

# Concurrent removal of intravitreal lens fragments after phacoemulsification with pars plana vitrectomy prevents development of retinal detachment

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Received: 2014-06-07 Accepted: 2014-08-14

## Abstract

• **AIM:** To evaluate the outcomes of "concurrent vitrectomy" to retrieve dislocated lens fragment during phacoemulsification.

• **METHODS:** In a retrospective, observational case series, data of patients who underwent "concurrent" pars plana vitrectomy (PPV) for dislocated lens fragments between the period 2000 and 2008 were reviewed. Data collected included patient demographics, pre-operative visual acuity, intra-operative occurrence of retinal breaks, duration of follow up, post-operative intraocular pressure, final best-corrected visual acuity (BCVA), presence of cystoid macular edema (CME) and occurrence of rhegmatogenous retinal detachment (RRD).

• **RESULTS:** A total of 58 eyes of 58 patients were included in the study. At 12mo the mean postoperative BCVA was logMAR 0.17 (20/30) with a range of logMAR 0 to 0.69 (20/20 to 20/100), with 96.6% (56/58) of patients showing post-operative improvement in visual acuity ( $P=0.005$ ). None of the patients developed postoperative retinal detachment, endophthalmitis or non-resolving uveitis at 12mo.

• **CONCLUSION:** Our study results suggest concurrent PPV for retained lens fragments after cataract surgery is beneficial and may decrease the risk of glaucoma and prevent development of RRD.

• **KEYWORDS:** phacoemulsification; dislocated lens fragments; vitrectomy; glaucoma; cystoid macular edema; retinal detachment

**DOI:10.3980/j.issn.2222-3959.2015.01.16**

Chalam KV, Murthy RK, Priluck JC, Khetpal V, Gupta SK. Concurrent removal of intravitreal lens fragments after phacoemulsification with pars plana vitrectomy prevents development of retinal detachment. *Int J Ophthalmol* 2015;8(1):89-93

## INTRODUCTION

The incidence of dislocated lens fragments ranges from 0.2% to 1.5% after cataract surgery [1-4]. Dislocated lens fragments are associated with a myriad of secondary complications including intraocular inflammation, glaucoma, cystoid macular edema (CME) and retinal detachment (RD) [5-9]. Pars plana vitrectomy (PPV) with removal of dislocated lens fragments is a well established method for removal of dislocated lens fragments and results in prevention of secondary complications such as CME and RD [10-14].

Although PPV is an accepted technique for the removal of retained lens fragments, the optimal timing of intervention remains controversial [4,15-17]. The timing after cataract surgery depends on the amount of retained lens material, course of the eye, and availability of vitreoretinal surgeon. PPV for removal of lens fragments has traditionally been delayed to allow the eye to recover from initial surgery [4]. However, this could result in prolonged intraocular inflammation and lead to delayed recovery [17]. Availability of an experienced vitreo-retinal surgeon and dedicated machinery would allow vitrectomy to be performed at the time of occurrence of posterior dislocation of nuclear fragments. Advantages of such "concurrent" vitrectomy for dislocated lens matter during phacoemulsification include reduced risk of intraocular inflammation, prevention of development of CME, secondary glaucoma and reduced incidence of post vitrectomy RD.

In this study we performed a retrospective chart review and compared surgical and clinical outcomes of patients undergoing concurrent PPV for removal of dislocated nuclear lens fragments into the vitreous cavity performed at our institution and compared it to clinical outcomes of delayed surgery reported in literature.

## SUBJECTS AND METHODS

The study was approved by the local institutional review board and all the subjects signed an informed consent. This was a retrospective comparative, consecutive, chart review of all patients undergoing unplanned concurrent PPV for retained lens fragments after complicated cataract surgery at the University of Florida Jacksonville between 2000 and 2008. Inclusion criteria included patients with age >21 years old, subjects who had undergone PPV at the same setting to

## Vitrectomy for dislocated lens fragments

retrieve the posteriorly dislocated nuclear fragments and follow-up of at least 12mo post operatively. Patients with follow-up of less than 12mo were excluded from the study.

At the 1y follow-up visit a chart review was performed and parameters reviewed included patient demographics, pre-operative Snellen visual acuity, intra-operative occurrence of retinal breaks, post-operative intraocular pressure (IOP), final best-corrected visual acuity (BCVA), presence of postoperative CME and occurrence of RD.

The data obtained was statistical analyzed using GraphPad Instat 3 software (SanDiego, CA, USA). Chi-square test was used to compare demographic data, Mann-Whitney  $U$  test was used to compare initial and final BCVA and the occurrence of complications. A  $P$  value of  $<0.05$  was considered statistically significant. Since all cases of dislocated lens fragments at our institution are managed with concurrent vitrectomy, a literature search using "PubMed" database using MesH with the key words "dislocated nuclear fragments"; "vitrectomy" was done to retrieve all the studies available to date. A Meta-analysis of studies involving vitrectomy to retrieve posteriorly dislocated nuclear fragments ( $n \geq 50$ ) was done. Parameters noted were BCVA, incidence of CME and RD. Results from the metanalysis were compared to that observed from our series.

**Surgical Technique** All surgeries were performed by two experienced surgeons (Chalam KV and Gupta SK). All patients were under topical anesthesia at the time of surgery and were converted to sub-Tenon's anesthesia after dislocation of lens fragments was recognized. The surgical techniques included closing the corneal tunnel with a 10-0 mono filament nylon suture and the incision was made water tight as soon as rupture in the posterior capsule with dislocation of the fragments was noted. Vitreous in the anterior chamber with small and soft anterior lens fragments were removed with a 20 G cutter introduced through the paracentesis incision. The vitrectomy technique in each eye consisted of a standard 3-port 20-g pars PPV using a Bausch&Lomb: Millennium™ vitrectomy system (Rochester, NY, USA). After performing a core vitrectomy, a posterior vitreous detachment, if not present, was induced in all eyes. The lens fragments were either removed using a vitrector or with a bimanual approach using a lighted pick and a vitrector. In cases of dense lens fragments, fragmatome was employed. After the removal of lens fragments prophylactic 360° laser retinopexy was performed in a circumferential pattern. Scleral depression was performed to examine the periphery in all the patients for retinal tears and any tears and residual lens fragments. Intraocular lens was implanted at the end of the procedure. The patients were examined at post-operative 1d; 1wk; 1 and 12mo, and data were collected as noted earlier.

**Table 1 Baseline characteristics of patients (n=58) enrolled in the study**

Variables	n
Mean age (a)	72.4
Age	
<60	5
60-69	12
70-79	35
>80	6
Gender	
M	26
F	32
Eyes	
OD	33
OS	25
Pre-existing ocular pathology (n=25)	
Glaucoma	4
Diabetic retinopathy	12
Age-related macular degeneration	6
Myopic maculopathy	3
Initial BCVA	
<20/200	8
20/200-20/80	12
20/80-20/50	34
20/50-20/30	4
IOP preoperative (mm Hg)	
<21	54
22-30	3
>30	1

BCVA: Best-corrected visual acuity; IOP: Intraocular pressure.

## RESULTS

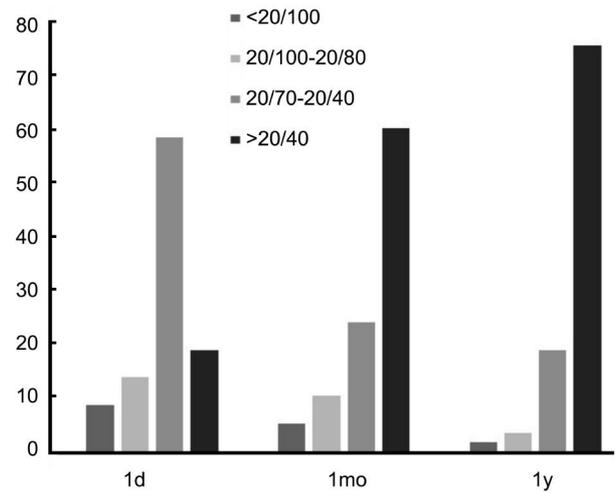
A total of 58 eyes of 58 patients were included in the study. The demographics of the patients are shown in Table 1. The mean age of the patients was 72.4y (range 59-83y). There was a slight preponderance of females (32/58, 55.20%) compared to males (26/58, 44.83%,  $P=0.2$ ). The mean follow up period was 18mo (range 14mo to 4y). Twenty-five patients had pre-existing eye diseases other than cataract that limited the vision of patients. The diseases included glaucoma (4/58) diabetic retinopathy (12/58), age-related macular degeneration (6/58) and myopic degeneration (3/58). The mean pre-operative BCVA was 20/60. Lens fragments were cortical in nature in 41.4% of patients (24/58) and both cortical and nuclear in 58.6% of patients (34/58). A vitrector was used in all the cases to remove the fragments and a fragmatome was used in 14/58 of the patients. Circumferential endolaser was applied in all cases; retinal tears were noted in 4 eyes (6.8%) of patients intra-operatively and supplemented with endolaser photocoagulation. No other intraoperative complications were noted at the time of PPV. At the end of vitrectomy, patients either had placement of an intraocular lens in the sulcus (54/58) or in the anterior chamber (4/58).

At 12mo the mean postoperative BCVA was logMAR 0.17 (20/30) with a range of logMAR 0 to 0.69 (20/20 to 20/100),

**Table 2 Final outcomes and complications of patients who were enrolled in the study**

Variables	n
Final BCVA (at 1a)	
<20/100	1
20/100-20/80	3
20/70-20/40	14
>20/40	40
IOP postoperative (mm Hg)	
<21	56
22-30	2
>30	0
Transient corneal edema	14
Chronic CME	2
Intraoperative retinal breaks	4
RRD	None

BCVA: Best-corrected visual acuity; IOP: Intraocular pressure; CME: Cystoid macular edema; RRD: Rhegmatogenous retinal detachment.



**Figure 1 Change in Snellen post-operative visual acuity in the study patients at 1d, 1mo and 1y follow up period.**

**Table 3 Studies (with n>50 eyes) reporting the incidence of post-operative complications in patients who underwent vitrectomy after posterior dislocation of lens fragments**

Series (a)	No. of eyes	Glaucoma (%)	RD (%)	CME (%)	Chronic CME (%)
Olsson <i>et al</i> <sup>[5]</sup> (2000)	125	3.3	21.5	NR	13.5
Al-Khaier <i>et al</i> <sup>[6]</sup> (2001)	89	17	10	9	NR
Hansson and Larsson <sup>[7]</sup> (2002)	66	18	11	NR	NR
Smiddy <i>et al</i> <sup>[8]</sup> (2003)	100	NR	8	NR	NR
Scott and Flynn <sup>[9]</sup> (2001)	343	2	12.8	28	6
Salam <i>et al</i> <sup>[10]</sup> (2005)	249	NR	10	NR	NR
Cohen <i>et al</i> <sup>[11]</sup> (2006)	91	NR	NR	25	5
Merani <i>et al</i> <sup>[12]</sup> (2007)	223	5	9	23.2	NR
Ho and Zaman <sup>[13]</sup> (2007)	82	7.3	4.9	4.9	NR
Ho <i>et al</i> <sup>[14]</sup> (2009)	166	8.4	3.6	9.6	1.8
Current (2013)	58	10.3	None	13.7	3.4

RD: Retinal detachment; CME: Cystoid macular edema; NR: Not recorded.

with 96.6% (56/58) of patients showing post-operative improvement in visual acuity ( $P=0.005$ ; Table 2, Figure 1). Corneal edema (14/58, 24.1%) noted in immediate postoperative period resolved in the follow up period. Immediate postoperative IOP rise was noted in 6/58 (10.3%) of patients which resolved in all cases with topical therapy. None of the patients developed secondary glaucoma. Mean post operative refraction was  $\pm 0.75$  spherical equivalent. CME was observed in 8 eyes (13.7%) which were persistent in 2 eyes (3.4%) at 12mo visit. None of the patients developed postoperative retinal detachment, endophthalmitis or non-resolving uveitis at 12mo.

In a Meta-analysis of 2390 eyes, the incidence of postoperative glaucoma was noted to be 7.8%, RD to be 11.7% and CME to be 12.1% and chronic CME to be 3.7% (Table 3). In our report with concurrent vitrectomy, we noted lower incidence of post-operative glaucoma, RD but a similar rate of CME and chronic CME.

## DISCUSSION

The incidence of dislocated nuclear fragments during phacoemulsification has decreased considerably with

improvement in surgical techniques and instrumentation<sup>[3]</sup>. However, it is still a complication of considerable magnitude in the setting of university hospital, where resident training is an integral part of patient care<sup>[18,19]</sup>. The timing of intervention for management of dislocated lens fragments is still under debate<sup>[2]</sup>. The advantages of early vitrectomy include decrease in patient stress levels, lessened operative time, reduced risks of repeated anesthesia, and reduced collateral damage to intraocular structures due to fewer interventions by cataract surgeon in trying to extract dislocated lens fragments. Disadvantages include reduced visualization through an edematous cornea, hypotony, suprachoroidal hemorrhage and patient fatigue due to prolonged operative time<sup>[5,6]</sup>. The most recent study on this topic concluded that the outcomes of same-day PPV (within 12h of cataract surgery) appear to be similar to non-same-day PPV<sup>[17]</sup>. However, there is still lack of literature on outcomes of intervention performed concurrently.

At our institution a retinal surgeon is available to perform vitreoretinal surgery for management of dislocated lens fragments at the time of the occurrence of the complication

and an operating room staff who are trained in assisting both anterior and posterior segment surgeries. By default, all patients were consented for a possible involvement of a vitreo-retinal surgeon in the event of occurrence of complication. This unique arrangement provided an opportunity for us to evaluate visual outcomes in patients who underwent "concurrent" vitrectomy in patients with dislocated lens fragments, providing data on the largest case series available to date with the use of this technique.

Wide range of visual outcomes are reported in the literature after intervention for dislocated lens fragments with 44%-68% of patients having final visual acuity better than 20/40<sup>[6,20,21]</sup>. As opposed to uncomplicated cataract surgery, where visual outcome is stable after 3-4wk, cataract surgeries complicated by lens fragment dislocation have a prolonged post-operative recovery with visual acuities stabilizing anywhere between 3 to 12mo post-operatively<sup>[20]</sup>. In our study, outcome measures were evaluated based on the visual acuity recorded at one year postoperatively. The mean BCVA in our patients was 20/30 with 96.5% of patients showing post-operative improvement in visual acuity. Chen *et al*<sup>[21]</sup> in their comparative study of a group of patients who underwent concurrent vitrectomy versus delayed vitrectomy reported that 76% had final BCVA  $\geq$  20/40, 21% between 20/40 and 20/200 and 3% worse than 20/200. When vitrectomy was delayed less than 1wk ( $n=22$ ) and greater than 1wk ( $n=11$ ) it was shown that chance of BCVA  $\geq$  20/40 became 45% and 27% respectively.

Secondary glaucoma is the most common complication described after vitrectomy for retained lens fragments. Reported rates of permanent glaucoma range from 0% to 40.9% after vitrectomy retained lens fragments with a weighted average of 7.8%<sup>[3]</sup>. Lens particle glaucoma, retained viscoelastic material and steroid induced raised IOP are some of the underlying mechanisms. Our series had no new cases of glaucoma in the 54 patients without pre-existing glaucoma. Our hypothesis is that concurrent vitrectomy resulted in less post-operative inflammation and reduced the need for prolonged post-operative steroid treatment, resulting in less postoperative IOP spikes.

The rate of RD in delayed vitrectomy range from 3.6%-21.5% with a trend towards lower detachment rates after earlier vitrectomy<sup>[10-14]</sup>. Concurrent vitrectomy with identification and laser of retinal tears resulted in prevention of RD in our case series. Early vitrectomy removes lens fragments and prevents development of intraocular inflammation and inhibits vitreous contraction, a common cause of retinal tears and detachment. Utilization of a 360° barricade endolaser retinopexy immediately posterior to the vitreous base in our patients further reduced the risk of new retinal breaks due to contraction of residual vitreous at the sclerotomy sites<sup>[22]</sup>. None of our patients developed RD in our series suggesting a

clear benefit of early vitrectomy and barricade laser. We believe concurrent vitrectomy and barricade laser eliminated the risk of RD in our patients. Morris *et al*<sup>[23]</sup> reported placing 3 rows of laser barricade with indirect ophthalmoscopic technique and having a rate of RD of 1.3%, but with a longer follow-up of 6y.

Suprachoroidal effusion and hemorrhages have been cited as a risk factor of same-day vitrectomy for retained lens fragments, but statistically significant differences have not been shown<sup>[6]</sup>. No choroidal effusions or hemorrhages were noted in our patients.

Management of retained lens fragments may include assessment of the size and density of fragments. It has been shown that nuclear fragment dislocation is associated with worse visual outcomes compared to cortical and epinuclear fragments regardless of size<sup>[24]</sup>. The majority of 34/58 (59%) cases in our series involved some element of nuclear fragments representing an earlier disruption of the capsular bag complex. Fourteen of these 34 patients required a fragmatome to remove lens particles.

Multiple gauge vitrectomy techniques have been employed to deal with lens fragments<sup>[25]</sup>. The advantage of larger gauge ports includes easy access for fragmatome without enlarging wounds size and faster operating time during surgery. The disadvantage includes the need for suturing wounds, potentially higher risk of endophthalmitis<sup>[25]</sup>. The size and density of fragments has been reported as being a deciding factor in the gauge of instruments to use<sup>[7]</sup>.

The increased risk of endophthalmitis with posterior capsular tear is well known. One previous series have noted that post-operative endophthalmitis has been associated with suture-less 25 gauge PPV greater than 1wk after initial cataract extraction<sup>[7]</sup>. None of the patients in our study developed post-operative endophthalmitis indicating early vitrectomy in cases of posterior capsular tear and retained lens fragments may be of utility.

The limitations of our study include its retrospective study design, absence of controls and results from a single institution.

In conclusion, our study results suggest concurrent PPV for retained lens fragments after cataract surgery is beneficial and may decrease the risk of glaucoma and prevent development of RD. However, prospective clinical trials enrolling large number of patients can provide insight on the timing of vitrectomy.

### ACKNOWLEDGEMENTS

**Conflicts of Interest:** Chalam KV, None; Murthy RK, None; Priluck JC, None; Khetpal V, None; Gupta SK, None.

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