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Article

Clinical Outcomes of Vitrectomy for Dislocated Lens Fragments and/or Intraocular Lens

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Abstract

Posterior dislocation of lens fragments is an uncommon complication of phacoemulsification. However, it is associated with sight-threatening sequelae. These may include intraocular inflammation, secondary glaucoma, corneal edema, cystoid macular edema, and retinal detachment. Proper management is crucial to reduce the risk of these complications. Pars plana vitrectomy with intravitreal emulsification of retained lens fragments is indicated. Optimal timing for intervention is controversial. The aim of this study was to determine clinical outcomes of prompt, early and late pars plana vitrectomy for dislocated lens fragments and / or IOL. Thirty-five eyes were included and divided into three subgroups according to the timing of PPV (prompt, early and late). All eyes underwent 23-gauge PPV. The results illustrated that 22.2 % of prompt PPV achieve good visual outcome compared to only 8.3% and 7.14 % in early and late subgroups respectively. More than one third of cases (35.7 %) in late PPV ended with poor visual outcome. We concluded that timing of PPV is an important factor affecting clinical outcomes in cases complicated with dislocated nuclear fragments and/or IOL. The prompt PPV was associated with the best outcome followed by the early PPV. Delayed PPV had the worst prognosis.

Keywords
Dislocated lens fragments, Pars plane vitrectomy, Cystoid macular edema

1. Introduction

Phacoemulsification is associated with a high success rate; however, complications may occur. Posterior capsule rupture (PCR) with posteriorly dislocated lens fragments is considered one of these serious complications (Stein, 2012). Although it is an uncommon complication with an incidence of 0.2 % to 1.5 %, it can be sight-threatening due to sequelae of severe intraocular inflammation, corneal edema, secondary glaucoma, cystoid macular edema (CME), increased risk of endophthalmitis and retinal detachment (Stein, 2012). Pars plana vitrectomy (PPV) is indicated in retained nuclear fragments to reduce intraocular inflammation and to prevent other sequelae. Optimal timing for intervention and its impact on outcomes is still controversial (Salehi, 2011).

2. Results

Regarding the timing of PPV intervention in relation to the cataract surgery, 9 eyes (25.71 %) were subjected to prompt or same-setting PPV, 12 eyes (34.29 %) had PPV early within one week after the cataract surgery (average was 3.5 days) and the remaining 14 eyes (40 %) had late PPV more than one week after the cataract surgery (average was 12.4 days, the range was 8-32 days). During the whole follow-up period, there was a highly statistically significant difference among the three subgroups regarding all clinical outcomes. All subgroups had significant improvement in both UCVA and BCVA by the end of the follow-up period.

The prompt PPV subgroup achieved better outcomes than the other two subgroups as illustrated in the table (Table 1).

Table 1. Final BCVA outcome in the three subgroups

Final BCVA	Good visual outcome (0.5 or better)	Moderate visual outcome (0.1-0.3)	Poor visual outcome (worse than 0.1)
Prompt	2(22.2%)	6(66.7%)	1(11.1%)
Early	1(8.3%)	9(75%)	2(16.7%)
Late	1(7.14%)	8(57.1%)	5(35.7%)

To detect the statistical significance difference between every two subgroups, the data were analyzed using one-way ANOVA- Post Hoc multiple comparisons as illustrated in the table (Table 2). There was a statistically significant difference between prompt PPV and late PPV in UCVA and BCVA all over the follow-up period. However, there was no statistically significant difference between early PPV and late PPV subgroups except in BCVA at 1 month.

Table 2. This is a table of the mean VA overtime in the three subgroups.

	Prompt PPV	Early PPV	Late PPV	P value**	P1 value***		
					Prompt/ early	Prompt/late	Early/ late
UCVA							
1 month	0.15±0.03	0.095±0.05	0.09±0.03	0.01	0.034	0.005	0.450
3 months	0.17±0.04	0.094±0.02	0.11±0.04	<.0003	0.473	0.005	0.407
6 months	0.23±0.04	0.112±0.03	0.13±0.05	<0.0002	0.161	0.037	0.519
9 months	0.24±0.06	0.135±0.05	0.15±0.06	0.001	0.298	0.049	0.398
12 months	0.29±0.09	0.143±0.05	0.12±0.08	<0.0003	0.427	0.045	0.348
BCVA							
1 month	0.20±0.05	0.14±0.05	0.05±0.05	0.005	0.342	0.003	0.033
3 months	0.24±0.06	0.14±0.05	0.05±0.05	<0.0007	0.277	0.014	0.167
6 months	0.31±0.09	0.18±0.08	0.08±0.08	<0.0002	0.335	0.007	0.063
9 months	0.32±0.10	0.19±0.07	0.07±0.07	0.001	0.358	0.004	0.036
12 months	0.34±0.95	0.21±0.20	0.17±0.12	0.04	0.161	0.026	0.880

**The data is presented as mean ± SD. **p-value was calculated by one-way ANOVA.*

****p1 value was calculated by ANOVA- Post Hoc multiple comparisons*

Additionally, there was no significant difference between prompt PPV and early PPV during the whole follow-up period except in UCVA at 1 month. IOP changes showed a significant difference in all follow-up visits between prompt PPV and late PPV subgroups. However, there was no significant difference between prompt versus early PPV subgroups or early versus late PPV subgroups. The incidence of postoperative complications was significantly higher in late PPV than the other subgroups except for hypotony which was encountered more in the prompt PPV subgroup as shown in table (Table 3).

Table 3. The incidence of postoperative complications.

	Prompt PPV	Early PPV	Late PPV	p value
Corneal opacification	0	1(8.3%)	2(14.3%)	0.08
Elevated IOP	1(11.1%)	2(16.7%)	4(28.6%)	0.004
Chronic iritis	1(11.1%)	1(8.3%)	2(14.3%)	0.02
IOL decentration	2(22.2%)	1(8.3%)	3(21.4%)	0.03
Spongiform macular edema	4(44.4%)	6(50%)	7(50%)	0.005
Cystoid macular edema	2(22.2%)	2(16.7%)	4(28.6%)	0.002

3. Discussion

The present study aimed to detect the clinical outcomes of PPV in dislocated nuclear fragments or IOL. Regarding the timing of PPV intervention in relation to the cataract surgery, patients were distributed into three groups as follows: Nine eyes (25.71 %) were subjected to prompt or same-setting PPV, 12 eyes (34.29 %) had PPV early within one week after the cataract surgery (average was 3.5 days) and the remaining 14 eyes (40 %) had late PPV more than one week after the cataract surgery (average was 12.4 days, the range was 8-32 days). Factors that affected the timing of PPV included availability of vitrectomy setting and posterior segment surgeon at the time of complicated cataract surgery, the status of the anterior segment especially presence of corneal edema or uveitis which precluded posterior segment visualization, and the nature of the dislocated item wherein cases of only dislocated IOL the risk of intraocular inflammation was minimal even with delayed PPV.

Many studies tried to correlate the outcomes with the timing of PPV comparing between early and late PPV. However, optimal vitrectomy timing is undetermined, and the effect of timing on outcomes is controversial. Some studies have suggested that outcomes are better if PPV is performed within two weeks of nucleus drop (Agarwal, 2014). Nevertheless, early PPV may avoid chronic glaucoma, and break the cycle of progressive lens-associated inflammation (HOF, 2007).

Additionally, visualization for the retinal surgeon may also be initially poor due to corneal edema. It may be preferable to wait for edema and inflammation to decrease with medical therapy prior to PPV (Zang, 2015). A large retrospective series conducted by Modi et al reported no difference in visual acuity outcomes and complication rates between same-day and deferred PPV (Modi, 2013). Also, Rofagha et al reported that most retrospective studies assessing the timing of vitrectomy and lensectomy showed no advantage for early (within 1 week) PPV. However, delayed vitrectomy beyond 30 days is associated with poorer outcomes (Rofaga, 2011).

Comparatively, several studies reported that early PPV carries a better visual prognosis than late PPV (Schaal, 2009; Ghasemi, 2012; Kalevar, 2017). In a retrospective review of the records of 78 patients who underwent pars plana vitrectomy for retained lens fragments, Chen et al compared the outcomes among three groups: same day, early, and late vitrectomy. They reported that no patients in the same-day vitrectomy group developed complications, and 76% achieved a final visual acuity of 6/12 or better. In the early vitrectomy group, all patients had elevated intraocular pressure, and 45% achieved a final visual acuity of 6/12 or better. In the late vitrectomy group, all patients presented with corneal edema, moderate or severe uveitis, and elevated intraocular pressure. Of these patients, 27% had cystoid macular edema, 36% developed retinal detachment, and 27% had a final visual acuity of 6/12 or better. They concluded that immediate pars plana vitrectomy for retained lens fragments may achieve a better visual outcome, with reduced risk of secondary glaucoma, retinal detachment, or cystoid macular edema (Chen, 2008).

In our study, we found that prompt or same-day PPV had better outcomes than delayed PPV, while there was no statistically significant difference between prompt and early PPV on one hand, and between early and late PPV on the other hand in some parameters. However, the main significant difference was between prompt and late PPV subgroups.

We found that there was a statistically highly significant difference ($p < 0.01$) in clinical outcomes among prompt, early, and late subgroups. To detect the statistical significance difference between every two subgroups, the data were analyzed using one-way ANOVA- Post Hoc multiple comparisons. We detected that a significant difference was present between prompt and late

subgroups, while there was no significant difference between prompt and early subgroups on one hand or between early and late subgroups on the other hand. More than one-third of cases (5 eyes, 35.7 %) in the late PPV subgroup ended with poor visual outcome compared to 16.7 % (2 eyes) and only 11.1 % (one eye) in early and prompt PPV subgroups respectively.

Regarding early postoperative complications, corneal edema was present in 5 eyes in both prompt and late subgroups compared to only 3 eyes in the early subgroup. In the prompt subgroup, this can be explained by the prolonged duration of surgery as the cataract surgery and PPV were performed in the same setting. While in the late subgroup, it can be explained by a higher incidence of intraocular inflammation. In addition, the late subgroups included cases with already compromised cornea following complicated cataract surgery where early PPV could not be performed due to poor visualization. The incidence of iritis and secondary glaucoma was higher in the late subgroups than in the other two subgroups.

The incidence of spongiform macular edema was 4 eyes (44.4 %), 6 eyes (50 %), and 7eyes (50 %) in the prompt, early and late subgroups respectively. Cystoid macular edema was detected in 2 eyes (22.2 %), 2 eyes (16.7 %), and 4 eyes (28.6 %) respectively. Comparatively, a lower incidence of CME was reported by some previous studies (Al-Amri, 2008; Prenner, 2012; Sieber, 2017; Yamane, 2017).

4. Patient and Methods

This paper presents a prospective nonrandomized interventional case series conducted in the department of ophthalmology, Sohag University Hospital, Sohag, Egypt, between February 2019 and December 2020.

35 eyes were included in the study group and 85 eyes in the control group. Control group: 85 eyes were included; all eyes were pseudo phakic with PCIOL after uneventful phacoemulsification. They were selected to be closely matched to the study group in the demographic properties with the same exclusion criteria. All participants agreed to sign in a written informed consent about the planned procedure, prognosis, and possible complications. Additionally, the approval of the ethical committee of the Sohag Faculty of Medicine was fulfilled. The study followed the tenets of the Declaration of Helsinki.

Thirty-five eyes of 35 patients with a posteriorly dislocated nucleus, nuclear fragment(s), and /or IOL during phacoemulsification for age-related cataract were recruited and distributed to three groups regarding the timing of PPV: prompt PPV, early PPV, and late PPV.

Individuals with one or more of the following conditions were excluded from the study: Previous pars plana vitrectomy cases complicated with retinal detachment or endophthalmitis, presence of CME documented before cataract surgery, diabetic retinopathy, coexisting glaucoma preoperatively, and lost follow up for more than two visits.

All individuals were subjected to routine ophthalmic examination including uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA); (in Snellen's decimal), autorefractometry when possible, intraocular pressure (by Goldmann applanation tonometer). Anterior segment examination (by slit lamp bio microscopy) with special emphasis on assessment of corneal clarity and wounds, anterior chamber, the integrity of the capsular bag, and the IOL (type, position, stability) and dilatability of the pupil. Posterior segment examination (by indirect ophthalmoscope) was done with special emphasis on posteriorly dislocated lens fragments (nature, size, site, number, and density), type, and site of dislocated IOL if present. Associated pathology as RD or vitreous hemorrhage should be excluded. The timing between cataract surgery and PPV was documented to differentiate between prompt PPV (immediately in the same surgical setting), early PPV (within one week), and late PPV (delayed more than one week).

Preoperative investigations: B-scan ultrasound was indicated in eyes with hazy media with difficult fundus viewing. Reevaluation of IOL calculation in aphakic eyes or unstable IOL was necessary.

All patients underwent a 23-Gauge vitrectomy system (Oertli OS-4 surgical platform, Switzerland). Fundus visualization during vitrectomy was achieved using a wide-angle viewing system;

binocular indirect ophthalmoscopy (BIOM, Oculus). Additional procedures were necessary in some cases for IOL repositioning, exchange, or secondary implantation.

Anterior segment assessment was performed to ensure better visualization. In some cases, suturing by 10-0 nylon was needed for leaky corneal wounds, removal of retained lens matter from AC, and reformation of the AC with viscoelastic was mandatory. Corneal protection during the procedure was achieved by the application of a thin film of dispersive viscoelastic to avoid corneal dryness and for better visualization. The first sclerotomy was made in the inferotemporal quadrant by inserting a 23-G cannula inserter at a 30 to 40 angle through the conjunctiva, sclera, and pars plana, 3.5 mm from and parallel to the corneoscleral limbus to create an oblique scleral tunnel. The infusion cannula was connected and secured to the microcannula. Assessment of intravitreal position of the infusion cannula was crucial before starting infusion to avoid suprachoroidal effusion and choroidal detachment. The supratemporal and superonasal microcannulae were inserted in a similar fashion as shown in figure (Figure 1).

Figure 1. PPV cannula insertion.

Then the 23-G Endo illumination probe was inserted, and the BIOM system was repositioned. The BIOM system was adjusted until clear image focusing and the field was adjusted using the focusing system of the surgical microscope. The used vitrectomy cutting parameters were as follows: Cut the rate of 2000 cuts/min and a vacuum level of 550 mmHg. Anterior vitrectomy was done associated with aspiration of any retained cortical material within the capsular bag (alternation between cut/irrigation-aspiration mode and irrigation-aspiration/cut mode). Next, all vitreous was removed, starting with core vitrectomy and then separation and removal of the posterior hyaloid (if not already separated). Intravitreal injection of a suspension of triamcinolone acetonide was injected for vitreous staining and to ensure complete removal of posterior cortical vitreous. The vitreous cutter and the Endo illumination probe were used for 360-degree scanning of the peripheral retina to exclude any associated retinal breaks.

Dealing with the retained lens fragments varied according to the nature, density, size, number, and location of the dislocated fragment. In cases with retained soft epinucleus, low-medium nuclear density, or small nuclear fragments, the dislocated fragment(s) was aspirated by the vitrectomy probe followed by emulsification in the mid-vitreous to avoid inadvertent retinal injury (see figure 2). The Endo illumination probe was used as a chopper to assist in fragmentation and removal of the nucleus or nuclear fragment(s). However, cases with retained high-density nuclear fragments necessitated the use of 20-gauge phacofragmatome or un-sleeved titanium phaco tip 30° (Oertli OS-4 surgical platform, Switzerland). Cases complicated with posteriorly dislocated IOL were subjected to one of the following procedures: IOL-repositioning or IOL-exchange. IOL-repositioning was

indicated in cases in which the dislocated IOL was foldable one-piece or three-piece IOL with adequate anterior capsular support. In such situations, the IOL was secured in the ciliary sulcus with optic capture technique through the anterior capsulorrhexis to ensure better centration and to reduce the risk of postoperative complications. In cases of three-piece IOL but in absence of adequate capsular support, suture less scleral fixation was tried using flanged haptic technique (Yamani procedure). However, IOL-exchange was indicated in cases in which the dislocated IOL was foldable one-piece IOL and in absence of adequate capsular support. The IOL was cut into two segments using Vann's scissor and removed through the main corneal wound (2.4 mm). Then, a three-piece foldable IOL was implanted for scleral fixation. Otherwise, the corneal wound was extended, and a PMMA-IOL was implanted in the anterior chamber.

Figure 2. This is a figure of intravitreal emulsification.

Finally, the scleral wounds were left un-sutured if there was no evidence of wound leakage. Otherwise, 7-0 vicarly stitches were used for adequate wound closure. If one incision was extended for the phacofragmatome, it was closed by vicarly stitches. Removal of the viscoelastic from the AC was performed using irrigation aspiration through the side-port incisions before stromal hydration. Postoperatively, all patients received moxifloxacin 0.1% five times per day for two weeks and prednisolone acetate 0.1% hourly during the first two days, then five times per day for a week, and three times for the next week.

All patients were examined on the second day of surgery. Follow-up visits were scheduled at the end of the 1st week, the 1st month, the 3rd month, the 6th month, 9th month, and the 12th month. In every follow-up visit, evaluation included detailed ophthalmological examination with special emphasis on posterior segment examination to exclude macular edema, OD cupping, retinal breaks…etc.

The Statistical Package for the Social Sciences version 17.0 (SPSS, Inc., Chicago, Illinois, USA) was utilized to analyze the data statistically. Chi-square test was used to compare demographic data, Mann-Whitney test was used to compare initial and final BCVA and the occurrence of complications. Independent-t-test was used to assess statistical significance among groups in predetermined parameters. Paired-t-test was used to assess statistical significance within the same group. ANOVA test was used for comparison among more than two groups. Statistical difference was considered significant if the *p-value* was less than 0.05 and highly significant if the *p-value* was less than 0.01.

5. Conclusions

We found that the timing of PPV was an important factor affecting both clinical and OCT outcomes in dislocated nuclear fragments and IOL. The prompt PPV was associated with the best outcome followed by

the early PPV. Cases in which, intravitreal ultrasound emulsification was indicated, were associated with poorer prognostic outcomes.

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الملخص العربي

نتائج جراحات الجسم الزجاجي في حالات سقوط أجزاء عدسة العين أو العدسة الصناعية

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تناولت هذه الدراسة النتائج الإكلينيكية بعد عمليات الجسم الزجاجي للحالات المضاعفة بسقوط أجزاء عدسة العين أو العدسة الصناعية تمت الدراسة على 35 مريض وتبين أن حوالي 22,2% من حالات نفس اليوم حققت نتائج مرضية بالنسبة لحدة الإبصار، في حين كانت النسبة حوالي 8,3 % فقط في العمليات المبكرة و7,14 % فقط في العمليات المتأخرة لأكثر من أسبوع. ونستنتج من هذه الدراسة أن توقيت العملية عامل مهم جداً وذا دلالة إحصائية مهمة.