

# Combination of capsular tension ring and capsular tension segment for the management of lens coloboma >4 clock hours

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Lens colobomas extending more than 4 clock hours and causing visual impairment require lens extraction along with capsular support devices with scleral fixation for adequate centration of the capsular bag and for prevention of capsular fornix aspiration with inadvertent extension of zonular dialysis intraoperatively. In this case series, we describe a technique for the management of isolated lens colobomas involving 4–5 clock hours by clear lens extraction and intraocular lens implantation using a combination of a capsular tension ring with a capsular tension segment (CTS) for the centration and stability of the capsular bag. Hoffman's corneoscleral pocket and half-bow sliding knot technique were used for scleral fixation of the CTS.

**Key words:** Capsular tension ring, capsular tension segment, capsular support device, Hoffman's scleral pocket, lens coloboma, lenticular astigmatism

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Lens coloboma occurs because of localized zonular absence and can cause diminution of vision due to either lenticular astigmatism with or without associated myopia or other ocular abnormalities such as fundal coloboma.<sup>[1]</sup> It is characterized by a straight edge/notch of the lens equator. It may be associated with amblyopia especially if it is unilateral or is associated with cataract or high myopia. Visual rehabilitation in these cases depends on the extent of coloboma, lens status (clear/cataractous), and laterality. Surgical management is indicated in cases with uncorrectable high refractive errors despite a clear lens or in cases with associated cataractous changes. As they are associated with zonular defects, lenticular tilt, and capsular bag instability, surgery in these cases is challenging. The management options include lens extraction and intraocular lens (IOL) implantation with capsular bag stabilization using capsular support devices. Capsular support devices are required for adequate centration of the capsular bag and the IOL, as well as prevention of inadvertent capsular fornix aspiration intraoperatively with extension of zonular dialysis.<sup>[2]</sup> Phacoemulsification has been found to be safer than manual small-incision cataract surgery for subluxated cataract with lens coloboma as nucleus rotation is hampered due to the absence of zonules and may lead to extension of dehiscence and conversion to intracapsular cataract extraction.<sup>[3]</sup> In a study by Gurler *et al.*, isolated lens colobomas could be managed well with crystalline lens extraction and IOL implantation using phacoemulsification, with capsular bag stabilization using

capsular tension ring (CTR) in cases with extent of coloboma <120° and modified CTR for cases with extent >120°.<sup>[4]</sup> In this technique, we are going to describe the management of isolated lens colobomas extending for 4–5 clock hours by phacoemulsification and a combination of CTR and capsular tension segment (CTS) for scleral fixation using Hoffman's corneoscleral pocket and Half bow sliding knot technique.

## Surgical Technique

A Hoffman's corneoscleral pocket of about 2–2.5 mm length is created at 6 o'clock position using a crescent knife [Fig. 1a].<sup>[5]</sup> Standard side port and main port incisions are made followed by a small decentered capsulorrhexis. Capsular hooks are applied to stabilize the capsular bag after which hydrodissection and phacoaspiration are performed without rotation of the lens. This is followed by implantation of the CTR (Aurolab, Madurai, India) subsequent to which the cortical matter aspiration is completed using a bimanual irrigation aspiration system. To achieve centration of the capsular bag, scleral fixation is done using CTS (Morcher GmbH, Stuttgart, Germany). A 9,0-polypropylene suture with straight needle at both ends is passed through the eyelet of CTS and needles are taken out

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through the Hoffman's pocket at a distance of about 1.5 mm away from the limbus [Fig. 1b]. After that, the sutures are retrieved through the pocket using Kuglen's hook to check their passage through the created pocket only. CTS is implanted in the capsular bag [Fig. 1c]. IOL implantation is done in the capsular bag. Suture knots are tied after cutting one of the suture ends near the needle end and taking the suture out of the pocket and the other suture is retrieved through the pocket by which loops are made to tie a half-bow sliding knot with the other suture as described by Chee.<sup>[6]</sup> Final knots are tied after viscoelastic aspiration to make a tight knot and ensure centration of capsular bag [Fig. 1d and e]. Capsulorrhexis can be secondarily enlarged to an adequate size of 5–5.5 mm. Pilocarpine injection into anterior chamber and hydration of side ports are followed to complete the procedure. Suture ends are trimmed at the end of procedure – one end is trimmed from inside the pocket and the other end is cut flush with the conjunctiva [Fig. 1f]. The technique is illustrated in the accompanying video.

## Results

Three eyes of two patients with isolated lens colobomas were managed by this technique, and the results are as follows:

### Case 1

A 24-year-old female presented with gradually progressive diminution of vision since childhood which was more in the left eye (OS) and was using glasses for the same. Her best-corrected visual acuity (BCVA) was 20/25 in the right eye (OD) and 20/80 OS with manifest refraction of  $-8\text{DS}/-1\text{DC} \times 180^\circ$  and  $-14\text{DS}/-6\text{DC} \times 175^\circ$ , respectively. Dilated evaluation revealed bilateral straight inferior equator of the lens with scanty zonules suggestive of lenticular coloboma which was extending from 4 to 8 o'clock hours OD and 3:30 to 8 o'clock hours OS [Fig. 2a and b]. There were no other ocular abnormalities including iris/fundal coloboma and no systemic associations. Pentacam HR (Oculus Inc., Lynnwood, WA, USA) revealed lenticular tilt which was more OS than OD [Fig. 2c and d]. Biometry revealed axial lengths of 25.08 mm OD and 27.76 mm OS. The patient wanted to get rid of glasses. She underwent clear lens extraction OS with capsular support device in the form of CTR and CTS with IOL implantation of +12D in the capsular bag. The patient was desirous of surgical correction in the contralateral eye as well and wanted spectacle independence. To provide spectacle independence for near work as well, she was planned for similar surgery with the aim of 1–1.25 diopters of myopia for monovision using +20.5D IOL power. During postoperative period, IOL and the capsular bag were well centered [Fig. 3a and b]. The patient attained final uncorrected visual acuity (UCVA) of 20/80 and N9 OD and 20/40 and N18 OS. Binocular UCVA was 20/40 and N9. She achieved BCVA of 20/20 OD and 20/30 OS with manifest refraction of  $-1\text{DS}/-1.75\text{DC} \times 85^\circ$  and  $-1.25\text{DC} \times 85^\circ$ , respectively. The left eye did not attain 20/20 visual acuity possibly because of amblyopia. On ITrace, there was significant decrease in internal aberrations of the eye and improvement in the quality of vision [Figs. 2e and 3c].

### Case 2

A 23-year-old male presented with diminution of vision in the right eye noticed for the past 1 year. He had UCVA of counting finger at 1 m OD and 20/30 OS and BCVA of 20/40 OD with

manifest refraction of  $-5\text{DC} \times 170^\circ$  OD and 20/20 OS with  $-0.25\text{DS}$ . Dilated examination revealed lens coloboma which was extending from 4 to 8:30 o'clock hours OD [Fig. 4a] and normal ocular examination OS. The patient underwent surgery as per the described technique. After 3 weeks, he had UCVA of 20/25 and BCVA of 20/20 with  $-0.5\text{DC} \times 15^\circ$  with well-centered capsular bag and IOL [Fig. 4b]. There was significant improvement in visual quality on iTrace [Fig. 4c and d].

None of the eyes had any intraoperative complication by this technique.

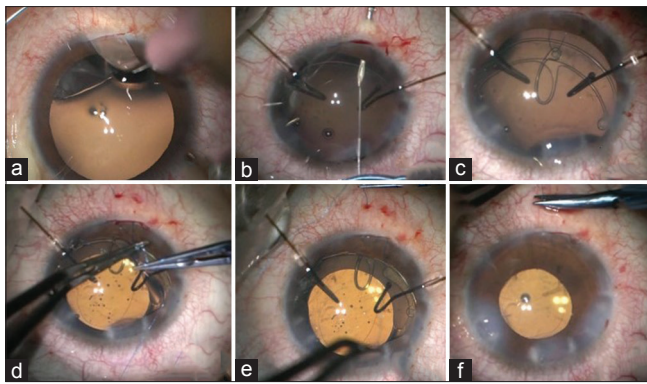
## Discussion

In cases with isolated lens coloboma, phacoemulsification with capsular support devices has been found to be an effective option with a coloboma of less than  $120^\circ$  being managed only with a CTR and those with greater than  $120^\circ$  extent being managed with a modified single eyelet CTR.<sup>[4]</sup> Modified CTR implantation needs more maneuverability and cannot be implanted until nuclear phacoemulsification is complete or if the anterior capsulorrhexis is discontinuous. However, CTS being a partial ring segment of only  $120^\circ$  of an arc with anteriorly positioned fixation eyelet for scleral fixation offers advantages over modified CTR with respect to easy maneuverability and its utility even in cases with anterior capsular tear or discontinuous capsulorrhexis as it does not require  $360^\circ$  rotation. It can be used even before nuclear phacoemulsification is completed.<sup>[7]</sup> However, CTS implantation alone may not be sufficient in eyes with greater extent of dialysis which may require implantation of two CTS segments/CTR implantation along with it to provide circumferential support.

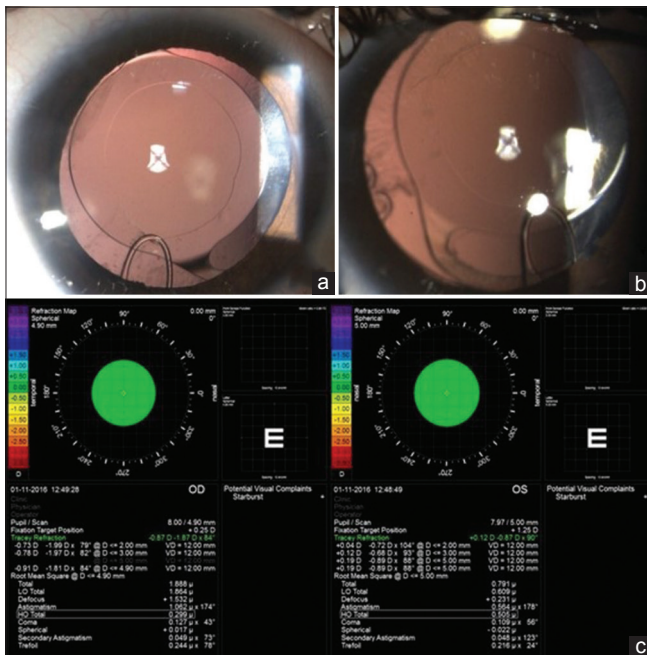
Use of a combination of CTS with CTR is reported only infrequently in published literature. Chee *et al.* have reported using a CTS for traumatic subluxated cataracts along with CTR or modified CTR.<sup>[8]</sup> Another case report describes the use of a combination of CTR and CTS in a case of microspherophakia with glaucoma. The advantage of using CTS in microspherophakia is to avoid possible trauma to the small capsular bag by modified CTR implantation which is sometimes associated with excessive shearing force during implantation.<sup>[9]</sup>

The rationale of fixing the CTS to the sclera using a Hoffman's corneoscleral pocket was that this technique avoids conjunctival peritomy or scleral cautery, provides a safer placement of the polypropylene suture under the created pocket and does not require scleral/conjunctival suturing, and is cosmetically better and comfortable to the patients. However, tying the knot without direct visualization is little tricky and can be associated with loose knot which may lead to decentration of the capsular bag. To overcome this, Chee *et al.* described a half-bow sliding knot similar to Seipser's knot which helps in easy adjustment of knot tension before final knot tying.<sup>[6,10]</sup> In the present series, optimal anatomic and visual outcomes were achieved in all the three eyes of isolated lens coloboma using a combination of a CTR and CTS and all eyes achieved good cosmesis and refractive results.

To conclude, isolated lens coloboma with extent  $>120^\circ$  can be safely and efficaciously managed surgically by phacoemulsification and posterior chamber IOL implantation using a combination of CTS and CTR. Hoffman's corneoscleral



**Figure 1:** Surgical steps. (a) Hoffman's corneoscleral pocket created at 6 o'clock position. (b) Needle of 9,0-polypropylene suture after passing through the CTS and taken out at the site of Hoffman's pocket. (c) CTS implantation. (d) Suture knot tying using half-bow sliding knot technique. (e) Tightening of suture knot by pulling the suture ends. (f) Trimming of suture ends



**Figure 3:** Case 1. Postoperative anterior segment photograph of right (a) and left eyes (b) showing well-centered IOL with CTS in place. (c) Postoperative ITrace of right and left eyes showing improvement in visual quality

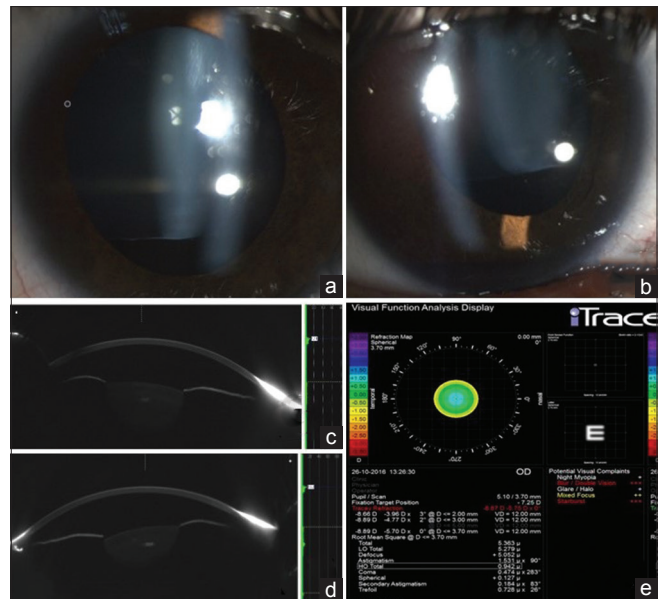
pocket technique can be used for its advantages over conventional scleral flap procedure.

**Declaration of patient consent**

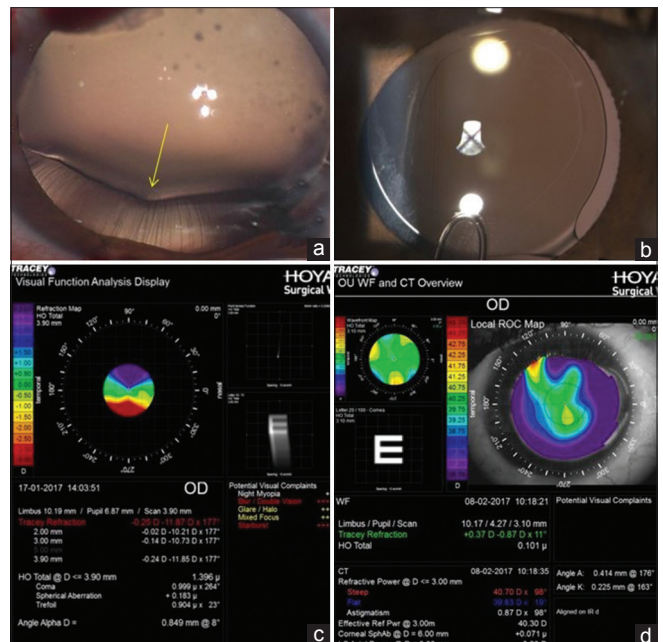
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Figure 2:** Case 1. (a) Right eye – coloboma extent from 4 to 8:00 o'clock hours. (b) Left eye – extent from 3:30 to 8 o'clock hours. Scheimpflug images of right (c) and left eyes (d) showing tilted lens more in left eye. (e) Preoperative ITrace of right eye showing poor visual quality



**Figure 4:** Case 2. (a) Lens coloboma extending from 4 to 8:30 o'clock hours with scanty zonules with a tent at the site of intact zonules (yellow arrow). (b) Postoperative photograph showing well-centered IOL and capsular bag with CTS in place. (c) Preoperative ITrace showing poor visual quality. (d) Postoperative ITrace showing improvement in visual quality

**Conflicts of interest**

There are no conflicts of interest.

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