

Original article

Surgical outcomes of 23-gauge vitrectomy for the management of lens fragments dropped into the vitreous cavity during cataract surgery



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Abstract

Purpose: To assess the clinical features and surgical outcomes of 23-Gauge (G) vitrectomy for lens fragments dropped into the vitreous during cataract surgery.

Methods: A retrospective, non-comparative, interventional case series at a single medical center. The medical records of 45 eyes from 45 consecutive patients who were referred to our hospital for surgical retrieval of phacoemulsification dropped lens fragments and who underwent 23-G vitrectomy were retrospectively reviewed. Data pertaining to patient demographics, pre- and post-operative Snellen visual acuity, and postoperative complications were recorded. Factors associated with dropped lens fragments were also examined.

Results: Mean patient age was 68.18 ± 11.47 years. The preoperative and postoperative mean logarithm of minimum angle of resolution (logMAR) visual acuity was 1.91 ± 0.59 (Snellen equivalent 0.06 ± 0.15) and 0.42 ± 0.51 (Snellen equivalent 0.54 ± 0.31), respectively. Forty-two eyes (93.3%) had dislocated lens fragments <50% of the total lens size. Two eyes (4.4%) had a large and hard lens nucleus, which necessitated the use of a 20-G fragmatome to efficiently and completely remove the lens material. At the final examination, 30 eyes (66.6%) had a visual acuity better than 20/40. Post-vitrectomy complications included elevated IOP for at least 3 months ($n = 5$ eyes, 11.1%), intraocular lens dislocation ($n = 2$ eyes, 4.4%), and cystoid macular edema ($n = 1$ eye, 2.2%). No cases of postoperative endophthalmitis or retinal detachment were observed.

Conclusions: A 23-G vitrectomy is safe and efficient for the surgical management of dropped lens fragments following cataract surgery.

Keywords: Complication, Dropped lens, Lensectomy, Phacoemulsification, 23 Gauge vitrectomy

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Introduction

Dislocation and dropping of lens fragments into the vitreous during phacoemulsification is a serious complication during cataract surgery that occurs in 0.1–1.5% of all cases.¹

In clear-corneal incision cataract extraction, the rate of posteriorly dislocated crystalline lens ranges from 0.3% to 1.1%.² Intravitreal retained lens fragments, with an incidence rate between 0.1% and 1.6%, are a rare but potentially serious complication of cataract surgery, which can result in poor

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visual acuity (VA) and other serious ocular complications.³ Posterior-capsule rupture during phacoemulsification is the most frequent cause.⁴ Three port 20-gauge (G) pars plana vitrectomy (PPV) has been the gold standard for vitreoretinal surgery since 1974, and standard 20-G PPV is an established surgical technique for retained lens fragments.^{5,6} Compared with traditional 20-G vitrectomy, 23-G PPV permits decreased operative and healing times, faster visual recovery, and reduced postoperative inflammation associated with conjunctival and scleral sutures.⁷ Additionally, diminished conjunctival scarring may result in a higher success rate for a patient's future surgical procedures.

Over the past decade, transconjunctival sutureless vitrectomy has been introduced and has dramatically reduced postoperative patient discomfort. In 2005, Eckardt⁸ promoted the 23-G transconjunctival system, in an effort to combine the benefits of the 25-G and 20-G instrumentation. This report reviews the safety and efficacy of the 23-G PPV for lens fragment retrieval from the vitreous cavity following cataract surgery.

Methods

The medical records of consecutive patients who underwent PPV for retained lens material (surgeons: HSK, HJC, YJY, MJC, JIH, SWC, CGK, and SJY) between June 2008 and June 2012 were reviewed. All surgeries were performed at Kim's Eye Hospital retina center. The study protocol was reviewed and approved by the Human Investigation Committee of institution and was done in compliance with the Health Insurance Portability and Accountability Act regulations. The conduct of this study adhered to the tenets of the Declaration of Helsinki.

We included all patients who underwent 23-G vitrectomy for retained crystalline lens material in the vitreous cavity and who had a minimum postoperative follow-up period of 2 months. Records were excluded from analysis if inflammatory or ocular surface disease with severe conjunctival scarring was present, or if the patient had a history of vitreoretinal or glaucoma surgery in the operative eye. Cases that required more than 2 sclerotomy sites, or those that were converted to a 20-G procedure, were also excluded.

Pre-, intra-, and postoperative medical record data were retrospectively collected. Demographic information and initial and final examination details, including visual acuity, noncontact tonometry (Tonometer TX-10, Canon, Utsunomiya-shi, Japan) intraocular pressure (IOP) measurements, PPV surgery details, and postoperative complications were noted. Hypotony was defined as an IOP of ≤ 5 mmHg, and elevated IOP was defined as an IOP of ≥ 21 mmHg. Indications for surgery included retained nuclear material or cortex, with or without marked intraocular inflammation, and/or uncontrolled IOP. Preoperative patient characteristics are summarized in Table 1. Best-corrected Snellen visual acuity measurements were converted into logarithm of the minimum angle of resolution (logMAR) units.

All surgical procedures were performed using a 3-port transconjunctival microcannula-based 23-gauge PPV system (Accurus[®] 800 CS, Alcon Manufacturing, Ltd., Irvine, CA). Microcannulas were inserted transconjunctivally, with the help of an insertion trocar, 3.0 mm posterior to the limbus in the inferotemporal, superotemporal, and superonasal

Table 1. Demographic characteristics of patients (n = 45).

Mean age (year, mean \pm SD)	68.18 \pm 11.47
Sex (male/female)	17/28
Lesion (OD/OS)	28/17
HTN	13/45 (28.9%)
DM	2/45 (4.4%)
DM and HTN	11/45 (24.4%)

quadrants. A 23-G microvitrectoretinal (MVR) blade was inserted tangentially, approximately 30° parallel to the limbus. The infusion cannula was placed in the inferotemporal quadrant, and plugs were used to temporarily close the other entry sites. A high speed vitrectomy probe (ACCURUS[®] 8065; Alcon Manufacturing, Ltd., Irvine, CA) with a cutting rate of 1500–2500 cuts/min and a vacuum level of 300–500 mmHg was used during PPV. The balanced salt solution bottle height was set at 50 cm. Retained lens material was removed with a 500 mmHg vacuum and a 1500 cuts/min linear cutting rate, which was decreased as aspiration was increased. A bimanual technique was used to push the nucleus into the port of the vitrectomy cutter with the endoilluminator probe. In cases where hard lens material was unable to be removed with the vitrectomy probe, 1 sclerotomy site was enlarged to accommodate a 20-G MVR blade and the fragmatome hand piece (ACCURUS[®]). Through this sclerotomy, intravitreal phacoemulsification with a 20-G titanium fragmatome (ACCURUS[®]) was performed to remove the hard nucleus fragments in the mid-vitreous with a vacuum level of 100–150 mmHg. Microcannulas were slightly withdrawn from the eye at the end of the operation. A gentle massage to the 23-G sclerotomy site was performed with a muscle hook to achieve a proper seal. In all cases of aphakia, an intraocular lens (IOL) was implanted. If the anterior capsulorhexis was intact, IOL sulcus insertion was performed. If the anterior capsulorhexis was not intact, IOL scleral fixation was performed. In eyes that received an intraocular lens implantation corneal stromal wound hydration was performed at the end of surgery to ensure water tight secure wounds. If the fragmatome was used, the 20-G sclerotomy created in the superotemporal quadrant was closed with 7–0 vicryl sutures.

Patients were monitored postoperative at day 1, week 1, month 1, month 3, and then every 3 months. Because most patients did not attend all clinical appointments, data were evaluated at the day 1 appointment and the final postoperative visit. All patients were examined on postoperative day 1, and at various times, depending on each patient's recovery, but for at least 2 months following surgery. Patients were monitored for complications including wound leakage, intraocular hemorrhage, retinal tears or detachments, hypotony, glaucoma, choroidal detachment, endophthalmitis, and cystoid macular edema. Statistical analysis was performed using SPSS statistical software (SPSS for Windows, Version 20.0; SPSS Inc, Chicago, IL). A *P* value of < 0.05 was defined as statistically significant.

Results

A total of 140 eyes (140 consecutive patients) had dislocated lens material, and were managed at our institution, between June 2008 and June 2012. Of these, 95 eyes underwent 20-G transconjunctival sutureless vitrectomy

(TSV) for retained lens fragments, and the remaining 45 eyes underwent 23-G TSV and were included in this study. There were 17 men (37.8%) and 28 women (62.2%) and mean patient age was 68.18 ± 11.47 years. Mean follow-up time following surgery was 4.62 ± 8.07 months. Demographic data, preoperative lens status, dropped nucleus size, and initial clinical findings are listed in Tables 1 and 2. Mean logMAR visual acuity was 1.91 ± 0.59 (Snellen equivalent 0.06 ± 0.15) and mean IOP was 26.04 ± 17.42 mmHg before PPV. The average time between cataract surgery and vitrectomy was 1.93 ± 4.12 days, and 25 (55.6%) patients underwent vitrectomy on the same day as cataract surgery. Thirty patients (66.7%) had retained lens material that was made up of <25% of the total lens, 12 patients (26.7%) had retained lens material that included 25–50% of the lens, and 3 eyes (6.7%) had retained lens material >50% of the total lens. Two eyes (4.4%) had a hard lens nucleus and the 20-G fragmatome was needed to efficiently and completely remove the lens material. Except for these 2 patients, sutures were not needed to close sclerotomy sites at the end of surgery. At the time of surgery, 21 patients (47%) were pseudophakic and 24 patients (53%) were aphakic. In all cases of aphakia, an intraocular lens (IOL) was successfully implanted. If the anterior capsulorhexis was intact (22 eyes, 92%), an intraocular lens (IOL) sulcus insertion was performed, otherwise IOL scleral fixation was performed (2 eyes, 8%).

On postoperative day 1, no eyes were hypotonous, and the mean IOP was 13.91 ± 6.27 mmHg. At the final examination, mean logMAR visual acuity had improved to 0.42 ± 0.51 (Snellen equivalent 0.54 ± 0.31) ($p < 0.05$) and 30 of 45 eyes (66.7%) had a visual acuity of 20/40 or better. Observed post-vitrectomy complications included elevated IOP for at least 3 months ($n = 5$ eyes, 11.1%), intraocular lens dislocation ($n = 2$ eyes, 4.4%), and cystoid macular edema (CME, $n = 1$, 2.2%). Retinal tear, retinal detachment, subluxation or dislocation of pseudophakic IOL and endophthalmitis were not observed in any eye during the post-PPV follow-up period (Table 3).

Table 2. Preoperative and intraoperative findings (45 eyes).

Anterior chamber cell	
None	3/45 (6.7%)
+ ~ ++	13/45 (28.9%)
++ ~ +++	16/45 (35.6%)
+++ ~ ++++	7/45 (15.6%)
++++ ~ many	6/45 (13.3%)
Corneal edema	34/45 (75.6%)
Size of dropped nucleus (%)	
<25	30/45 (66.7%)
25–50	12/45 (26.7%)
>50	3/45 (6.7%)
Preoperative lens status	
Pseudophakic	21 (46.6%)
Aphakic	24 (53.3%)
IOL scleral fixation	2/45 (4.4%)
IOL sulcus insertion	22/45 (48.9%)
Time to PPV ^a (days)	1.93 ± 4.12
Baseline BCVA ^b (LogMAR ^c)	1.91 ± 0.59
Baseline IOP ^d (mmHg)	26.04 ± 17.42

Values are expressed as mean \pm SD.

^a PPV = pars plana vitrectomy.

^b BCVA = best corrected visual acuity.

^c LogMAR = the logarithm of minimum angle of resolution.

^d IOL = intraocular lens.

Table 3. Postoperative findings (45 eyes).

Postoperative first day IOP ^a (mmHg)	13.91 ± 6.27
Follow-up period (months)	4.62 ± 8.07
Final visual acuity (Snellen) ($n = 45$)	0.54 ± 0.31
Final BCVA ^b (LogMAR ^c) ($n = 45$)	0.42 ± 0.51
Final IOP ^a (mmHg) ($n = 45$)	13.97 ± 4.55

Values are expressed as mean \pm SD.

^a IOP = intraocular pressure.

^b BCVA = best corrected visual acuity.

^c LogMAR = the logarithm of minimum angle of resolution.

Discussion

Posterior dislocation of lens fragments is an uncommon event during cataract surgery. It is associated with complications such as intraocular inflammation, corneal edema, elevated intraocular pressure, retinal detachment, and vitreous hemorrhage.⁹ Vitreoretinal surgery is an effective method of removing retained lens fragments after phacoemulsification.¹⁰ The 23-G sutureless vitrectomy technique is becoming increasingly popular for an expanding number of conditions, such as non-clearing vitreous hemorrhage, epiretinal membrane, macular hole, vitreomacular traction, and intraocular foreign body removal. Generally, posteriorly dislocated lenses or dropped nuclei are contraindications to this sutureless technique.¹¹ Therefore, pars plana vitrectomy for retained lens fragments has traditionally been performed with 20-G vitrectomy systems. But the 23-G vitrectomy has several advantages over the 20-G procedure because the smaller scleral holes are self-sealing (no sutures required), thereby remarkably reducing tissue damage.¹² Additionally, the smaller sclerotomy incision size leads to reduced levels of operative trauma, postoperative pain, inflammation, and induced corneal astigmatism. Patients also have faster anatomical and visual recoveries.¹³ Visual acuity improved in all of our patients who underwent 23-G TSV for retained lens fragments after cataract surgery with phacoemulsification. Additionally, 66.7% of eyes achieved a final visual acuity of 20/40 or better, on the higher end of the reported 42–71.3% following 20-G PPV for retained lens fragments.^{14–17} Horozoglu et al.¹⁸ also reported improved visual acuity in 17 of 17 patients who underwent 23-G TSV for retained lens fragments after complicated cataract surgery with phacoemulsification. In this case series, all retained lens fragments were removed with the 23-G vitrectomy cutter in 88.2% of eyes, and 70.6% of eyes had final visual acuity of 20/40 or better. Ho et al.¹⁹ reported successful 25-G TSV in 17 eyes with retained lens fragments after complicated cataract surgery. All lens fragments were removed without using a phacofragmatome and an improvement in visual acuity was reported in all eyes. The final visual acuity was 20/40 or better in 52.9% of eyes. Therefore, our visual outcomes with 23-G vitrectomy are comparable with previous reports of standard 20-G vitrectomy.

Postoperative complications after 20-G vitrectomy for dropped lens fragments include glaucoma (2–11%), retinal detachment (8–22%), and cystoid macular edema (28%).^{20–25} Our incidence of postoperative complications with 23-G TSV was smaller than or comparable to these rates with elevated IOP, retinal detachment, and CME eyes observed in 13.8%, 0%, and 2.7% of eyes, respectively. Previous reports suggest that there may be an increased rate of endophthal-

mitis with sutureless vitrectomy compared with standard vitrectomy,^{26,27} but none of our patients developed endophthalmitis.

Forty-two patients (93.3%) had retained lens material that included <50% of the lens. Three eyes (6.7%) had retained lens material >50% of the total lens, among them, 2 eyes had a hard lens nucleus and the 20-G phacofragmatome was needed to efficiently and completely remove the lens material. The decision to use phacofragmatome was made intraoperatively, depending on the density and size of the lens material.

Because the smaller gauge of these vitrectomy systems gets blocked easily by lens material, it was not possible to remove large, hard lens fragments with the vitrector alone. Because no commercially available 23-G phacofragmatome exists, we were forced to enlarge the 23-G sclerotomy port to accommodate the larger 20-G phacofragmatome in these eyes. In our study, as already mentioned, a 20-G phacofragmatome was used in 4.4% of eyes, lower than reported rates of 40% with 20-G vitrectomy.²⁸

The primary limitations of our study included a small sample size, retrospective study design, lack of comparative 20-G and 25-G vitrectomy groups, a short follow-up period, and the inclusion of cases performed by multiple surgeons. Although all surgeons decided to convert to 20-G vitrectomy with fragmentation when hard lens material could not be removed efficiently with the 23-G system, this decision was still surgeon dependent. Despite these limitations, this study can help guide the operative approach for patients with retained lens fragments, and this study is the largest series to date on the safety and efficacy of the 23-G approach to removing retained lens fragments after cataract surgery.

We have shown that 23-G vitrectomy allows for the minimally complicated management of dropped lens fragments following complicated cataract surgery. The procedure is particularly successful when retained lens fragments are small (<50% of the lens) and the anterior capsulorhexis is intact, possibly making the 23-G vitrectomy the first choice of intervention. To the best of our knowledge, this is the first report on the use of 23-G vitrectomy in Aisa for the management of posteriorly dislocated lens fragments and dropped nuclei.

Conflict of interest

The authors declared that there is no conflict of interest.

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