Glued capsular hook: Technique for fibrin glue–assisted sutureless transscleral fixation of the capsular bag in subluxated cataracts and intraocular lenses

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We describe a technique that uses a capsular hook to obtain sutureless fibrin glue–assisted transscleral fixation of the capsular bag. The hook passes through a sclerotomy created under a scleral flap and engages the capsulorhexis rim, providing scleral fixation intraoperatively and postoperatively. A standard capsular tension ring expands the capsular fornix. The haptic of the hook is tucked into a scleral tunnel for postoperative fixation. The scleral flap is closed with fibrin glue. The glued capsular hook is used for subluxated cataracts and IOLs. It anchors the capsular bag to the sclera, providing vertical and horizontal stability, and stabilizes the bag intraoperatively and postoperatively. The technique was used in 7 patients, who were followed for more than 4 months.

Financial Disclosure: Dr. Jacob has a patent pending for the glued capsular hook models. No other author has a financial or proprietary interest in any material or method mentioned.

J Cataract Refract Surg 2014; 40:1958–1965 © 2014 ASCRS and ESCRS

Online Video

The management of subluxated cataracts and intraocular lenses (IOLs) depends on the degree of zonulodialysis.[1,2] For subluxations up to 3 to 4 clock hours, a capsular tension ring (CTR) is often sufficient, but for more extensive subluxations, the capsular bag must be anchored to the scleral wall to avoid continued decentration and subluxation. Traditionally, the anchoring has been achieved using sutures to fixate the bag to the sclera. Suture fixation, however, has disadvantages, including the need for surgical skill and expertise; increased surgical time; need to pass long, thin, and difficult to maneuver needles; and the possibility of long-term suture-related complications. We describe a technique that uses a glued capsular hook (Figure 1) to achieve sutureless fibrin glue–assisted transscleral fixation of the capsular bag. The technique stabilizes the bag intraoperatively as well as postoperatively. This technique was described by one of us (SJ).

SURGICAL TECHNIQUE

The technique can be used in patients with subluxated cataracts, colobomatous lenses, or subluxated IOLs (Figure 2, *A*). Exclusion criteria include patients with autoimmune or other rheumatological diseases.

The side of the eye with missing or weak zonular fibers is determined, and a partial-thickness scleral flap centered on the affected zone is made (Figure 2, *B*). The following steps are those used for phacoemulsification in subluxated cataracts. An anterior vitrectomy is done in case vitreous is prolapsing into the anterior chamber in the area of dialysis. The capsulorhexis is created using the surgeon's preferred technique, avoiding excessive traction on the zonular fibers and

Submitted: April 23, 2014.
Final revision submitted: June 3, 2014.
Accepted: June 8, 2014.

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http://dx.doi.org/10.1016/j.jcrs.2014.10.009
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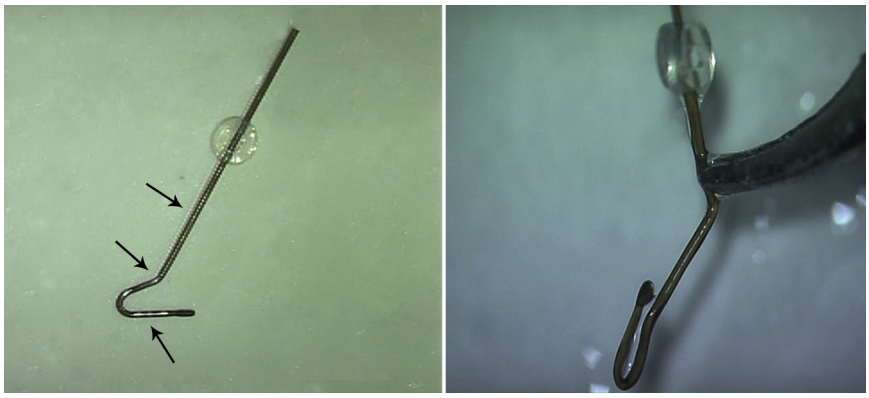

Figure 1. *Left*: Before intraocular use, the bend at the junction of the hook and the haptic is straightened out. The haptic is also bent firmly to 90 degrees at mid shaft with a needle holder to allow it to turn into the intrascleral tunnel. The hook element is compressed to obtain a tight fit Arrows show the sites to be bent. *Right*: The intended sites to be bent are held with a forceps for demonstration. The final bent configuration is seen.

using the microrhexis forceps as required. Cortical cleaving hydrodissection and hydrodelineation are then performed gently to loosen the cortex and delineate the nucleus, being careful not to churn up the cortex. A sclerotomy is made under the scleral flap about 1.5 mm from the limbus using a 20-gauge needle (Figure 2, *C*). While piercing the sclera, the needle is pointed vertically down, aimed at the optic nerve to avoid touching the posterior capsule. The haptic of a capsular hook (Capsule Care, Madhu Instruments Pvt Ltd.) is bent 90 degree at mid shaft to obtain a change in direction. Simultaneously, the pre-existing proximal bend on the shaft is straightened and the hook element compressed to achieve a tight fit (Figure 1). It is then inserted into the posterior chamber through the sclerotomy (Figure 2, *C*) in a plane between the iris and the anterior capsule and used to engage the capsulorhexis rim (Figure 2, *D*). A cohesive ophthalmic viscosurgical device (OVD) can be injected under the iris to create space and to push the iris upward at the site of zonulodialysis to facilitate insertion in the right plane. After the capsulorhexis margin is engaged, the capsular bag complex is centered and the silicone stopper is pushed forward on the hook to hold it in place. (Figure 2, *E*). A CTR is then implanted in the capsular bag (Figure 2, *F*). For larger subluxations, additional capsular hooks can be implanted via limbal paracenteses if required (Figure 3, *A* and *B*).

After the bag is stabilized by capsular hooks, phacoemulsification is performed in the usual manner (Figure 3, *C* and *D*) followed by epinucleus and cortex aspiration (Figure 3, *E*). The IOL is then implanted in the bag (Figure 3, *F*). An intrascleral tunnel is made at the edge of the scleral flap parallel to the limbus with a 26-gauge needle. The silicone stopper of the capsular hook is removed carefully while the hook is held firmly at the sclerotomy with a needle holder, avoiding traction on the hook (Figure 4, *A*). Excess haptic length is trimmed, and the haptic is tucked into the scleral tunnel parallel to the limbus (Figure 4, *B*). Limbal capsular hooks are removed. Further centering of the bag is done, if desired, by adjusting the degree of the haptic tuck into the scleral tunnel. This retains the entire capsular bag complex in its centered position. The scleral flap is closed with fibrin glue (Tisseel, Baxter Healthcare Corp.) (Figure 4, *C*). The OVD is then removed from the eye (Figure 4, *D*). The conjunctiva is also closed with fibrin glue (Figure 4, *E* and *F*) (Video 1, available at: http://jcrsjournal.org).

Results

The capsular hook technique was used in 7 eyes (4 left eyes and 3 right eyes) of 7 patients (4 men and 3 women). The mean patient age was 49.57 years ± 15.86 (SD) (range 28 to 70 years). Causes for zonular dialysis were injury (n = 5), intraoperative dialysis (n = 1), and congenital absence of zonular fibers (n = 1). Additional translimbal hooks were used in 2 cases. One transscleral glued capsular hook was used in all cases except 1 with generalized phacodonesis in which 2 diametrically opposite glued capsular hooks were implanted. However, in that case, IOL tilt was seen postoperatively and an additional hook was inserted superiorly. The mean follow-up was 4.07 ± 2.1 months. The mean preoperative and postoperative corrected distance visual acuities were 0.24 ± 0.25 and 0.78 ± 0.18, respectively and the mean preoperative and postoperative IOPs, 17 ± 7.59 mm Hg and 14.86 ± 2.61 mm Hg, respectively. Grade 2 cells and flare were seen in 3 cases that responded well to steroids. No other postoperative complications were encountered. All IOLs were well centered without tilt (Figures 5 and 6).

DISCUSSION

Subluxated cataracts have been a surgical challenge, and numerous devices and techniques to manage them have been described, including the CTR developed by Hara et al.,[3] Nagamoto,[4] and Nagamoto and Bissen-Miyajima,[5] Legler et al.,[A] and various modifications made by Henderson and Kim,[6] Dick,[7] and Nishi et al.[8] For dialysis of greater than 3 to 4 clock hours, a CTR with a fixation

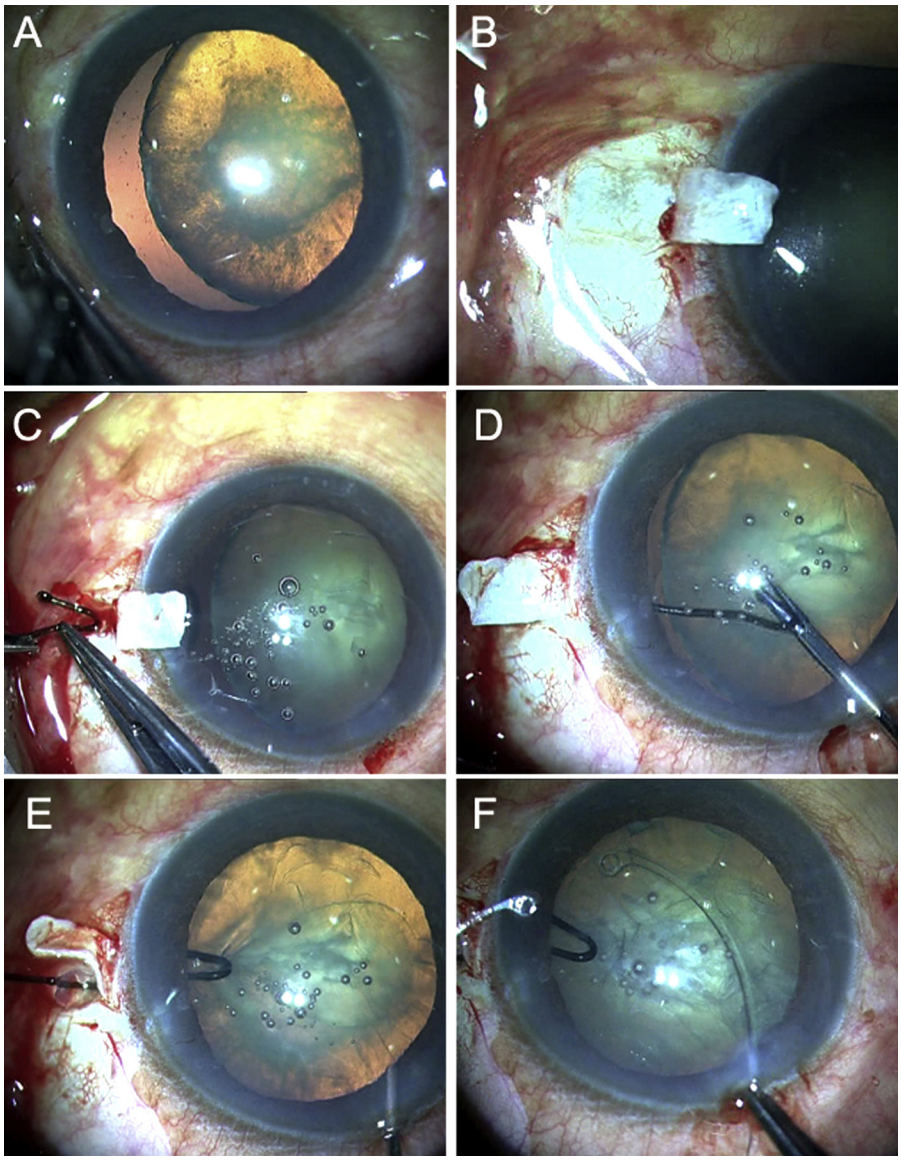

Figure 2. *A*: Posttraumatic subluxated cataract of about 180 degrees is shown. *B*: A partial-thickness scleral flap is centered on the affected zone of zonular dialysis. *C*: The capsulorhexis is created followed by cortical cleaving hydrodissection and hydrodelineation. The capsule hook is then inserted into the posterior chamber through a 20-gauge sclerotomy created under the scleral flap about 1.5 mm from the limbus. The hook emerges between the iris and the anterior capsule. *D*: The capsulorhexis margin is engaged aided by a 23-gauge microforceps. *E*: The capsular bag complex is centered by pulling the hook, and the silicone stopper is pushed forward on the hook to hold it in place. *F*: A CTR is implanted in the capsular bag.

element was developed by Cionni and Osher[9] to allow safe phacoemulsification and in-the-bag IOL implantation. Hasanee and Ahmed[10] and Hasanee et al.[B] capsular tension segments (CTS), Assia et al.[11] anchor, and Yaguchi et al.'s[12] T-shaped capsule stabilization hooks serve a similar purpose, and 1 or more of these can be implanted depending on the degree of subluxation. All these devices are inserted and sutured onto the scleral wall with 9-0 or 10-0 polypropylene (Prolene) for intraoperative and postoperative support and centration of the capsular bag. Many sutures are now also sutured with polytetrafluoroethylene (Gore-Tex) for longevity. In 2011,[13,14] we described fibrin glue–assisted sutureless scleral fixation via the glued endocapsular ring/segment, which has 2 portions, a hemi-ring/segment for fornix expansion and a haptic that is tucked intrasclerally. Lens removal and secondary IOL implantation are also performed for subluxated cataracts.[15,16] We previously described the glued IOL,[17,18] which can also be used for IOL fixation after primary lensectomy/lens extraction.

Microhooks in the form of iris retractors were described by Lee and Bloom[19] and Novák.[20] Capsule stabilization devices or capsule hooks such as the Mackool capsule retractors[21,22] and those described by Nishimura et al.[23] have been used for capsular bag stabilization during cataract surgery to avoid stress to the remaining zonular apparatus during the steps of phacoemulsification. Although these provide vertical stabilization to the bag, they require simultaneous insertion of a CTR or CTS during surgery. The hooks are inserted via paracentesis incisions made at the time of phacoemulsification. After capsule stabilization and centration have been

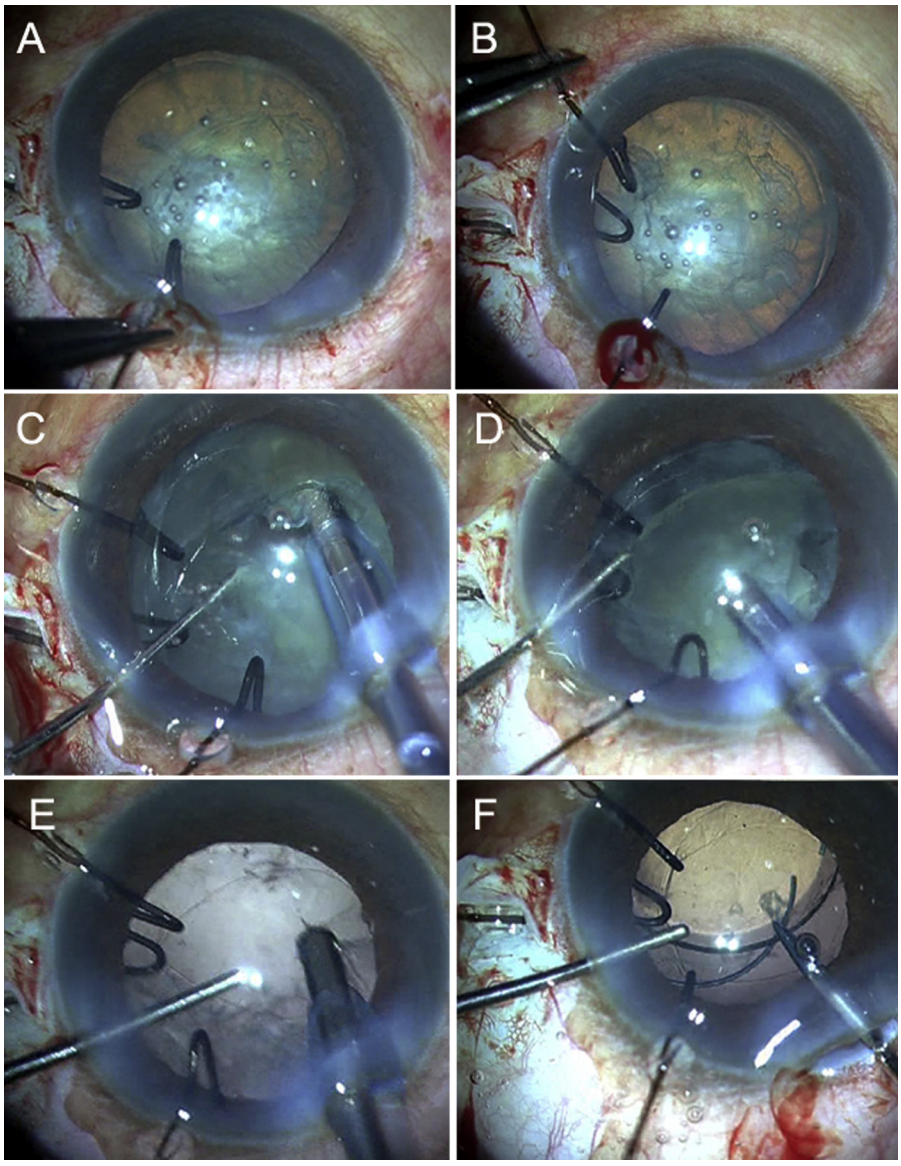

Figure 3. *A*: Additional intraoperative support is obtained by implanting a translimbal capsule hook via a limbal paracentesis. *B*: The bag is further stabilized by a second translimbal capsule hook. *C*: Phacoemulsification continues, and the nucleus is chopped in the bag. *D*: Each chopped quadrant is emulsified in the iris plane. *E*: This is followed by epinucleus and cortex aspiration. *F*: The IOL is implanted in the bag.

achieved by suture fixation of the CTR/CTS, the hooks are explanted.

Our technique inserts the capsule hook through a sclerotomy made under the scleral flap to provide intraoperative as well as postoperative support to the capsular bag. As the transscleral fixation does not provide centrifugal equatorial expansion of the capsular bag in the area of zonulodialysis, we combine it with implantation of a standard CTR. The CTR redistributes capsular forces to the area of intact zonular fibers, expands the fornix, decreases flaccidity of the posterior capsule and the risk for aspiration of the fornix/capsular bag into the phaco tip while also decreasing vitreous prolapse through the area of dialysis. However, the standard CTR does not provide vertical support to the bag and is not sufficient in larger dialyses. The combination of a standard CTR with a glued capsular hook provides both horizontal and vertical stability. As with Gabor and Pavlidis's[24] and Scharioth et al.'s[25] sutureless transscleral IOL fixation and the glued IOL,[17,18,26–28] the haptic tuck anchors the capsular bag transsclerally. A similar technique can also be used for subluxated in-the-bag IOLs.

Unlike the anterior pull of translimbal capsule hooks, the pull of the glued capsular hook is horizontal. Hence, it is important that the structure of the capsule hook be adequately soft and have a rounded tip to prevent peripheral fornix tears. During surgery, decentration of the capsulorhexis should be avoided to leave an adequate anterior capsule rim to the side of subluxation. Openings that are too small or a capsulorhexis extending to the equator should be avoided. In the presence of vitreous prolapse around the

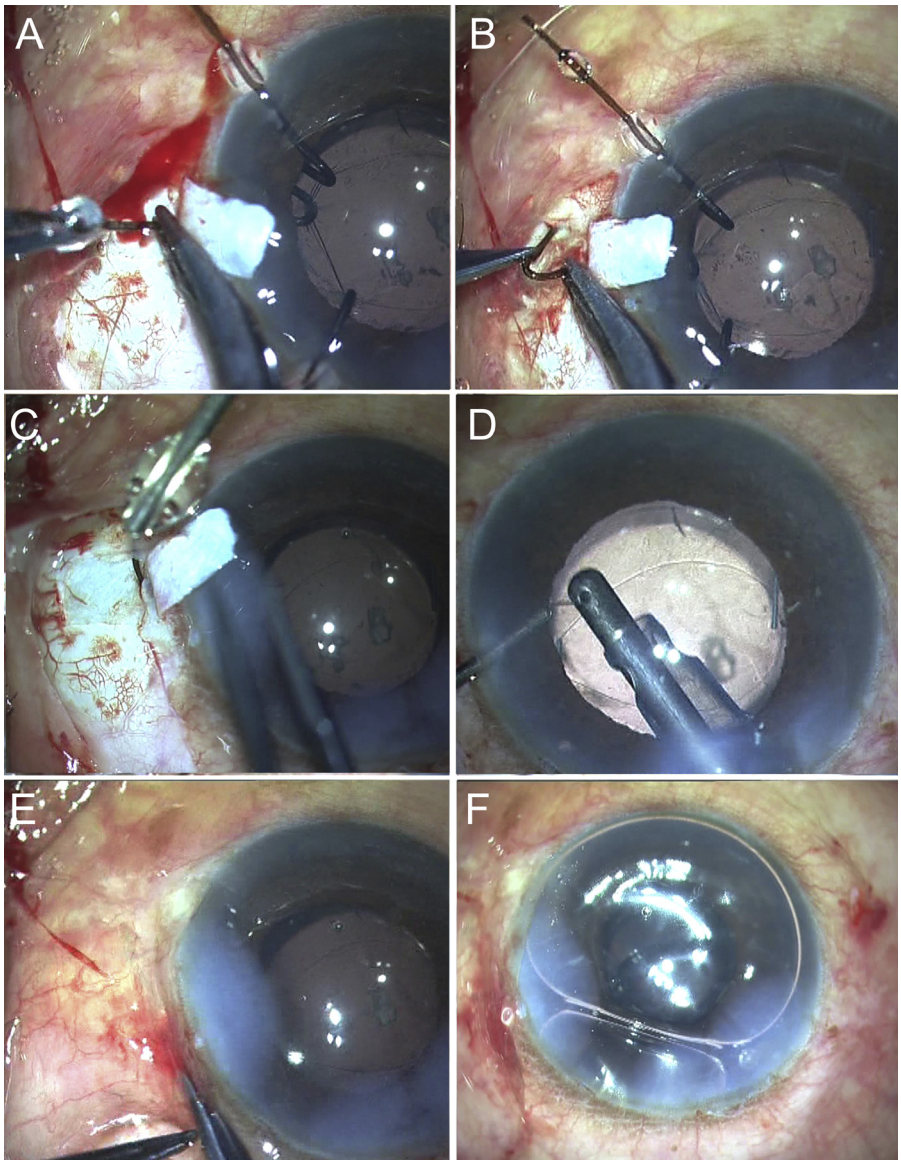

Figure 4. *A*: The silicone stopper of the capsule hook is removed carefully while the hook is held firmly at the sclerotomy. *B*: The excess length of the haptic is trimmed, and the haptic is tucked into a 26-gauge intrascleral tunnel created parallel to the limbus. *C*: The limbal capsule hooks are removed. Centration of the bag is adjusted by adjusting the degree of haptic tuck into the scleral tunnel. The scleral flap is closed with fibrin glue. *D*: The OVD is removed from the eye. *E*: The conjunctiva is closed with fibrin glue. *F*: Clear corneal incisions are hydrated. An air bubble is placed in the anterior chamber.

subluxation, an anterior vitrectomy should be performed at the start of the procedure to prevent traction on vitreous strands. The hook can be easily inserted via the sclerotomy to engage the capsulorhexis rim. The insertion can be facilitated by injection of a cohesive OVD under the iris to push the iris upward at the site of zonulodialysis. Inserting the hook at the appropriate angle allows the hook to emerge at the plane between the iris and the anterior capsule. A vitrector should be used to cut any vitreous that may be entangled on the hook before pushing the hook forward. Alternately, the hook can be inserted via the clear corneal incision by grasping the haptic with a microforceps introduced through the sclerotomy and externalizing it.

Before intraocular use, the haptic must be bent firmly into an arc with a needle holder to enable it to turn into the intrascleral tunnel. The bend at the junction of the hook and the haptic is also straightened (Figure 1, *A* and *B*), and the hook element is compressed to allow good apposition on the capsulorhexis rim. While trimming, turning, and tucking the haptic into the tunnel, the haptic should be held firmly, preferably with a needle holder to avoid transmission of traction to the glued capsular hook or the capsular bag and to prevent disengagement from the capsulorhexis. Transscleral tucking of the haptic is easy and there is no need for complicated, time consuming, and difficult maneuvers that involve passing long needles across the anterior chamber. Surgery is therefore easy and rapid, and overall surgical time is reduced. The degree of centration is adjusted by adjusting the degree of tuck of the haptic. This easy adjustability is unlike the adjustability of a sutured CTR/CTS where

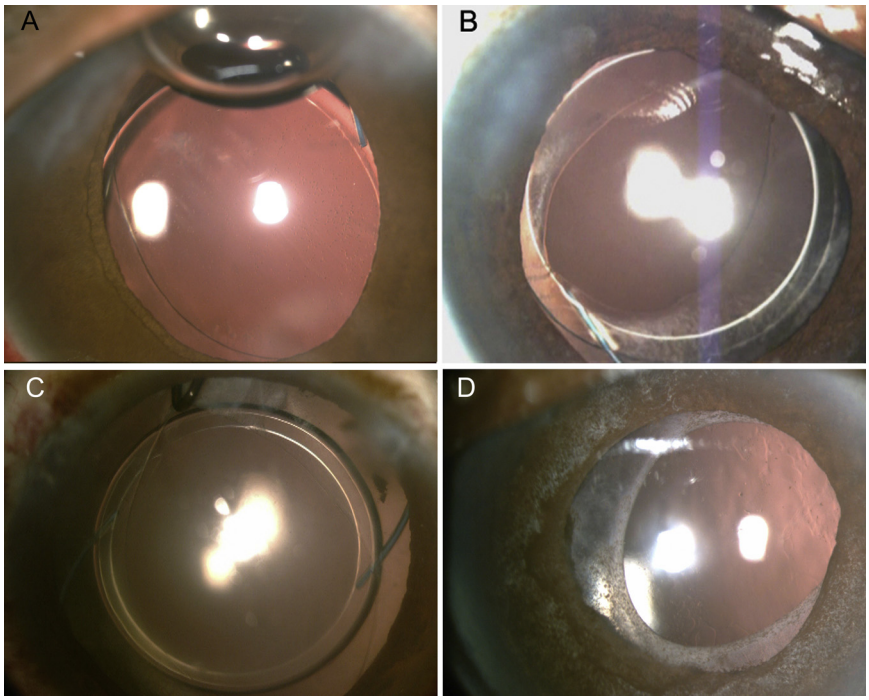

Figure 5. Postoperative views. *A*: First-day postoperative appearance shows a well-centered IOL and a quiet eye. *B*: Seven-week postoperative appearance with glued capsular hook shows a well-centered IOL. Ovalization of the capsulorhexis is seen in all cases toward the direction of the hook. *C*: Six-month postoperative appearance with a glued capsular hook shows a well-centered IOL. The terminal portion of the hook can be seen engaging the capsulorhexis and providing good centration to the IOL. *D*: Six-month postoperative appearance shows a well-centered IOL and ovalized capsulorhexis.

final centration depends on tautness of the suture; adjusting the tautness is complicated, requiring extra time and effort by the surgeon.

Capsular tension rings have been reported to drop into the vitreous intraoperatively and postoperatively,[29–33] and removing them may require pars plana vitrectomy. The glued capsular hook is always secured via the silicone stopper or by intrascleral haptic tuck, and therefore chances of the segment dropping into the vitreous intraoperatively or postoperatively through an area of large zonular defect is less likely. Intrascleral haptic tuck as a method of scleral fixation has been used for sutureless transsclerally fixated IOLs.

In our experience, the glued capsular hook, supplemented by translimbal hooks if necessary, provide good bag stability intraoperatively for required phacoemulsification maneuvers. The glued capsular hook centers the bag by engaging the capsulorhexis and pulling the capsular bag toward the side of subluxation. The capsulorhexis is ovalized toward the direction of pull. As with translimbal capsular hooks, the silicone stopper should not be overtightened, nor should overtucking of the haptic be done to avoid capsulorhexis tear or overpulling and impaction on the zonular fibers on the other side.

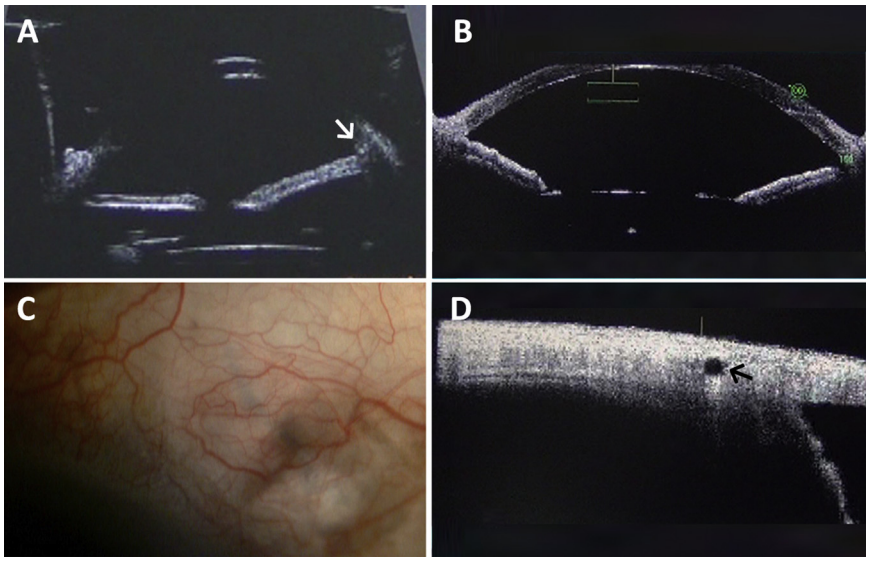

Figure 6. *A*: Ultrasound biomicroscopic image shows a well-centered IOL with no tilt. Posttraumatic anterior synechiae are seen (*white arrow*) *B*: Anterior segment optical coherence tomography (OCT) image shows a well-centered IOL with no tilt. *C*: Scleral flap with tucked haptic is seen. *D*: Anterior segment OCT shows intrascleral tucked haptic (*black arrow*).

With large subluxations, more than 1 glued capsular hook can be implanted. However, as with sutured CTR/CTS, we recommend using this device in nonprogressive conditions such as posttraumatic subluxations, intraoperative zonular dialysis, and congenital loss of zonular support. With progressive pathologies such as Marfan syndrome and pseudoexfoliation, it is possible that over time, with increasing zonular weakness, the glued capsular hook may not continue to provide adequate support in all meridia, leading to late luxation. A lensectomy with a glued IOL may be preferable in such situations.

We use fibrin glue to seal the scleral flap over the haptic. This creates a hermetic seal that prevents egress from or ingress into the eye. Surgical fibrosis develops early under the flap and around the haptic sealing the flap into place to ensure flap adhesion even when fibrin glue has degraded. We have been using glue to seal the scleral flap over the haptic of glued IOLs since 2007 and have found it safe and effective for use in this manner.[17,18,26–28] The commercially available fibrin glue is virus inactivated and is checked for viral antigen and antibodies with polymerase chain reaction; chances of transmission of infection are low. Other techniques for closing the flap such as multiple sutures on the flap may be used along with a provocative Siedel test to check for leaks, although our preference is to use fibrin glue.

It is relatively simple to explant the glued capsular hook during surgery if required. The haptic is released from the scleral tunnel and rotated outward through the sclerotomy after disengaging the capsulorhexis. Alternatively, the haptic can be pulled inward with a microforceps passed through a paracentesis and removed via the phaco incision.

The glued capsular hook allows sturdy and robust fixation of the capsular bag to the scleral wall. The glued capsular hook used in this study is made of medical-grade monofilament nylon of 3-0 gauge. This material is adequately soft and does not cause capsular fornix tears. It also has adequate rigidity for good structural support and has a rounded tip. Nylon may undergo hydrolysis within the body, and therefore the long-term outcome remains to be seen. The larger gauge of fixation used in the glued capsular book may provide more longevity. Currently available capsular hooks made of polypropylene, polyvinylidene fluoride, PMMA, and polyimide can be used in this technique to avoid the possible disadvantage of nylon. The long-term outcome of the more current use of 9-0 polypropylene and 8-0 polytetrafluoroethylene sutures for fixation of CTR/CTS also has to be studied. Polypropylene is known to be subject to oxidative biodegradation, especially when exposed to light.[34] The glued capsular hook would have to be compared with these fixation modalities on a long-term basis to determine the advantages and disadvantages of each.

To conclude, the glued capsular hook is a new technique to anchor the capsular bag to the sclera both intraoperatively and postoperatively. The technique is easy and can be performed quickly. Combined with a standard CTR, it provides vertical and horizontal stability. It allows sutureless fibrin glue–assisted transscleral fixation of the capsular bag and thereby eliminates issues associated with suture fixation of CTRs and CTSs. Our initial intraoperative and postoperative results are promising. However, further studies with more patients and longer follow-up are required to assess the long-term safety and stability of the glued capsular hook.

WHAT WAS KNOWN

- In subluxations larger than 3 to 4 clock hours, a CTR/CTS is required to anchor the bag to the sclera with sutures.

WHAT THIS PAPER ADDS

- The glued capsular hook technique easily and rapidly anchors the capsular bag to the sclera both intraoperatively and postoperatively without the use of sutures.
- In combination with a standard CTR, the technique provides both vertical and horizontal stability and allows sutureless fibrin glue–assisted transscleral fixation of the capsular bag.

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