DOI:10.14744/bej.2023.57625
Beyoglu Eye J 2023; 8(2): 123-127

Case Report

Combined Capsular Tension Ring and Segment Implantation in Phacoemulsification Surgery for the Management of Microspherophakia with Secondary Angle-Closure Glaucoma

Nilgun Solmaz,[1] Turker Oba,[2] Feyza Onder[1]

[1]Department of Ophthalmology, Health Sciences University, Haseki Training and Research Hospital, Istanbul, Türkiye
[2]Department of Ophthalmology, Karaman Training and Research Hospital, Karaman, Türkiye

Abstract

We present the long-term results of the implantation of a capsular tension ring (CTR) and Ahmed capsular tension segments (CTS) together for the management of mikrospherophakia in a 35-year-old female patient. The patient had uncontrolled secondary angle-closure glaucoma, despite previous laser peripheral iridotomy, and visual impairment due to lenticular myopia. Clear lens extraction was performed under general anesthesia. The capsular bag was stabilized with a classical CTR and two Ahmed CTSs sutured to the sclera. A single-piece hydrophobic acrylic intraocular lens (32.0 D for the right and 30.0 D for the left eye) was implanted in the capsular bag. The anterior chamber depth was stable, and intraocular pressure (IOP) was 10–12 mmHg in both eyes in the early post-operative period. The bag complex gradually moved forward, IOP gradually increased, and the left eye underwent trabeculectomy surgery in the 4th year of follow-up.

Keywords: Capsular tension ring, capsular tension segment, glaucoma, microspherophakia

Introduction

Microspherophakia is a rare developmental anomaly, characterized by bilateral small spherical crystalline lenses and zonular abnormalities. The lens zonules are hypoplastic, elongated, and weak. The spherical lens leads to lenticular myopia and shallow anterior chamber (1,2). Glaucoma is a common complication that affects almost 50% of microspherophakic eyes (3,4). Anterior subluxation of the lens may cause pupillary block and acute angle-closure glaucoma (1,3). Recurrent acute attacks or chronic incomplete pupillary block result in chronic closed-angle glaucoma (4). The condition may be isolated, familial, or may be associated with systemic disorders such as Weill–Marchesani syndrome, Marfan's syndrome, and homocystinuria (2,4).

Glaucoma treatment is a challenging process in microspherophakia. Anti-glaucomatous medications and peripheral laser iridotomy mostly provide a temporary decrease in intraocular pressure (IOP) and almost 60% of these cases require surgical intervention (5). Nevertheless, there is no consensus on the choice of surgical treatment modalities.

How to cite this article: Solmaz N, Oba T, Onder F. Combined Capsular Tension Ring and Segment Implantation in Phacoemulsification Surgery for the Management of Microspherophakia with Secondary Angle-Closure Glaucoma. Beyoglu Eye J 2023; 8(2): 123-127.

Address for correspondence: Nilgun Solmaz, MD. Department of Ophthalmology, Health Sciences University, Haseki Training and Research Hospital, Istanbul, Türkiye
Phone: +90 533 421 00 19 **E-mail:** nilgunsolmaz@hotmail.com

Submitted Date: February 12, 2022 **Revised Date:** February 01, 2023 **Accepted Date:** March 09, 2023 **Available Online Date:** May 01, 2023
Beyoglu Eye Training and Research Hospital - Available online at www.beyoglueye.com

We report a case of microspherophakia with secondary angle-closure glaucoma treated with clear lens extraction surgery and intraocular lens implantation (IOL) using the combination of standard capsular tension ring (CTR) and capsular tension segments (CTSs).

Case Report

A 35-year-old woman was consulted with uncontrolled glaucoma in both eyes, despite previous bilateral laser peripheral iridotomy and medical treatment. The corrected distance visual acuity (CDVA) was 20/50 in both eyes with −4.0–2.0 × 130 and −6.75–1.25 × 40 correction in the right eye and left eye, respectively. The slit-lamp examination revealed extremely narrow anterior chambers and small spherical crystalline lenses bilaterally (Fig. 1). The IOP was variable, and it ranged from 13 to 24 mmHg in the right eye and from 30 to 40 mmHg in the left eye in 2 h. There were no peripheral anterior synechiae on gonioscopy. Optical coherence tomography revealed continuously incomplete closure and opening at the anterior chamber angle. On fundus examination, the cup-to-disc ratio was 0.8 in the right eye and 0.9 in the left eye. Visual field tests revealed moderate and advanced glaucomatous changes, respectively, in the right and left eye. No systemic anomaly or family history was reported by the patient. Therefore, the patient was diagnosed with isolated microspherophakia with secondary angle-closure glaucoma. Bilateral clear lens extraction and intraocular lens (IOL) implantation were planned for glaucoma management. Using the IOLMaster 500 (Carl Zeiss Meditec, Oberkochen, Germany), the measured corneal curvature was 42.40/44.23 diopters (D) and 42.25/44.06 D, the axial length was 20.72 mm and 21.45 mm, and the IOL power calculated by Hoffer Q for emmetropia was +32.0 D and +29.0 D, respectively, in the right and left eye.

We performed the cataract surgery under general anesthesia and administered 20% mannitol infusion pre-operatively to dehydrate the vitreous. The left eye was operated first. Since the anterior chamber was extremely narrow and the lens was unstable, the continuous curvilinear capsulorhexis was very challenging. After nuclear and partial cortical material aspiration, a classical CTR (type 13, size: 12.3/10 mm, Morcher GmbH, Stuttgart, Germany) was inserted to expand the capsular bag and decrease the flaccidity of the posterior capsule, and two Ahmed CTSs (type 6D, Morcher GmbH) were implanted to stabilize the bag. We used a PC 9 polypropylene suture (Alcon Laboratories, Inc., Fort Worth, TX, USA) and modified Z suture technique (6) for scleral fixation of the Ahmed CTSs at 2 and 8 o'clock positions. A single-piece hydrophobic acrylic IOL (AcrySof SN60AT, 30.0 D, Alcon Laboratories, Inc., Fort Worth, TX, USA) was implanted in the capsular bag. Six weeks later, the same procedure was performed on the right eye and an AcrySof SN60AT, 32.0 D, was implanted in the capsular bag. At the post-operative 1st month, the IOL was centered, the anterior chamber depth was normal (Fig. 2), and IOP was 12 mmHg versus 10 mmHg, without anti-glaucomatous therapy in the right and left eye, respectively. The CDVA was 20/25 in both eyes and the objective refraction was-3.0–2.0D × 135 and +0.50–1.50D × 40 in the right and left eye, respectively.

Although the capsular bag was stabilized with CTSs, glaucoma crisis developed due to the anterior movement of

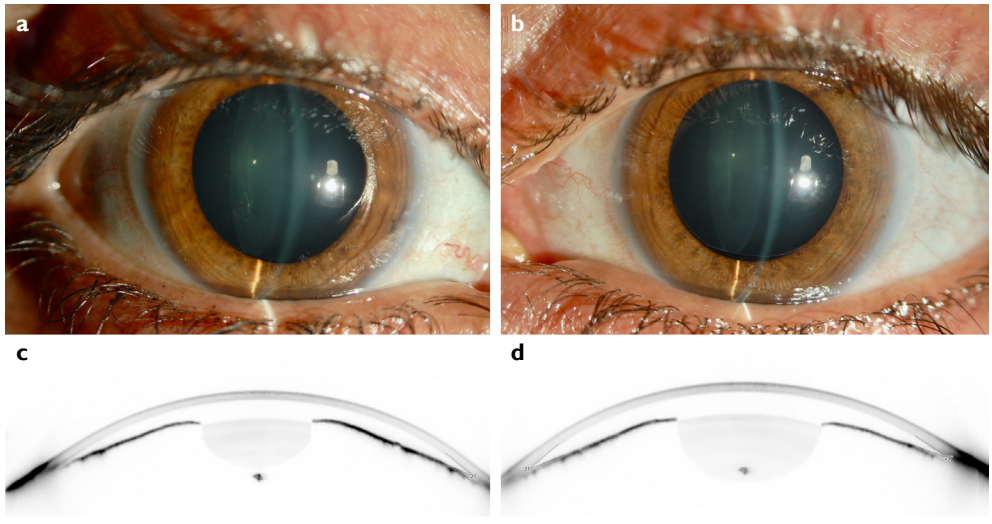

Figure 1. (a, b) The extremely narrow anterior chamber and the small spherical crystalline lens in the right and left eye, respectively. The equatorial diameter of the lenses is about 7.5–8.0 mm in both eyes. **(c, d)** The three-dimensional image of the anterior segment was obtained by the Sirius corneal topography system (The Sirius Costruzione Strumenti Oftalmici, Italy). The anterior chamber depth is 1.07 mm and 1.15 mm in the right and left eye, respectively.

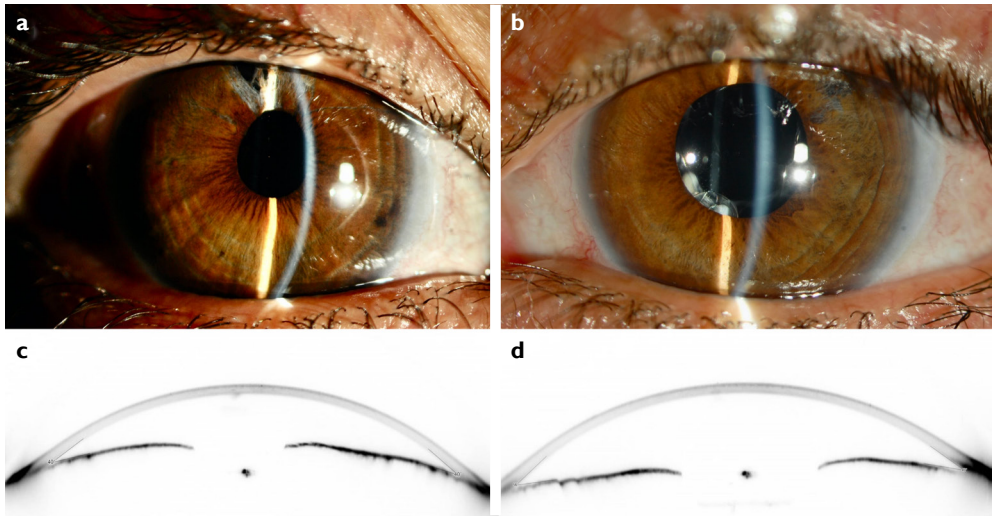

Figure 2. (a, b) The view of the anterior segment in the right and left eye, respectively, at post-operative 1st month. The capsular bag is stable and intraocular lens is centered bilaterally. **(c, d)** The three-dimensional image of the anterior segment was obtained by the Sirius corneal topography system. The anterior chamber depth is 2.90 mm and 3,59 mm in the right and left eye, respectively.

the capsular bag complex in the right eye at the 7th-month follow-up. The IOP returned to normal after administration of 20% mannitol infusion, brinzolamide/timolol fixed combination and brimonidine twice a day. About a year later, the patient presented with complaints of pain in the right eye and decreased vision bilaterally. She mentioned that laser treatment was applied to both eyes in another eye clinic a few days ago. However, iridoplasty scars were seen only in the right eye. The IOP was normal, the anterior chambers were shallow bilaterally and myopic shift occurred due to the capsular bag complex moving forward. We thought that the fixation sutures may have been loosened before laser iridoplasty or that the sutures may have been damaged due to laser iridoplasty. The patient was operated to restore the depth of the anterior chamber. There was no significant relaxation or suture damage. Nevertheless, we tightened the Z sutures as much as possible and the suture tips were elongated with a PC-9 and tied on the sclera so that they would not slip. Therefore, the anterior chamber depth was increased to 3.20 mm versus 3.37 mm in the right and left eye, respectively, and myopic shift resolved. The IOP remained stable in low tens with brinzolamide–timolol fixed combination and brimonidine for 2 years. Then, it gradually increased to high tens and latanoprost was added to the treatment bilaterally. In the left eye, the anterior chamber depth gradually decreased, the IOP increased to the high 20s despite maximum topical anti-glaucomatous therapy and trabeculectomy surgery were required in the 4th year of the follow-up.

In the 5th year of follow-up, the visual acuity was 20/20 versus 20/50, the ACD was 3.17 versus 2.82 mm, and the IOP was 12 versus 18 mmHg under topical anti-glaucomatous treatment, in the right and left eye, respectively.

Discussion

In microspherophakia cases, various treatment modalities have been recommended for glaucoma management, which includes trabeculectomy, lensectomy, or combined procedures (2,5,7). However, lensectomy should be considered the first choice in these cases, as it is an effective approach for managing both glaucoma and visual impairment due to lenticular myopia and progressive lens subluxation. Nevertheless, there is no standard surgical technique due to the variability in zonular weakness. Furthermore, the surgery may result in aphakia and lead to several complications due to the loss of vitreous body (8).

Phacoemulsification is a challenging procedure in microspherophakia due to an extremely shallow anterior chamber, an unstable small spherical lens, and zonular weakness; however, it enables us to implant the IOL into the capsular bag. In a few case reports, successful results of phacoemulsification were reported with IOL implantation into the capsular bag without any capsular bag fixation, but the patients in these studies were very young and their follow-up periods were very short (9-11). We think that if the capsular bag is not stabilized with a Cionni-modified CTR or classical CTR and CTS combination, IOL implantation is not feasible due to progressive zonular insufficiency.

In our case, we did not prefer Cionni ring insertion because of its rigidity and implantation difficulty. Furthermore, it is difficult to determine the diameter of the Cionni ring in these cases. An incompatibility between the capsular bag

expansion and the compressed diameter of the Cionni ring may lead to rupture of the capsular bag or the position of the two arms of the Cionni ring may be too close to each other. Therefore, we used a classical CTR to expand and two CTSs to stabilize the capsular bag.

The combined insertion of CTS with classical CTR was previously described as "dual support technique" by Khokhar et al. (12) They performed the technique on a 9-year-old child with microspherophakia and reported that the IOL was centered and the IOP was in the normal range in the 4-week follow-up. Kim et al. (13) operated on children with ectopia lentis using a similar technique and reported that the technique was effective and reliable. Canabrava et al. (14) also used a partially similar technique for managing Marfan syndrome and microspherophakia, then reported that the bag-IOL complex was stable in 3-month follow-up. However, the follow-up periods of all cases were very short, and long-term results have not been reported.

In our opinion, the advantages of this technique may be listed as follows: allowing in-the-bag IOL placement, preventing IOL decentration and capsular phimosis by creating a symmetrical centrifugal force, and reducing the risk of dislocation of the bag complex. However, due to the small diameter of the bag complex, the fixation sutures go a longer way in microspherophakia compared to other subluxation cases, and the bag complex can swing like a sail between two fixation sutures, leading to pseudophacodonesis and forward displacement. In our case, although we tightened and tied the fixation sutures to eliminate the possibility of slipping, forward movement of the bag complex in the left eye continued. The anterior chamber depth gradually decreased and IOP gradually increased.

For microspherophakia cases, other options may be pars plana lensectomy or intracapsular lens extraction combined with scleral- or iris-fixated IOL implantation (15,16). Subbiah et al. (15) reported that intracapsular lens extraction combined with scleral-fixated IOL implantation provided satisfactory visual results and IOP control in the 18-month follow-up. On the other hand, Yasar (17) reported an increase in the IOP 6 months after lensectomy. The patient eventually underwent two trabeculectomies during the long follow-up period. Senthil et al. (3) also reported that IOP control was achieved without antiglaucomatous treatment in only 7 of the 14 eyes that underwent pars plana lensectomy with anterior vitrectomy. In the same study, the success of trabeculectomy was also reported as "moderate." One of the most important findings of this study was that in 30% of cases, glaucoma results in blindness.

Coexistence of different glaucoma mechanisms limits the success of lensectomy in IOP control thus complicating the management of glaucoma. Nevertheless, combined CTR and CTS-assisted phacoemulsification surgery may be a preferable option because of its good visual results and prevention of possible complications due to vitreous loss, secondary implantation, or aphakia.

Conclusion

In microspherophakia cases, after CTR and CTSs-assisted phacoemulsification surgery, forward displacement of the bag complex may occur. IOP is expected to remain within normal limits for a while, but it may gradually increase, and glaucoma surgery may be required.

Disclosures

Informed consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept: N.S., F.O.; Design: N.S., T.O., F.O.; Supervision – F.O., N.S.; Data collection and/or processing – N.S., T.O.; Analysis and/or interpretation – N.S., T.O.; Literature search: N.S., T.O.; Writing: N.S.; Critical reviews: N.S., T.O., F.O.

References

1. Macken PL, Pavlin CJ, Tuli R, Trope GE. Ultrasound biomicroscopic features of spherophakia. Aust N Z J Ophthalomol 1995;23:217–20.[CrossRef]
2. Khokhar S, Pillay G, Sen S, Agarwal E. Clinical spectrum and surgical outcomes in spherophakia: A prospective interventional study. Eye (Lond) 2018;32:527–36. [CrossRef]
3. Senthil S, Rao HL, Hoang NT, Jonnadula GB, Addepalli UK, Mandal AK, et al. Glaucoma in microspherophakia: presenting features and treatment outcomes. J Glaucoma 2014;23:262–7.
4. Muralidhar R, Ankush K, Vijayalakshmi P, George VP. Visual outcome and incidence of glaucoma in patients with microspherophakia. Eye (Lond) 2015;29:350–5. [CrossRef]
5. Senthil S, Rao HL, Babu JG, Mandal AK, Addepalli UK, Garudadri CS. Outcomes of trabeculectomy in microspherophakia. Indian J Ophthalmol 2014;62:601–5. [CrossRef]
6. Dinç E, Vatansever M, Dursun Ö, Markirt HG, Aydın B, Yilmaz A, et al. Scleral fixated intraocular lens implantation with a modified Z-suture technique. Int Ophthalmol 2018;38:2357–61. [CrossRef]
7. Satana B, Altan C, Basarir B, Alkin Z, Yilmaz OF. A new combined surgical approach in a patient with microspherophakia and developmental iridocorneal angle anomaly. Nepal J Ophthalmol 2015;7:85–9. [CrossRef]
8. Willoughby CE, Wishart PK. Lensectomy in the management of glaucoma in spherophakia. J Cataract Refract Surg 2002;28:1061–4. [CrossRef]
9. Bhattacharjee H, Bhattacharjee K, Medhi J, DasGupta S. Clear lens extraction and intraocular lens implantation in a case of

microspherophakia with secondary angle closure glaucoma. Indian J Ophthalmol 2010;58:67–70. [CrossRef]
10. Khokhar S, Pangtey MS, Sony P, Panda A. Phacoemulsification in a case of microspherophakia. J Cataract Refract Surg 2003;29:845–7. [CrossRef]
11. Behndig A. Phacoemulsification in spherophakia with corneal touch. J Cataract Refract Surg 2002;28:189–91. [CrossRef]
12. Khokhar S, Gupta S, Kumar G, Rowe N. Capsular tension segment in a case of microspherophakia. Cont Lens Anterior Eye 2012;35:230–2. [CrossRef]
13. Kim EJ, Berg JP, Weikert MP, Kong L, Hamill MB, Koch DD, et al. Scleral-fixated capsular tension rings and segments for ectopia lentis in children. Am J Ophthalmol 2014;158:899–904. [CrossRef]
14. Canabrava S, Lima AC, Arancibia AE, Dornelas LF, Ribeiro G. Novel double-flanged technique for managing marfan syndrome and microspherophakia. J Cataract Refract Surg 2020;46:333–9.
15. Subbiah S, Thomas PA, Jesudasan CA. Scleral-fixated intraocular lens implantation in microspherophakia. Indian J Ophthalmol 2014;62:596–600. [CrossRef]
16. Fouda SM, Al Aswad MA, Ibrahim BM, Bori A, Mattout HK. Retropupillary iris-claw intraocular lens for the surgical correction of aphakia in cases with microspherophakia. Indian J Ophthalmol 2016;64:884–7. [CrossRef]
17. Yasar T. Lensectomy in the management of glaucoma in spherophakia: Is it enough? J Cataract Refract Surg 2003;29:1052–3.