CASE REPORT
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Complete resolution of hyperopic shift in anterior capsular contraction syndrome after Nd:YAG laser capsulotomy: a case report

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ABSTRACT

Background: Anterior capsular contraction syndrome (ACCS) is a disorder in which the anterior capsulectomy opening shrinks excessively. One of the many factors that have been discovered to aggravate the problem is a lack of zonular support for the lens capsule. The prognosis for non-progression of contractions after Nd:YAG anterior capsulotomy is quite excellent. This study aims to present a complete resolution of the hyperopic shift in an anterior capsular contraction syndrome (ACCS), a rare complication of cataract surgery.

Case Illustration: This case report presented a 63-year-old female who developed ACCS in the right eye two years after uncomplicated cataract surgery and intraocular lens implantation. A moderate hyperopic shift of +3.00 D was noted in the affected eye at the initial presentation. Slit-lamp examination revealed an anterior capsule opacification and anterior capsular contraction with fibrosis surrounding the capsulorhexis opening. Ocular and systemic past medical history was unremarkable, and no known risk factors associated with contraction syndrome were found. Nd:YAG laser capsulotomy with six relaxing incisions was performed to release the anterior capsular contraction. Two weeks following capsulotomy, the patient's visual acuity remarkably improved to LogMAR 0.00 without correction. The hyperopia was completely resolved, and a decrease in anterior chamber depth compared to pre-capsulotomy measurement was noted. ACCS is a possible complication following capsulorrhexis performed in uneventful cataract surgery, which may occur in patients with no known ocular or systemic risk factors. ACCS is commonly asymptomatic, and hyperopic shift is a rare manifestation of ACCS. The backward shift of the intraocular lens (IOL) induces hyperopia due to the anterior capsule contraction. The preferred treatment for ACCS is relaxing incisions using Nd:YAG laser capsulotomy.

Conclusion: Hyperopic shift in ACCS is a rare complication of cataract surgery. However, prompt treatment of contraction release with Nd:YAG laser capsulotomy effectively restored visual function.

Keywords: anterior capsular contraction syndrome, capsulorhexis, laser capsulotomy.
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INTRODUCTION

Anterior capsular contraction syndrome (ACCS) is a disorder in which the anterior capsulectomy opening shrinks excessively. It has been documented as a rare complication following continuous curvilinear capsulorhexis (CCC) in cataract surgery and is linked to a variety of conditions including pseudoexfoliation syndrome, high myopia, diabetes mellitus, uveitis, advanced age, and myotonic muscular dystrophy. ACCS is caused by fibrous metaplasia of lens epithelial cells (LECs), which produce fibrotic alterations after cataract surgery.[1] LEC converts into myofibroblasts when levels of the cytokines interleukin (IL)-1, IL-6, transforming growth factor (TGF) beta, and fibroblast growth factor rise. One of the many factors that have been discovered to aggravate the problem is a lack of zonular support for the lens capsule. Recent research has connected considerable capsule contraction in the presence of weak zonules to higher levels of TGF-beta 2 and monocyte chemoattractant protein-1.[2] If the contraction forces are not managed, they can cause IOL angulation or decentration, or even IOL dislocation and retinal detachment in severe cases.[3,4] To control and prevent late problems in ACCS, prompt recognition and treatment are necessary.

The majority of ophthalmologists perform Nd:YAG LASER anterior capsulotomy as a straightforward and painless outpatient operation. The anterior capsule contraction may typically be prevented by introducing four or more 1mm radial nicks into the fibrotic anterior capsular annulus.[3,4] The LASER has an anterior focus and an energy range of 1 to 3 mJ. The IOL should not be struck; radial Nicks should be used. Some surgeons have attempted to use the LASER to remove a capsule annulus. However, it is not recommended because it deposits in the angle and frequently leads to raised intraocular pressure. We recommend performing this when phimosis has only proceeded to a depth of less than 4mm to avoid potential late zonular dehiscence.[3,4]

The prognosis for non-progression of contraction after Nd:YAG anterior

capsulotomy is quite excellent. Suppose treatment is not administered, the risk of pseudophacodonesis, IOL decentration, tilt, or dislocation, which can develop unexpectedly, increases. Clinical follow-up of patients at high risk for capsular contraction syndrome is one of the most effective measures of prevention when sufficient surgical precautions have been taken. As previously stated, the risk of the most extreme type of this illness is greatest in the first 3 to 6 months following cataract surgery. The earliest signs of this condition are either direct visibility of the capsule at the slit lamp or changes in the position of the IOL and the resulting alterations in refraction. If the front capsular aperture appears to be contracting, surgeons should use an Nd:YAG laser to make relaxing radial incisions across the capsulorhexis margin. This procedure usually relieves the capsular force on the lens implant and zonules if done early enough.[3,4]

In some cases of capsular contraction syndrome, the thickened fibrotic tissue can become so dense that radial incisions are difficult. In this case, surgeons can utilize a Nd:YAG laser to remove the ring of capsular tissue from around the phimotic aperture. The contraction rarely causes so severe deformity that doctors must remove and replace the IOL. Furthermore, there is a considerable danger of capsular dislocation and vitreous loss. Thus, surgeons will almost certainly insert the new IOL in the sulcus rather than the grossly deformed, fibrotic bag. When faced with the aforementioned obstacles, it is essential to plan for the worst-case situation.[3,4]

Despite all prophylactic measures, the most serious complication of capsular contraction syndrome is increasing zonular dehiscence, while researchers have noted that dehiscence can occur without signs of pathologic contraction. This problem, in either instance, necessitates surgical intervention. If there is evidence of capsular/IOL instability, the surgeon should consider putting scleral sutures. This procedure is sophisticated and dangerous, although it is less dangerous than "rescuing" the complete bag/lens complex from the vitreous. The process is beyond the scope of this article. However, Ahmed et al. describe it elegantly.[3,4]

Herein, we report a case of a 63-year-old female with no known risk factors who developed anterior capsular contraction syndrome in the right eye two years after uneventful cataract surgery with the implantation of IOL.

CASE REPORT

A 63-year-old woman arrived with developing right-eye impaired vision. Two years ago, the patient had an uncomplicated cataract surgery with intraocular lens (IOL) implantation in the right eye (Figure 1). The patient reported that his right eye's visual acuity improved after surgery. The patient denied any past trauma or pharmaceutical use. The patient's previous medical history and family medical history were ordinary. Previous glasses use was also denied.

The right eye's visual acuity at the time of presentation was as follows: uncorrected visual acuity (UCVA) was LogMAR 0.60 and best corrected visual acuity (BCVA) was LogMAR 0.00 with S +3.00 hyperopic shift. The intraocular pressure measured 17 mmHg. Slit lamp examination revealed anterior capsule opacification and anterior capsular contraction with the presence of fibrosis surrounding the capsulorhexis opening. IOL remained in the capsular bag. Fundus examination was within normal limits. Anterior chamber depth and axial length were 3.71 mm and 24.73 mm respectively. A diagnosis of anterior capsular contraction of the right eye was made.

Nd:YAG laser capsulotomy to relax anterior capsular contraction was performed, with 6 relaxing incisions made at 1, 3, 4, 7, 9 and 11 o'clock positions. Two weeks after laser capsulotomy (Figure 2), visual acuity of the right eye improved to LogMAR 0.00 without correction. Follow-up slit lamp examination revealed anterior capsule opacification with no contraction and IOL remained in the capsular bag. Intraocular pressure and fundus examination were normal. The anterior chamber depth decreased to 3.63 mm with the axial length of 24.76 mm.

DISCUSSION

ACCS is a potential complication of cataract-removal surgery that occurs three

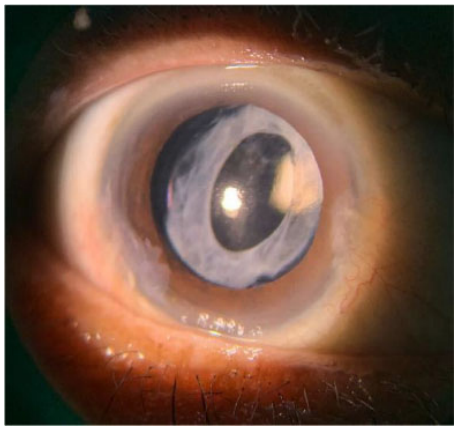

Figure 1. Photograph of the eye before Nd:YAG laser capsulotomy.

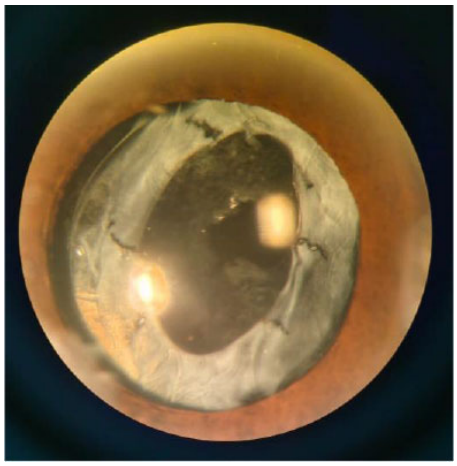

Figure 2. Photograph of the eye after Nd:YAG laser capsulotomy.

months or more after the procedure. It is a condition distinguished by anterior capsule opacification, excessive constriction and fibrosis of the capsulorhexis opening, and IOL decentration.[2,5-7] The fibrous metaplasia of lens epithelial cells (LECs) on the inner surface of continuous curvilinear capsulorhexis (CCC) is known to cause capsular contraction syndrome.[5] This fibrotic alteration causes anterior capsule opacification and excessive constriction of the anterior capsule opening, which may impede the visual axis and lead to additional IOL problems such as pseudophacodonesis and IOL decentration or dislocation.[1,5]

ACCS has been linked to a variety of ocular and systemic disorders that either enhance inflammatory activity in the anterior chamber or compromise the blood-aqueous barrier. Diabetes mellitus, uveitis, retinitis pigmentosa, myotonic dystrophy, late age, and, in

particular, pseudoexfoliation syndrome, a disorder that causes zonular instability, are all examples. The existence of these characteristics should thus warn ophthalmologists about the risk of ACCS in the coming months.[1] The pathogenesis of ACCS is known to involve cytokines released by remnant LES, which initiate the fibrous metaplasia process. In eyes with cataracts, lens epithelial cells were shown to produce interleukin-1 (IL-1) and IL-6, which may stimulate collagen synthesis and fibrosis.[1,8] Transforming growth factor (TGF-), a cytokine discovered to be increased in the aqueous humor during surgery, upregulates the receptor for transforming growth factor-2 (TGF-2). TGF-2 is critical in mediating the differentiation of LECs to myofibroblasts. It may also have a role in the development of posterior capsule opacification (PCO) and anterior subcapsular cataract (ASC).[1,9-11] Zhang et al. discovered a higher level of TGF-2 in patients with high myopia, which could explain their link with ACCS.[9]

Other surgical risk factors, such as limited capsulorhexis size, insufficient excision of remaining LECs, and IOL design and materials, may potentially contribute to the development of CCC.[9] Hydrophobic acrylic IOLs were shown to cling better to the anterior capsule, leaving less room for LEC proliferation and migration to the optic surface. Hydrophilic optics, on the other hand, adhere less to the anterior capsule and exhibit more frequent capsular contraction than hydrophobic lenses.[9,12] Other studies, such as those conducted by Joo et al.[13] and Sacu et al.[14], indicated that IOL material did not influence capsular shrinkage or capsulorhexis contraction.

Interestingly, our patient had no inherent risk factors. The patient had no history of excessive myopia, ocular inflammation, or systemic illnesses. Only two patients in a study of 20 patients with anterior capsular contraction after phacoemulsification had no recognized risk factors, whereas others had uveitis, myopia, pseudoexfoliation syndrome, diabetes, and trauma.[7] This demonstrates that ACCS occurs seldom in persons who do not have underlying risk factors. There was no decentration or tilting of the IOL, indicating that zonular dehiscence was unlikely to be the culprit.[15] External factors, such as a smaller capsulorhexis opening and more preserved lens epithelium, may have contributed to the ACCS in our case. Capsule shrinkage is caused by a force imbalance between the force applied by zonular fibers and the centripetal force created by capsular contraction. Because capsular fibrosis is caused by lens epithelial metaplasia, the possibility of capsular contraction increases with more retained epithelium, which is the case with smaller capsulectomy.[2] This is consistent with a study by Joo et al., who found that eyes with LEC removed intraoperatively showed less capsule shrinkage than eyes without LEC removal, and the difference was statistically significant. It was also discovered that three months after surgery, most eyes with an initial capsulorhexis size of less than 5.5 mm had an opening of less than 5 mm. Those with an initial capsular opening greater than 5.5 mm ended up with an opening greater than 5 mm.[13] Davison discovered similar results in his study, showing wrinkled haze and greater laser capsulotomy rates in eyes with a small capsulorhexis aperture of roughly 4.5 mm paired with small optic IOL implantation.[2] A minimum capsulorhexis diameter of 5 to 5.5 mm was thus recommended, well-centered and as round as possible, especially in susceptible eyes. Can-opener capsulotomy, which involves intentionally establishing anterior radial capsular defects, may be explored in individuals with severe zonular weakness.[2,13]

The patient in our study presented with progressive hazy vision caused by anterior capsule opacification. Furthermore, at the time of presentation, the patient had a hyperopic shift of S +3.00 D, with UCVA and BCVA of 5/20 and 5/6.5, respectively. After two weeks, visual acuity recovered to 5/5. The anterior chamber depth was likewise found to drop from 3.71 mm at presentation to 3.63 mm post-capsulotomy. This suggested that when the capsular contraction occurred, the anterior chamber depth increased but subsequently recovered to its initial depth once the fibrosis was removed via capsulotomy. The explanation behind this is most likely due to IOL deformation caused by capsular contraction. The IOL bows backward posteriorly as the capsular bag compresses, exerting strain on it.[16] The optic position within the eye determines the efficiency of an IOL. Each 1.00 mm axial movement of an average power IOL is predicted to result in a 1.25 diopter shift in refraction. An anterior shift in IOL position results in myopia, while a backward shift results in hyperopia.[17] This is consistent with Oh et al.'s description of a case of IOL anterior vaulting induced by physical trauma, which presented with shorter anterior chamber depth and myopic shift. Myopia was resolved and the anterior chamber depth increased after the IOL exchange.[18] A posterior vaulting of the IOL within the capsular bag would be suggested by a hyperopic shift and deepening of anterior chamber depth, as reported in our investigation.[16] Refractive changes after cataract surgery should be watched because they may be an early sign of ACCS. Eldin et al. found that following a laser capsulotomy to relieve the fibrosis and lower the contraction stress imposed by the capsule on the IOL, the refractive power returned to emmetropia. This is supported by a statistically significant difference in refraction between before and one day after laser capsulotomy ($p = 0.00766$).[19]

ACCS is best treated with Nd:YAG laser capsulotomy. The laser was used to make radial incisions at the capsulorhexis aperture, alleviating the tension generated by the contraction and allowing the IOL to revert to its normal shape.[20] In a long-term research conducted by Ye et al., Nd:YAG laser anterior capsulotomy resulted in stable or enhanced vision, with no patients experiencing capsular contraction recurrence after 2 years.[4] Even yet, Nd:YAG laser capsulotomy may not be appropriate for some patients, such as those with thicker anterior capsule hyperplasia, obstruction of anterior capsule opening, IOL deviation, nystagmus, or other diseases that prevent eye fixation.[21] Other methods, such as microscissor surgery, vitrectorrhexis, or capsular peeling, may be considered in these circumstances.[22-24] The anterior capsule aperture was not considerably obstructed in our patient, the IOL stayed in the capsular bag, and fixation was possible. As a result, Nd:YAG laser capsulotomy was chosen in our instance.

The operation successfully relieved the contraction during the post-operative evaluation, with enhanced visual acuity. Long-term monitoring is advised to detect any recurrence of contraction.

In light of this case report's promising results, there are several avenues for future research in this area. Conducting a larger-scale clinical study involving a diverse patient population would provide more robust evidence of the effectiveness of Nd:YAG laser capsulotomy in resolving hyperopic shifts associated with anterior capsular contraction syndrome. This could help establish standardized protocols and guidelines for its use in clinical practice. Also further investigations into the long-term outcomes and stability of refractive changes following Nd:YAG laser capsulotomy are essential to assess the durability of this treatment approach. This should include monitoring visual acuity, refraction, and potential complications over an extended period. In conclusion, these future studies' recommendations aim to advance our understanding of treating hyperopic shifts in anterior capsular contraction syndrome and guide evidence-based clinical decision-making.

CONCLUSION

ACCS is a possible complication following CCC performed in cataract surgery, which may occur in patients with no known ocular or systemic risk factors. Presentations include blurred vision, possible hyperopic shift, with anterior capsule opacification and contraction as seen in slit lamp examination. This report presented a case of anterior capsular contraction syndrome of the right eye two years after uncomplicated cataract surgery with IOL implantation. The patient had no known risk factors for ACCS. A hyperopic shift of +3.00 D was noted at the initial presentation. Nd:YAG laser capsulotomy was performed to release the capsular contraction. During post-capsulotomy follow-up, it was noted that the hyperopia resolved and the anterior chamber depth decreased, with significant improvement in visual function. Prompt treatment of contraction release with Nd:YAG laser capsulotomy is therefore effective in restoring visual function and prevent further complications in cases of ACCS.

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CONFLICT OF INTEREST

In this review article there is no potential conflict of interest.

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AUTHOR'S CONTRIBUTION

All authors contributed equally to this review article.

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