Management of retained lens fragments in complicated cataract surgery
Soraya Rofagha and Robert B. Bhisitkul

Department of Ophthalmology, University of California San Francisco, School of Medicine, San Francisco, California, USA

Correspondence to Robert B. Bhisitkul, MD, PhD, Professor of Clinical Ophthalmology, UCSF Beckman Vision Center, 10 Koret Way K301, San Francisco, CA 94143, USA
Tel: +1 415 476 8633; e-mail: BhisitkulR@vision.ucsf.edu

Current Opinion in Ophthalmology 2011, 22:000–000

Purpose of review
To evaluate and review the current literature on the management of retained lens material with pars plana vitrectomy (PPV) and lensectomy after complicated cataract surgery.

Recent findings
Recent studies on retained lens fragments in cataract surgery support early referral to a vitreoretinal specialist, and indicate that visual outcomes are favorable with current vitrectomy and lensectomy techniques. Nearly 83% of patients without preexisting eye disease who undergo PPV achieve visual acuity of 20/40, whereas 5.5% of patients have postoperative acuity of 20/200 or worse. In a multivariate analysis, the predictors for 20/40 or better vision were presenting acuity, insertion of a posterior chamber lens at the time of cataract surgery, and absence of preoperative eye disease. Retinal detachment and secondary glaucoma were the major causes of ocular morbidity. Most retrospective studies assessing the timing of vitrectomy and lensectomy show no advantage for early (within 1 week) PPV. Delayed vitrectomy beyond 30 days is associated with poorer outcomes. With technological advances, small gauge vitrectomy is considered a viable alternative surgical approach to standard vitrectomy with phacoemulsification.

Summary
Given favorable outcomes reported with planned PPV, the primary intraoperative goals of the cataract surgeon encountering posterior displacement of lens material are to remove lens material that is accessible from the anterior approach, remove vitreous from the anterior segment, and place an anterior or preferably posterior chamber intraocular lens. Early involvement of the retinal surgeon facilitates the evaluation and timing for vitrectomy and lensectomy based on the clinical course.

Keywords
cataract surgery, lensectomy, pars plana vitrectomy, retained lens fragments

Introduction
Approximately 3 million cataract surgeries are performed annually and the incidence of retained lens fragments after cataract surgery has been reported to be between 0.3 and 1.1% [1,2]. Decreased visual acuity can result from corneal edema, phaco-uveitis, secondary glaucoma, cystoid macular edema, and retinal detachment. Although complicated cataract surgery can be a source of frustration for the anterior segment surgeon and initially disappointing to the patient, patients referred for pars plana vitrectomy (PPV) for retained lens fragments generally have good final outcomes. Review of the recent large series in the literature shows that between 76.4 and 82.6% of patients without pre-existing eye disease achieve final visual acuity of 20/40 or better [3**].

Most recently, Ho et al. [3**] studied 166 patients with posteriorly dislocated lens fragments during cataract removal who had at least 3 months of follow-up. The visual acuity result was 20/40 or better in 72.3% of patients and 20/200 or worse in 10.8% of patients. This is consistent with the eight previously reported large series [4–11] in which between 44 and 71.3% of patients achieve 20/40 or better and between 10.3 and 21% have final visual acuity of 20/200 or worse. In addition, when patients with preexisting eye disease were excluded, 82.6% had visual acuity of 20/40 or better and only 5.5% had vision 20/200 or worse. Furthermore, in the...
2 Special commentary

series by Ho et al., every patient who presented to the vitreoretinal surgeon with visual acuity better than 20/200 had final visual acuity of 20/63 or better. In this study, the only significant predictors for 20/40 vision or better were presenting vision \( P < 0.001 \), insertion of a posterior chamber lens at the time of cataract surgery \( P < 0.005 \) and absence of preoperative eye disease \( P < 0.001 \). Reasons for final visual acuity 20/200 or worse included preexisting eye disease \( \text{odds ratio (OR)} 4.22; 95\% \text{ confidence interval (CI)} 1.25–14.27 \) and development of glaucoma \( \text{OR} 12.81; 95\% \text{ CI} 2.81–58.56 \), but not pre-existing glaucoma or retinal detachment \( [3^{**}] \). Since 1992, 26 studies have reported outcomes on a total of 2390 patients who have undergone PPV after complicated cataract surgery. The prevalence of retinal detachment in these studies varies widely from 3.6 to 21.5\% \( [3^{**}] \). Likewise, the prevalence of raised intraocular pressure or glaucoma varies from 2 to 40.9\% \( [3^{**}] \). The wide range in these statistics is most likely explained by differences in outcome measurement and variable follow-up time.

Role of the anterior segment surgeon

In the event of complications during cataract surgery that result in dropped lens material, the goal of the anterior segment surgeon should be to do ‘just as much surgery as possible’ \( [12^*] \). The primary goals are to complete the anterior nuclear and cortical lens removal, to clear the vitreous from the anterior chamber and wound sites, and if possible, to place a posterior or anterior chamber intraocular lens. The placement of posterior chamber intraocular lens was the only surgeon-related factor predictive of vision 20/40 or better in a recent large, retrospective, multivariate analysis. Specifically, this study showed that better visual acuity was achieved with a posterior chamber intraocular lens compared to an anterior chamber intraocular lens or aphakia \( \left( P \leq 0.001 \right) \) \( [3^{**}] \).

If future vitreoretinal surgery is anticipated at the time of complicated cataract surgery, the anterior segment surgeon should suture clear corneal wounds in order to avoid further complications of a flat anterior chamber and hypotony during vitrectomy. Leakage from the clear cornea wound during vitrectomy can result in intraocular lens (IOL) dislocation, IOL-endothelial touch, iris incarceration and prolapse, and hemorrhagic choroidal detachment with subretinal and/or vitreous hemorrhage \( [13^*] \).

In recent years, anterior segment surgeons have adopted PPV techniques and instruments in the management of complicated cataract surgery \( [14] \). Evidence is not available to compare the efficacy and safety of these approaches to planned subsequent surgery by a vitreoretinal specialist. For the cataract surgeon, pars plana instruments are often used under direct visualization through the pupil with coaxial illumination. Surgical control is circumscribed in comparison to standard PPV using wide-angle viewing systems and endoillumination, and may promote incomplete lens fragment removal, further capsular disruption, or retinal traction and breaks. The only study in the literature that directly addresses the risk of retinal detachment after posterior-assisted levitation is a retrospective review of 14 patients who underwent posterior-assisted levitation during complicated cataract surgery in Singapore \( [15] \). One patient (7\%) developed a macula-off retinal detachment with proliferative vitreoretinopathy. In 2008, Chaudhary \( [16] \) reported three cases of complex retinal detachment after posterior-assisted levitation, which to date have not yet been reported in the literature. Although these surgical approaches have not been systematically studied, it is possible that complications may be underreported.

Timing of vitrectomy

In the setting of retained lens fragments, expedited PPV is generally indicated for uncontrolled glaucoma, moderate to severe uveitis, and hyphema or vitreous hemorrhage, and may be influenced by a desire for earlier visual rehabilitation, especially if there is poor vision in the fellow eye. Advantages of delaying PPV include allowing time for corneal edema and acute sclero-conjunctival injection to improve and allowing surgery to be circumvented if small nuclear or soft cortical fragments spontaneously absorb. For retained lens fragments, early vitrectomy (defined as within 1 week following initial cataract surgery) has traditionally been favored to curtail inflammation and lead to improved visual results. However, this rationale has not been supported by most studies, including several recently reported. There are nine series in the literature that report outcomes on at least 100 cases \( [3^{**},4–11] \). Six of these series \( [3^{**},4–8] \) addressed the question of whether the timing of PPV affects visual outcome and no association was found in the majority. In the most recent study, the median interval between cataract surgery and PPV was 4 days (range 0–139 days) and visual outcome did not depend on any interval studied (within 3 days, within 1, 2, 3 weeks, and within 1 month). Ho et al. \( [3^{**}] \) did not find that early vitrectomy was among the factors predictive for good visual outcome in a multivariate analysis, but they did find it associated with the reduced occurrence of secondary glaucoma, a strong predictor of poor outcome. Merani et al. \( [4] \) did find that vitrectomy delayed for more than 30 days was associated significantly with risk of retinal detachment and predicted poorer visual outcome.

Additionally, conservative management may allow a substantial portion of patients to forego vitrectomy surgery altogether. In a recent series of 42 patients referred for
management of retained lens fragments and followed for at least 1 year, Schaal and Barr [17*] found that 36% were successfully managed without need for vitrectomy. Among the patients treated medically, mean visual acuity was 20/38 at both 1 month and 1 year (range 20/70–20/20), with no difference at these time points compared with patients treated surgically with PPV. Spontaneous resorption of lens material is in general more expected with fragments that are small (a quadrant or less), or predominantly composed of lens cortex with the typical fluffy white appearance. Because spontaneous resolution is best monitored with serial fundus examinations, this can be another advantage of early referral to the vitreoretinal specialist. In each of the retrospective series outlined here, the timing of vitrectomy surgery was by physician discretion, reflecting selection bias and limiting definitive conclusions.

Although data from prospective trials are scant, these recent studies on retained lens fragments, together with clinical experience, support vitreoretinal referral within 2–3 days, allowing vitrectomy at 1 week or less for severe cases (uncontrolled glaucoma, increased phaco-uveitis, possibly hyphema, or vitreous hemorrhage), and at longer intervals as an option for cases amenable to medical management with topical antibiotics, frequent corticosteroid drops, and if indicated, IOP-lowering medications. In this way, more time can improve corneal clarity, wound healing and inflammation to facilitate subsequent vitrectomy and lensectomy surgery, as well as allow time to address social issues such as patient anxiety. Finally, observation of several weeks or more may be warranted for cases wherein self-resolution appears likely and further surgery may be obviated. Postoperative management can include ultrasonography when needed to rule out retinal detachment, and optical coherence tomography for early detection of postoperative macular edema due to mechanical or inflammatory causes.

Vitreoretinal surgical approaches
If the clear corneal wound had not been secured at the time of cataract surgery, an initial step is to suture the wound. The basic goals of vitrectomy include removal of residual anteriorly prolapsed or incarcerated vitreous, and thorough posterior vitreous removal to avoid traction during lens fragment removal. Attention is paid to the position and stability of the IOL. While using the fragmatome, lens fragments are first lifted away from the retinal surface by aspiration, so as to employ phacoemulsification only in the mid/anterior vitreous cavity, thereby limiting exposure of the macula to sonication energy. Efforts are made to limit direct endothelialization of the macula to avoid phototoxicity. Surgical techniques for lens fragment removal vary according to physician preference, including bimanual crush techniques, adjuvant use of heavy perfluorocarbon liquid to elevate dropped fragments, the concurrent use of intravitreal triamcinolone acetonide for gel visualization as well as for the treatment and prevention of cystoid macular edema [18], and prophylactic 360° laser for prevention of retinal detachment [19*].

The traditional approach for PPV for the removal of retained lens fragments is through the use of 20-gauge vitrectomy with phacofragmentation. However, since the debut of the first vitreous cutter in 1972, there has been continuous progress in vitreoretinal instrumentation with a notable advance in 1990 with the introduction of 25-gauge transconjunctival sutureless three-port vitrectomy. The advantages of 25-gauge vitrectomy compared with standard 20-gauge vitrectomy include the decreased surgical trauma of the sclera and conjunctiva, faster operating times, postoperative patient comfort and faster visual recovery. Sutureless wounds that do not self-seal, however, may be associated with serious complications such as wound leakage, hypotony and endophthalmitis. Recent experience with 25-gauge systems to remove lens material without the use of a phacofragmatome has been reported as a possible alternative to standard 20-gauge techniques. The authors of these small retrospective series note that conclusions in terms of visual outcomes, and rates of glaucoma, retinal detachment, and cystoid macular edema cannot be made until there is more widespread experience with micro-incisional vitrectomy techniques in dropped lens cases [20,21*]. As an alternative, in the setting of small gauge vitrectomy, once the vitreous removal is complete, a single port can be enlarged with the 20-gauge microvitreoretinal (MVR) blade to introduce a standard fragmatome for ultrasonicication of the lens fragments, with attention to the lower infusion rates of which small gauge infusion cannulas are capable. To date, a fragmatome designed for small gauge PPV is not available.

Although PPV effectively manages the morbidity from retained lens fragments, the surgery is not without its own risks. Data from the larger series in the literature report the risk of rhegmatogenous retinal detachment after PPV for retained lens fragments to be 4.0–10.3% [5–7,11,22,23]. The largest study in the literature, which reports outcomes on 343 patients, found that 25 patients (7.3%) developed rhegmatogenous retinal detachment before vitrectomy and 19 patients (5.5%) developed rhegmatogenous retinal detachment after vitrectomy. Nearly half (42%) of the detachments after vitrectomy occur after the 3-month standard postoperative period and 50% are macula-off detachments [22]. Retinal reattachment was achieved in 91% of the patients in this series; only 18% achieved final visual acuity of 20/40 or better and 53% had vision of 20/200 or worse. Because of this, some vitreoretinal surgeons have advocated the use
of prophylactic encircling laser posterior to the vitreous base to reduce the risk for retinal breaks [19*].

Conclusion

Patients who undergo PPV for retained lens fragments generally do well, with the proportion of patients achieving final visual acuity of 20/40 or better between 76.4% [4] and 82.6% [3*], after excluding preexisting eye disease. In the case of complicated cataract surgery, the anterior segment surgeon should perform anterior vitrectomy to clear prolapsed or incarcerated vitreous and secure the clear corneal wound. A posterior chamber intraocular lens may be placed, if possible, while avoiding maneuvers to remove dropped fragments due to limitations in visualization and unnecessary surgical risks. Referral to a vitreoretinal specialist in the first few days allows prompt vitrectomy to be arranged for severe cases with uncontrolled glaucoma or uveitis, and deferred surgery for medically manageable cases, which may allow for nonsurgical resolution. The most serious threats to long-term visual potential remain retinal detachment and secondary glaucoma. Vitrectomy within 1 month may prevent vision loss from glaucoma and delayed vitrectomy beyond 1 month may increase the risk of retinal detachment. With successful cooperation between the anterior segment surgeon and the vitreoretinal specialist, the well being of the patient can be safeguarded in the event of complicated cataract surgery and retained lens fragments.

Acknowledgement

R.B.B. is a member of advisory boards of Genentech Inc. and Allergan Inc. He is a consultant to Santen Inc. The authors have no financial interests related to the topic of this manuscript.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as: • of special interest •• of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 000–000).

3 Ho LY, Doh BH, Wang L, Bunker CH. Clinical predictors and outcomes of pars plana vitrectomy for retained lens material after cataract extraction. Am J Ophthalmol 2009; 147:587.e1–594.e1. This study retrospectively reviewed 166 patients with complicated cataract surgery who underwent PPV and showed favorable outcomes in a multivariate analysis for patients with better presenting visual acuity, insertion of a posterior chamber intraocular lens and absence of preoperative eye disease.
13 This editorial comments on how publication bias may result in the under-reporting of complications resulting from anterior segment techniques to retrieve dropped fragments as well as how selection bias by vitreoretinal specialists can under-estimate the benefits of early vitrectomy.
17 Schaal S, Barr CC. Management of retained lens fragments after cataract surgery with and without pars plana vitrectomy. J Cataract Refract Surg 2009; 35:863–867. This retrospective review of 42 patients referred to a vitreoretinal practice for PPV showed that over one-third of the patients were treated successfully with medical therapy alone.
21 Ho LY, Walsh MK, Hassan TS. 25-Gauge pars plana vitrectomy for retained lens fragments. Retina 2010; 30:843–849. This study was a retrospective case series of 17 patients who underwent 25-gauge PPV for retained lens fragments and found results comparable to 20-gauge techniques.