult patient with zonular weakness secondary to trauma and the other in 3 children with subluxated lenses due to Marfan syndrome.

Capsular tension devices are used to effectively manage zonular weakness in cataract surgery.^{1,2} These implants include temporary fixation devices such as Microsurgical Technology and MacKool capsular hooks and long-term fixation devices such as the Cionni, Malyugin-Cionni, and Henderson capsular tension rings (CTRs) and the Ahmed capsular tension segment (CTS).^{3–5} The Cionni modified CTR and Ahmed CTS feature an anteriorly positioned eyelet, which allows scleral suture fixation to assist in maintaining capsular bag integrity.⁶ Although this feature has the advantage of stabilizing the lens capsule and reducing the risk for future intraocular lens (IOL) dislocation, a single point of fixation can lead to peaking and stress on the anterior and/or posterior capsule.

We describe the Ambati CTS (Morcher Ophthalmics), a new poly(methyl methacrylate) CTS that features 2 eyelets instead of 1 (Figure 1). Using this CTS in cases of zonular insufficiency and subluxated or dislocated lenses has several advantages. We describe surgical techniques for placing the CTS in adults and children.

SURGICAL TECHNIQUES

Adult with Traumatic Cataract

A 62-year-old man presented with complaints of progressively worsening and painless vision loss in his left eye due to the development of significant cataract. The history in that

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eye was significant for penetrating anterior segment trauma from glass during a motor vehicle accident when the patient was 33 years old. The foreign-body injury resulted in a scleral laceration, which was subsequently repaired, with residual loss of iris tissue and zonular fibers at 10 o'clock; the anterior and posterior capsules remained intact.

At the initial consultation, the corrected distance visual acuity (CDVA) in the left eye was 20/600 and did not improve with refraction. The examination of the eye showed evidence of the remotely repaired scleral laceration, significant injury-related zonular loss, and slightly subluxated 4+ nuclear sclerotic and 2+ posterior subcapsular cataracts. There was also a 2+ nuclear sclerotic cataract in the right eye. Both eyes showed signs of dryness, and punctual plugs were placed bilaterally on initial consultation.

Conventional phacoemulsification in the left eye was considered high risk, as the lack of zonular support from the 10 o'clock position to the 11 o'clock position posed a significant risk for poor centration and predictability. Phacoemulsification assisted by the new CTS was therefore selected.

Under general anesthesia, a partial-thickness blade was used to create limbal relaxing incisions for 30 degrees at the superior limbus and 50 degrees at the inferior limbus. The blade then created a 4.0 mm incision inferotemporally. A crescent blade was used to enter the incision and create a partial-thickness scleral Hoffman pocket at the superonasal limbus. A stab blade was used to create paracenteses at the limbus superotemporally, inferotemporally, and inferonasally.

After the anterior capsule was stained with trypan blue and the anterior chamber filled with an ophthalmic viscosurgical device (OVD), a cystotome and a Utrata forceps were used to create a continuous curvilinear capsulorhexis with the assistance of a Verus capsulorhexis-guide device (Mile High Ophthalmics, LLC). The capsulorhexis was intentionally displaced slightly temporally so it did not abut the nasal edge of the lens where zonular loss could be seen. After the capsulorhexis was completed, an OVD on a cannula was used to viscodissect the lens nucleus surrounding the lens capsule. Following this, the lens rotated freely. A CTR was then inserted through 1 of the paracenteses and dialed into position so the opening of the ring faced temporally, with maximum support in the area of the zonular dialysis.

The lens nucleus was removed using the phacoemulsification handpiece and a vertical chopper in a vertical chop fashion. After complete removal of the lens nucleus, bimanual irrigation/aspiration (I/A) was used through 2 paracenteses to remove all cortical material from the lens capsule. After removal of all cortical material, a posterior capsule plaque, which was not central in the visual axis, was noted along with a few pieces of cortical material behind the posterior capsule, which likely migrated through the area of zonular loss. Because of the risk, a decision was made to avoid entering the vitreous or pursuing the small fragments.

After cortical removal, the CTS was looped with an 8-0 polytetrafluoroethylene suture (Gore-Tex, W.L. Gore & Associates, Inc.) (off-label) on a double-armed needle and then inserted through the main temporal incision. This was moved to abut the lens capsule in the area of zonular loss. Both ends of the suture were then passed through the sclera, exiting the

eye 2.0 mm posterior to the limbus within the area of the previously formed Hoffman pocket. A push-pull device was then used to retrieve the suture through the pocket. The suture ends were tied, creating a horizontal mattress suture, which secured the CTS to the sclera and was buried in the pocket. The lens capsule was noted to be more symmetrical after this step (Video 1, available at <http://jcrcjournal.org>).

The IOL was inserted through the temporal incision. The leading haptic was inserted into the ciliary sulcus, and the optic and trailing haptic were also inserted. The trailing haptic was tucked into the ciliary sulcus, and the optic was captured by the anterior lens capsulorhexis; the haptics were rotated to a position 90 degrees from the area of zonular weakness. The IOL was noted to be in a good position and stable.

After the OVD was injected into the eye, a micrograsper was used to pull the iris into position and acetylcholine chloride (Miochol) was injected to constrict the pupil. A large iris defect of roughly 3 to 4 clock hours was noted nasally. A 10-0 polypropylene suture (Prolene) was passed through the superior and inferior iris defect margins and out the limbus at both ends. The sutures were then retrieved through the main temporal incision using the push-pull device and a tying forceps. Using the McCannel technique, slipknots were tied externally and slid into position to perform an iris cerclage and bring the peripheral superior and inferior iris together. Three throws were made, and the iris was noted to come together, forming a reasonably round pupil. Bimanual I/A was used to remove all the OVD from the anterior chamber. Antibiotics were injected into the subconjunctival space. The wounds were hydrated and found to be watertight.

At the 1-month postoperative follow-up, the CDVA in the left eye had improved to 20/20 (Figure 2). There were no complications.

Children with Marfan Syndrome and Subluxated Lenses

A 2-year-old, a 4-year-old, and a 10-year-old child, each with Marfan syndrome, ectopia lentis, and otherwise normal examinations under anesthesia had phacoemulsification and IOL with CTS implantation in 1 eye each.

In each eye, a capsulorhexis was performed under general anesthesia with use of capsular devices from Microsurgical Technology. After the lens material was evacuated, a peritomy and light cautery with a 23-gauge tip were performed. Two marks were made 2.0 mm posterior to the surgical limbus and 4.0 mm apart, and a 23-gauge (or 25-gauge) trocar (Alcon Laboratories, Inc.) was used to enter the eye. An 8-0 polytetrafluoroethylene suture (off-label) was preplaced through the eyelets of the CTS. A 25-gauge snare (Microsurgical Technology) was used to grasp and externalize the suture. The CTS was placed in the capsule after cohesive OVD was used to expand the capsule. The suture was tied loosely. An IOL (SA60AT) was injected into the capsular bag. The suture was loosened and the bag complex positioned for centration by maneuvering the tension before securing the knot. The corneal incisions were closed with 10-0 polyglactin (Vicryl) absorbable sutures (Video 2, available at <http://jcrcjournal.org>).

At the 1-month postoperative follow-up, the CDVA was unchanged from the preoperative records, which reported fix-and-follow visual acuity, in the 2 year old and the 4 year old and had improved to 20/25 in the 10 year old. There were no complications.

DISCUSSION

We have described adult and pediatric cases using the Ambati CTS, which provides 2-point fixation for zonular weakness. The CTS has several advantages in cases with subluxated or dislocated lenses and zonular insufficiency. It is easy to use, with an 8-0 polytetrafluoroethylene suture (off-label) looped through the eyelets outside the eye prior to implantation and docking needles placed through a Hoffman pocket to retrieve the suture. In the adult patient with traumatic cataract, this resulted in a stable horizontal mattress suture that was buried. In the cases of children with subluxated or dislocated lenses, it enabled manipulation of each individual 8-0 polytetrafluoroethylene suture through the sclerotomies, allowing the surgeon to rotate the device into its exact position. Placing the sclerotomies 2.0 mm posterior to the surgical limbus optimizes capsule fixation. It is critically important to leave sufficient anterior capsular rim to enable positioning and centration of the IOL and the CTS.

This CTS is distinguished from other capsular tension devices by having 2 eyelets close to each other, allowing the single implant to distribute tension to 2 points. This enables 2-point scleral fixation, which may provide more durable capsular stability and greater reduction of risk for anterior capsule tear than other capsular tension implants. The new CTS avoids too much stress at 1 point on the anterior capsulotomy, preventing peaking of the capsulorhexis, which may reduce the risk for anterior capsule tear. Two-point fixation with preplacement of the suture may also prevent intraocular tilting of the device. Finally, the CTS may offer advantages in scenarios of near-complete zonular instability, in which 2 of the devices could be used to provide 4-point fixation of the capsular bag.

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WHAT WAS KNOWN

- Capsular tension segments are used to effectively manage zonular weakness in cataract surgery.
- Existing CTS devices may provide only a single point of scleral fixation, which can lead to peaking of the anterior and/or posterior capsule and stress on the capsules.

WHAT THIS PAPER ADDS

- Having 2 eyelets close to each other means the new CTS can distribute tension to 2 points in scleral fixation, which may provide more durable capsular stability and a greater reduction in the risk for anterior capsule tear than other capsular tension implants.
- Two-point fixation with preplacement of the suture technique may also prevent intraocular tilting of the device.

Figure 1.
Schematic of the new CTS. (*Figure courtesy of Olaf Morcher and Balamurali Ambati.*)

Figure 2.
One-month postoperative appearance of eye in the adult patient with traumatic cataract. The IOL, CTS, and iris cerclage are intact.