Management of subluxated cataract with capsule anchor implantation

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We describe a small case series that provides preliminary evidence of the usefulness of a new capsule-anchoring device for the management of subluxated cataracts. Three eyes of 3 patients with traumatic subluxated cataract causing a significant visual loss were enrolled. Phacoemulsification was performed in all cases with implantation of a capsule-anchoring device (AssiAnchor) because partial zonular dehiscence was present. A significant visual improvement was achieved in the 3 cases. The capsular bag was well centered and the anchors firmly attached to the capsulorhexis and sclera at 12 months postoperatively. The capsule-anchoring device was helpful in managing traumatic subluxated cataracts, enabling effective centration of the intraocular lens–capsular bag complex and, consequently, effective visual restoration.

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Phacoemulsification surgery in cases of subluxated cataract following blunt injury is considered a complex and challenging procedure. In these cases, the surgical management may lead to many complications, including lens dislocation into the vitreous cavity, vitreous loss with retinal detachment, and expulsive hemorrhage. Iris hooks provide only temporary stabilization of the lens capsule during surgery. However, other devices have shown long-term efficacy in preserving the capsular bag in eyes with subluxated cataracts. In cases with mild zonular defect, capsular tension rings (CTRs) implanted before or after cataract surgery are able to stabilize the capsular bag and enable proper insertion of the intraocular lens (IOL). In more extensive cases of lens subluxation, endocapsular rings combined with fixation hooks or capsular tension segments and secured to the sclera are used. Complications such as anterior capsule tear with progression to radial tear at the posterior capsule, risk for iatrogenic zonular dehiscence, iritis, corectopia, and broken fixation sutures have been reported with these devices. Recently, another capsule-supporting device, the capsule anchor (AssiAnchor [Hanita Lenses]) (Figure 1), was developed for moderate and severe crystalline lens subluxation. The aim of this small case series was to provide preliminary evidence of the usefulness of the capsule anchor in the management of subluxated cataracts.

PATIENTS AND METHODS

Patients

Three eyes of 3 patients were enrolled in the case series. Inclusion criteria were patients with significant subluxated cataract (greater than 1 quadrant and approximately greater than 4 clock hours with or without vitreous prolapse into the anterior chamber), history of blunt trauma, visual deterioration, significant refractive astigmatism induced by a crystalline lens subluxation, and age more than 18 years. Exclusion criteria were patients with previous ocular surgery, history of penetrating trauma including retinal detachment, choroidal hemorrhage, corneal injury, and abnormal iris. No patient was excluded preoperatively, and only 1 patient was excluded after surgery because of the presence of a mature luxated cataract with posterior capsule rupture.
during phacoemulsification. The nucleus density of the nucleus was graded as 3 or 4 in all cases according to the Lens Opacification Classification System III.10 All patients were adequately informed and signed a consent form. The study adhered to the tenets of the Declaration of Helsinki and was approved by the local ethics committee.

Preoperative and Postoperative Examination

Preoperatively, all patients had a complete ophthalmologic examination including uncorrected (UDVA) and corrected (CDVA) distance visual acuity, Goldmann applanation tonometry, slitlamp examination with assessment of the zonular defect, corneal topography and ocular aberrometry (OPD Scan III, Nidek Co., Ltd.), optical biometry (IOLMaster v.4.3, Carl Zeiss Meditec AG), and fundoscopy. Postoperatively, patients were evaluated at 1 day, 1 month, 6 months, and 12 months. In some cases, a longer follow-up was achieved. At 1 day, only the UDVA, intraocular pressure (IOP), and integrity of the anterior segment were evaluated. The postoperative examination protocol was identical to the preoperative protocol, with additional analysis of the IOL position by optical coherence tomography (OCT) (Visante, Carl Zeiss Meditec AG).

Surgical Technique

All surgeries were performed by the same experienced surgeon (P.M.) using a standard technique of sutureless coaxial phacoemulsification with the Infiniti Vision System and the Ozil handpiece (Alcon Surgical, Inc.). A combination of topical drops and retrobulbar anesthesia was used in all cases. Adequate dilation was obtained with preoperative mydriatic drops, and a 2.6 mm clear corneal incision was performed. Trypan blue was injected into the anterior chamber to improve visualization during creation of the capsulorhexis and to facilitate insertion of the capsule-anchoring device beneath the anterior capsule. A careful anterior vitrectomy with the Ultravit system (Alcon Surgical, Inc.) was performed to release the vitreous traction in the area of zonular dialysis. After the vitrectomy, the anterior chamber was filled with a cohesive ophthalmic viscosurgical device (OVD) (sodium hyaluronate 1%–chondroitin sulfate 4% [Provisc]) to maintain an adequate anterior chamber depth during surgery and a curvilinear capsulorhexis with a diameter between 4.0 mm and 5.0 mm was made using a forceps. At the location of the cataract subluxation, a peritomy was performed and a scleral flap created. A double-armed 10-0 polypropylene (Prolene) suture was inserted through the scleral wall to the anterior chamber. Polypropylene 10-0 was selected for its easy manipulation, knotting, and biocompatibility. Before the capsule-anchoring device was secured, a partial-thickness scleral flap was created to avoid exposing suture knots; this prevented conjunctival irritation. The flap was created with a diamond blade at a depth of one third the scleral thickness. A 27-gauge needle was used as a guide to externalize the suture through a paracentesis in the opposite side. In the same manner, a suture needle was reinserted into the anterior chamber to create a loop. The cortical separation from the anterior capsule by hydrodissection facilitated insertion of the device (Video 1).

The capsule-anchoring device was implanted through the 2.6 mm clear corneal incision (Figure 1). Before implantation

Figure 1. Implantation of the capsule-anchoring device in a conventional phacoemulsification procedure. Top: Insertion of the device through a 2.5 mm corneal incision. Middle: Clipping of the device to the capsule. Bottom: Phacoemulsification surgery with implantation of the IOL after implantation of the device.
was started, a safety suture through the proximal hole was used. After successful fixation, the safety suture was extracted. The proximal part (handle) of the anchor was maneuvered beneath the capsulorhexis edge, which was one of the most complex steps of the surgical procedure. After this, the distal part (base) was placed in the loop to center the lens. A Sinskey hook and a 23-gauge vitreoretinal forceps were used to facilitate insertion of the anchoring device. After this, the device was sutured at 1.5 mm from the corneal limbus. A gentle flow of a balanced salt solution from the syringe was used to release the trapped cortex, and then the cortex was carefully aspirated using bimanual irrigation/aspiration cannulas. After uneventful phacoemulsification, a CTR (Tensiobag, Carl Zeiss Meditec AG) was inserted to restore the contour of the capsule. An IOL (1-piece or 3-piece Acrysof IOL, Alcon Surgical, Inc., or 1-piece CT475, Carl Zeiss Meditec AG) was implanted in the capsular bag through the main incision using the Royal injector (ASICO LLC) and cartridge “B” or “C” of the AT.Smart cartridge set (Carl Zeiss Meditec AG) and the AT.Shotter A1-2000 injector (Carl Zeiss Meditec AG). At the end of surgery, the OVD was evacuated using bimanual aspiration cannulas. Postoperative topical therapy included a combination of topical antibiotic and steroids.

**Capsule-Anchoring Device**

The AssiAnchor is made of poly(methyl methacrylate) (PMMA) (Figure 1). The shape is similar to that of a paperclip, consisting of 2 proximal arms (handle) allowing firm grasp of the capsulorhexis edge beneath the anterior capsule and 2 distal arms (base) with a hole securing the transscleral fixation using a 9-0 or 10-0 polypropylene suture. The proximal hole is used as a temporary safety suture to prevent capsule dislocation into the vitreous cavity. The single-piece device has an overall length of 3.00 mm and a width of 2.48 mm. The insert can be implanted before or after removal of the crystalline lens. Depending on the magnitude of the crystalline lens subluxation, 1 or more devices can be inserted. The capsule-anchoring device enables cataract surgery of a subluxated lens, centers the subluxated capsule, and provides wide contact between the device and the anterior capsule.

**CASE REPORTS**

**Case 1**

A 60-year-old woman with a history of blunt injury to her left eye 6 months earlier attended our clinic with complaints of blurred vision. On examination, the CDVA was 0.30 logMAR (objective refraction, −1.25 −2.75 × 56; keratometry, 43.25 @ 173/43.75 @ 107) and the IOP was 16 mm Hg. On slitlamp examination, a clear cornea, deep anterior chamber, and iridophacodonesis with prolapsed vitreous into the anterior chamber were observed. A traumatic cataract slightly displaced anteriorly and decentered was observed, with temporal zonular dehiscence from 2 o’clock to 5 o’clock (Figure 2). A capsule-anchoring device was implanted at the 3 o’clock position. No postoperative inflammation was observed. At 24 months, the CDVA was 0.00 logMAR (objective refraction, 0.00 −0.50 × 10; keratometry, 43.00 @ 7/44.15 @ 97) and the IOP was 19 mm Hg. The IOL and the capsular bag were well centered (Figure 3), and the anchor was firmly attached to the capsulorhexis and sclera (Figure 2).

**Case 2**

A 55-year-old man attended our clinic after blunt injury to his right eye. He complained of decreased visual acuity immediately after the trauma. On examination, the CDVA was 0.30 logMAR (objective refraction, −0.50 −2.00 × 121; keratometry, 44.75 @ 178/45.50 @ 88) and the IOP was 27 mm Hg. The anterior chamber was deeper in the nasal region, and iridophacodonesis was present with prolapsed vitreous into the anterior chamber. The traumatic cataract was displaced temporally and decentered, with nasal zonular dehiscence extending from 12 o’clock to 6 o’clock (Figure 2). The subluxated capsular bag was centered using 2 capsule-anchoring devices placed at 1 o’clock and 4 o’clock. At 19 months, the CDVA was 0.00 logMAR (objective refraction, −0.50 −0.75 × 143; keratometry, 44.75 @ 175/45.75 @ 85) and the IOP was 18 mm Hg. At the last postoperative visit, an insignificant corectopia was present, the IOL implanted in the capsular bag was well centered (Figure 3), and the 2 anchors were firmly attached to the capsulorhexis and sclera (Figure 2).

**Case 3**

A 45-year-old man attended our clinic with a recommendation for cataract extraction. The cataract had been induced by blunt trauma to the left eye and generated poor vision and elevated IOP. On examination, the CDVA was 0.50 logMAR (objective refraction, +0.25 −1.25 × 23; keratometry, 41.25 @ 179/43.25 @ 89) and IOP was 28 mm Hg. On slitlamp examination, a mild reaction in the anterior chamber with significant iridophacodonesis was present. The traumatic subluxated cataract was displaced and decentered, with extension of the zonular dehiscence from 1 o’clock to 5 o’clock (Figure 2). To maintain the proper position of the capsular bag, a capsule-anchoring device was implanted at the 3 o’clock position. A mild postoperative inflammation was present in the initial postoperative period, resulting in posterior synechiae in the upper part of the iris. At 12 months, the CDVA was 0.10 logMAR (objective refraction, +0.75 −1.25 × 21; keratometry, 41.25 @ 177/42.75 @ 87) and the IOP was 14 mm Hg. Significant fibrosis of the anterior capsule was observed, although the IOL–capsular bag complex was well centered. The anchor was not visible because of the posterior synechiae (Figure 2).

**DISCUSSION**

The capsule anchor was developed to manage subluxated cataracts. It facilitates creation of a centered IOL–capsular bag complex and therefore effective visual restoration. Intraocular lens decentration has been shown to be associated with a significant degradation of the retinal image. The combination of IOL decentration and tilt induces an unpredictable refractive error that depends on the relationship between the geometric axes of the decentration and tilt. Furthermore, IOL tilt influences the level of ocular coma-like aberrations. The current small case series describes 3 cases of subluxated cataract in which the use of the capsule anchor provided a successful outcome. To our knowledge, this small case series is the first scientific evidence of the usefulness of the capsule anchor for the management of subluxated cataracts.
In the 3 cases evaluated, the capsule anchor achieved centration of the capsular bag and, consequently, of the IOL, which was easily visualized and confirmed by OCT. The proximal arms of the capsule anchor were in contact with the capsulorhexis edge, and the distal arms were secured to the scleral wall. The lateral arms of the proximal part of the anchor created a large contact area with the capsule, and the tips supported the capsule equator. Transscleral fixation enabled stabilization of the anterior capsule. The mechanism of action of the capsule anchor provided effective centration of the IOL–capsular bag complex. In more severe or complex cases, CTRs can be implanted along with the capsule anchor to restore and maintain the circular contour of the capsular bag.

The first scientific evidence of the usefulness of a capsule anchor for management of a subluxated lens was reported by Ton et al. The authors developed and tested experimental models of a PMMA 1-plane intraocular anchoring device consisting of 2 handles that grasp the edges of the capsulorhexis and a base for scleral fixation with a single 10-0 or 9-0 polypropylene suture. They implanted this device in porcine eyes and living rabbit eyes in which lens subluxation was achieved by tearing about one third of the zonular fibers. The study confirmed the safety and efficacy of the device in the experimental animal models. Two years later, the same research group reported the outcomes of implanting a similar anchoring device in 2 patients with traumatic subluxated lenses and 2 patients with Marfan syndrome. They found that the capsule-anchoring device was effective in fixating the lens capsule to the scleral wall in those cases of significant zonular dehiscence. We also observed successful management of subluxated cataracts caused by blunt trauma using the new capsule-anchoring device. In our 3 cases, no significant complications occurred during the follow-up period. Therefore, the capsule anchor can be considered an additional option for the management of subluxated cataract. Future studies evaluating the performance of these devices in larger sample sizes and during a longer follow-up should be conducted.

In our 3 cases, effective centration of the IOL–capsular bag complex was the main factor in the excellent visual outcomes. This is consistent with the results in previous case reports and case series evaluating the
management of subluxated cataract with various techniques or devices.²–⁵,⁷,⁹ Chee and Jap² preserved the capsular bag in a group of eyes with traumatic subluxated cataract with the aid of a Cionni modified CTR in 36 eyes (87.8%) and a combination of a capsular tension segment (CTS) and a CTR in 2 eyes. In that case series, only 9 of the 41 eyes (22.0%) had a preoperative CDVA of 20/40 or better compared with 38 eyes at the last visit (92.7%, P < .001). Santoro et al.⁵ evaluated the outcomes in 5 cases of subluxated cataract that was managed using 4 or 5 disposable nylon iris hooks placed on the capsulorhexis edge. The mean decimal visual acuity improved significantly with surgery, from 0.26 ± 0.18 (SD) to 0.68 ± 0.33 (P < .001). Vasavada et al.¹ reported that the CDVA improved in 35 of 41 eyes (85.4%) in which phacoemulsification surgery was combined with implantation of Cionni modified CTRs for the management of subluxated cataracts. In our 3 cases, a significant improvement in CDVA was achieved, with 2 of the cases achieving 0.00 logMAR postoperatively and 1 achieving 0.10 logMAR. Therefore, adequate centration of the IOL was achieved in all 3 cases. As previously stated, IOL decentration or tilting would have induced a significant deterioration of the visual acuity and quality.¹¹,¹²

The aim of our small case series was to provide evidence of the clinical usefulness of capsule anchors in cases of subluxated cataract. The potential benefit of these devices over others, such as CTRs, is being evaluated and should be clarified in future studies comparing the results obtained with the capsule anchor and those obtained with devices such as CTRs. This clarification will allow the clinician to know the advantages and disadvantages of each device for the management of subluxated cataract. It should be mentioned that the main advantage of the AssiAnchor from our perspective is that it provides stabilization of the capsular bag before the phacoemulsification process, enabling successful insertion of the IOL in the subluxated capsular bag, even one with a CTR.

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