

Use of the chop hook to stabilize the capsular bag in patients with crystalline lens dislocations and cataracts

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Abstract

Objective: To observe the treatment effects of chop hook-assisted phacoemulsification surgery in patients with crystalline lens dislocation.

Methods: Thirty-seven eyes with cataracts and crystalline lens dislocations underwent cataract surgery. An L-shaped chop hook was introduced into the anterior chamber, and the tip was pushed or pulled to the centre of the anterior capsular edge of the zonular dialysis during the cataract operation. Postoperative follow-up was conducted for ≥ 1 month.

Results: All patients' postoperative visual abilities improved except one patient with glaucoma. One patient who underwent –5D intraocular lens implantation exhibited vision of 1/50. Visual acuity was less than 6/20 in 6 eyes, 6/20 to 10/20 in 7 eyes, and greater than 10/20 in 22 eyes.

Conclusions: L-shaped chop hooks can be used to push or pull the anterior capsular edge of the zonular dialysis for protection and avoidance of further zonular damage. This strategy provides satisfactory effects and reduces use of additional instruments.

Keywords

Chop hook, lens dislocation, cataract

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Introduction

Crystalline lens dislocation or subluxation is a complicated situation in cataract surgery. Lens subluxation was previously classified as a contraindication to phacoemulsification (PHACO). Common techniques in cataract surgery include extracapsular cataract extraction and intraocular lens (IOL) implantation in the ciliary sulcus, intracapsular cataract extraction, secondary IOL

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implantation, and crystalline lens removal and suture fixation of the IOL. However, these procedures present several disadvantages including long operation times, large incisions, and IOL tilt and decentration.¹ The postoperative effects of this surgery have improved as PHACO techniques have improved. Nevertheless, improper intraoperative treatments increase the dislocation range, which results in failed IOL implantation. In previous studies, an iris hook auxiliary²⁻⁵ or a capsular hook were used in this surgery. In the present study, we used an L-shaped chop hook to push or pull the edge of the capsular bag for protection and avoidance of further damage to the zonules. This strategy provides a satisfactory effect without the use of an iris hook or capsular hook.

Methods

Routine preoperative systemic and eye examinations were performed, including slit lamp, intraocular pressure (IOP), corneal endothelial cell, and A/B ultrasound biomicroscopic examinations. The lens dislocation range was 2 to 6 o'clock.

Topical anaesthesia and routine disinfection were performed. A side port incision was made with a disposable 15° metal blade located at the corneal sclera had a width of 0.75 mm. After injection of a viscoelastic agent into the anterior chamber of the eye, a three-step, limbal corneal sclera tunnel, self-sealing incision was made in the corneal scleral with a 2.2- to 2.7-mm metal blade. The centre of the anterior capsule was cut with a sharp needle. Capsulorhexis forceps were used to grasp the capsule and perform a 4.5- to 5.5-mm capsulorhexis. An L-shaped chopper was inserted from the corneal scleral into the anterior chamber. The left hand was used to position the L-shaped chopper (Figure 1A) toward the anterior capsule using the chop-divide method. If the tip of the L-shaped chop

hook (Figure 1B) entered the anterior chamber from the opposite side of the zonular dialysis, the f-face of the tip of the L-shaped chop hook (Figure 1C) was pushed to the centre of the anterior capsular edge of the zonular dialysis. If the L-shaped chop hook entered the anterior chamber from the identical side of the zonular dialysis, the e-face of the tip of the L-shaped chop hook (Figure 1D) was pulled to the centre of the anterior capsular edge of the zonular dialysis. Timely supplementation with a viscoelastic agent was applied to sustain the capsular bag and anterior chamber. Next, the same method was applied while suctioning the cortex and implanting the IOL. After providing informed consent, some patients with lens dislocations beyond 4 o'clock underwent implantation of a capsular tension ring (CTR) before implantation of the IOL. The IOLs were implanted in the capsular bag using injectors. The haptic positions were adjusted to stable positions. If the pupils were not round, anterior vitrectomy was performed to remove the prolapsed vitreous body. The incision was hydrated and was not sutured. A subconjunctival injection of dexamethasone (0.5 ml) was administered and tobramycin dexamethasone eye ointment was applied. The patients were given tobramycin dexamethasone for 3 to 4 weeks. *No iris hooks or capsular hooks were used in any patients. This strategy provided satisfactory effects and reduced the use of additional instruments.*

All patients were followed up postoperatively for at least 1 month. Follow-up visits occurred on the first day, at the first week, and at the first month postoperatively if the patient had no complications such as a lens dislocation range of greater than 3 o'clock. The patients with lens dislocation ranges greater than 3 o'clock returned for follow-up visits for at least 3 months. The patients also returned if they had any complaints. The postoperative visual acuity and IOP were measured, the IOL position was determined,

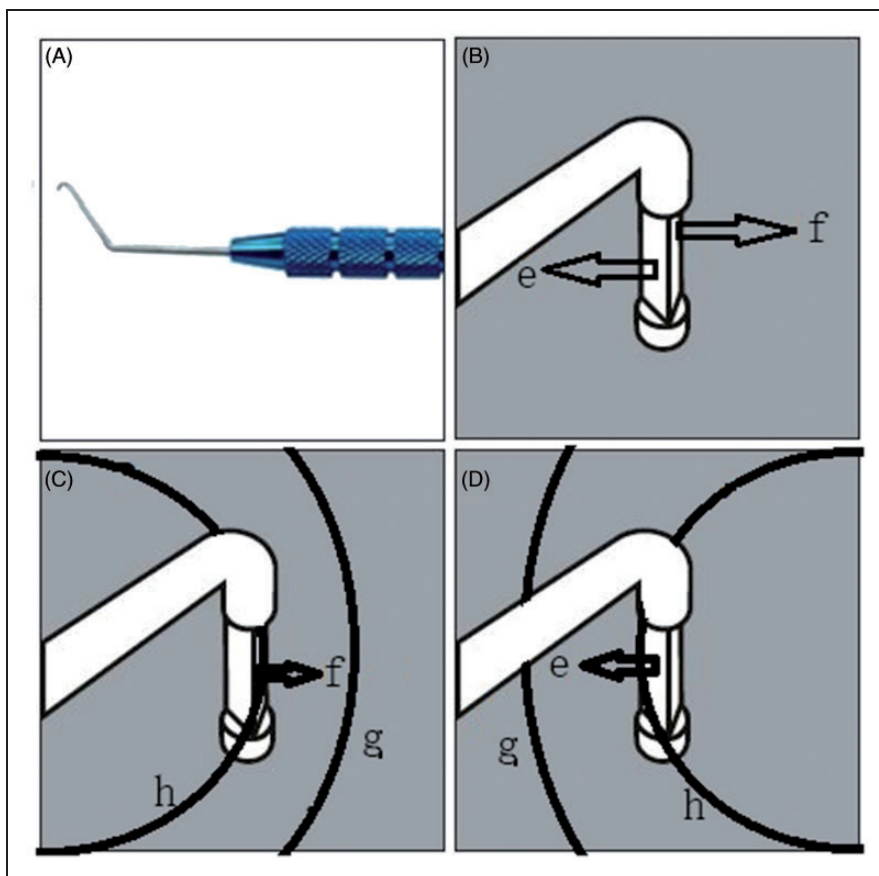


Figure 1. Schematic drawing of the technique. A: L-shaped chopper. B: Tip of L-shaped chopper. C: Pushed to the anterior capsular edge of the zonular dialysis (f). D: Pulled to the anterior capsular edge of the zonular dialysis (e). (g) Zonular dialysis. (h) Anterior capsular edge.

and the cornea and anterior chamber were examined. The patients were also assessed for any other complications.

Results

Thirty-seven eyes with cataracts and crystal-line lens dislocations (22 male and 15 female patients) underwent cataract surgery from November 2012 to January 2016. The patients were aged 5 to 78 years (average, 59 years). The cases included 14 right eyes and 23 left eyes. One eye had a cataract with absolute glaucoma and a high IOP without light perception, 11 had light perception, and

29 were within 1/20 visual acuity. The corrected visual acuity of all 37 patients was less than 6/20. Among all patients, the following conditions were noted (some eyes were affected by more than one condition): trauma history ($n=20$), glaucoma ($n=5$), congenital zonular dialysis relaxation ($n=2$), retinitis pigmentosa ($n=3$), pseudo-exfoliation syndrome ($n=2$), pathological myopia ($n=5$), and unknown history ($n=4$). Two patients presented with corneal oedema near the incision during the early post-operative follow-up. Two patients exhibited high IOP (30 mmHg) within 1 day after surgery; the viscoelastic content under the

IOL may have been insufficiently aspirated in these patients. After anterior chamber drainage and drug treatment, the IOP returned to a normal level on the second day postoperatively. No patients presented with posterior capsule rupture, and all IOLs were successfully implanted in the capsular bag. Moreover, all lenses were in the correct position as observed in the pupillary central optical zone. The postoperative visual acuity improved in all patients except one, who had glaucoma with no light perception. One patient who underwent -5D IOL implantation presented with vision of 1/50. Furthermore, 6 eyes had visual acuity of less than 6/20, 7 eyes had visual acuity of 6/20 to 10/20, and 22 eyes had visual acuity of greater than 10/20.

Discussion

*The predisposing risk factors for common suspensory ligament relaxation include exfoliation syndrome, advanced age, a history of trauma, premature retinopathy, and a history of intraocular surgery.*⁶ Compared with lenses that undergo conventional cataract surgery, lenses with zonular dysfunction or rupture cannot maintain a normal position. The capsular bag cannot maintain normal tension, and the surgical difficulty and complication risks increase significantly. These risks include capsular rupture, loose and falling lenses, unclean nucleus vitreous cortical aspirations of the lens, vitreous body prolapse, failed IOL implantation, IOL decentration or dislocation, and retinal detachment.

*An auxiliary iris hook²⁻⁵ or capsular hook is used in surgical repair of crystalline lens dislocation or subluxation.*⁷ *The iris hook was the earliest internationally applied tool that was used in PHACO to expand the size of the pupil⁸ and divide it to create flexible⁹ and rigid iris retractors.*¹⁰ *The earliest iris hook was developed by Hohwig¹¹ and was applied to treatment of lens subluxation by Merriam and*

*Zheng.*¹² *Iris hook retractors may damage the edge of the pupil, and the use of capsular retractors during the operation may damage the side of the capsular bag. Iris hooks may also damage the sphincter muscle.*¹³ *Because the iris hook tip is short, it can slide from the anterior capsule during PHACO and thus may fail to sustain the capsular bag.*¹⁴ *The number of incisions is also consistent with the increasing number of retractors, modified capsular anchors,¹⁵ and peripheral corneal damage⁷ due to factors such as retractor expansion.*¹⁶ *CTRs have been inadvertently threaded through capsule retractor loops.*¹⁷ *The substantial tension of the CTR may cause it to snap the zonular region and interfere with the irrigation of the cortex.*¹⁸ Additionally, lens dislocation is uncommon, and experience with these additional instruments is required, limiting the application of this procedure.

In the present study, an L-shaped chopper was used to divide the lens nucleus, and the head of the L-shaped chopper was used to push away the capsular edge of the zonular dialysis at the centre on the opposite side or to pull it at the centre on the identical side. The L-shaped chop hook was used to push the capsular edge of the zonular dialysis to stop the prolapse of the vitreous body and reduce the lens fluctuation and risk of zonular breakage. The suction cortex and rolling force of the viscoelastic agent are reduced upon capsular and centripetal attraction. In this strategy, neither an iris hook nor a capsular hook was needed. Additional incisions were not required for placement of the iris or capsular retractors; therefore, the operation time and cornea astigmatism were decreased. Fewer incisions are also associated with a decreased opportunity for infection, and a decreased surgery time reduces operation costs.

Five patients exhibited glaucoma. After diagnosis of primary acute angle-closure glaucoma caused by trauma, two patients underwent trabeculectomy and exhibited

shallow anterior chambers with high IOP and postoperative complications. Both of these patients had a history of trauma and crystal subluxation. One patient with an iron bullet wound sustained 25 years before the surgery exhibited a retinal pigment epithelium that manifested bone-like changes. *In one patient with no light perception, lens-heavy inflation induced disappearance of the anterior chamber and the cornea was oedematous and damaged. Thus, the patient underwent a cataract operation to save the eyeball.* The pathogenesis of glaucoma secondary to lens subluxation is relatively complex, and the existing operation methods for these patients have no uniform standards. PHACO combined with anterior vitrectomy, posterior chamber IOL implantation, and blunt angle separation is a safe and effective treatment for these patients.¹⁹ According to the suspensory ligament rupture ranges of the PHACO IOL implants and the CTR implantations, for lens dislocation of more than three quadrants, the choice of trabeculectomy combined with cataract surgery, intraoperative vitreous prolapse and the anterior chambers of the patients with anterior vitrectomies is suggested.²⁰ The outcome of an operation for glaucoma alone is likely to be poor. In one study, the shallow anterior chamber and even the anterior chamber disappear, and surgical removal of the lens was applied twice.²¹ The bag tension ring combined with PHACO, IOL implantation, and real angle separation is a safe and effective surgical treatment for lens subluxation associated with secondary angle-closure glaucoma.²²

In this study, five eyes exhibited high levels of myopia. One of these patients underwent eye surgery because of trauma 7 years previously (whether the injury caused the zonular dialysis or the high level of myopia induced the zonular dialysis was unclear), and the remaining four patients had no trauma history. The patients with long axial lengths presented with high levels

of myopia. These pathological changes increase the difficulty of cataract surgery. Some of the difficulties encountered include the collapse and displacement the IOL due to zonular dialysis. Tang et al.²³ applied CTRs to the surgical treatment of cataracts associated with high levels of myopia. High levels of myopia with fragile zonules complicate the surgery because of the distinct anatomy. However, moving the cortex and nuclear pieces away and maintaining the anterior chamber is difficult in patients with high levels of myopia in the deep anterior chamber. When an L-shaped chop hook was used to assist the PHACO surgery in the present study, the implantation of the artificial lens into the capsular bag was smoothly performed while the visual acuity of the patients was significantly increased.

In this study, two cases of pseudo-exfoliation syndrome were noted. This syndrome manifests as the development of a grey-white dandruff-like stripping material around the lens with a saw-tooth-shaped, lace-like, grey-white opacity of the ring particles at the pupil edge. Most elderly persons develop this syndrome, and the incidence is increasing each year. The occurrence of this syndrome is not significantly different between men and women. Cataracts and stripping oliation syndrome with crisp and easily broken zonules, a weakened iris contraction force, ciliary zonule degeneration, and iris epithelial depigmentation are likely to occur in patients with postoperative capsular rupture. Other complications and postoperative visual acuity factors are related. After chop hook-assisted PHACO and IOL implantation, the patients' acuity reached 20/20.

Conclusion

The chopper is an instrument that is routinely used during PHACO. In patients with zonular dialysis, the e-face or f-face of the tip of the L-shaped chop hook can be used

to pull or push the edge of the zonular dialysis capsular bag to enhance the stability of the operation, increase the convenience of cataract PHACO, facilitate aspiration of the cortex, and prevent heavy zonular dialysis injury and prolapse of the vitreous body. Furthermore, neither iris hooks nor capsular hooks are needed, and no additional incision to the cornea or iris damage occurred in this study. Therefore, this procedure for IOL implantation is cost-saving and safe for patients. In summary, L-shaped chopper-assisted PHACO and lens implantation for the treatment of partial crystalline lens dislocation is a safe procedure that reduces the incidence of complications.

Statement of Ethics

The study conformed to the tenets of the Declaration of Helsinki.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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