Early Vitrectomy for Retained Lens Fragments in Eyes with Pre-existing Co-morbidities

Eşlik Eden Oküler Morbiditesi Olan Gözlerde Vitreusa Düşen Lens Parçalarının Tedavisi için Erken Vitrektomi

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ABSTRACT

Purpose: To evaluate whether performing early pars plana vitrectomy (PPV) affects visual outcomes of patients with retained lens fragments after a complicated cataract surgery (CS).

Material and Methods: 38 eyes of 38 consecutive patients that underwent PPV for retained lens fragments at Gazi University, Ophthalmology Department from May 2007 to February 2011 were reviewed. Associated ocular co-morbidities, time interval between CS and PPV, and their effect on visual prognosis were evaluated.

Results: The mean follow-up period after PPV was 6.3 months. 21 patients (55%) had PPV within 1 week of CS (group A), and 17 patients (45%) had PPV after more than 1 week of CS (group B). In group A, 14 (66.6%) patients had preexisting ocular co-morbidities whereas in group B only 3 patients (18%) had preexisting ocular co-morbidities. PPV caused significant improvement in final VA's in both groups. The mean pre-PPV logMAR best corrected visual acuity (VA) improved from 1.51 to 0.9 in group A ($p < 0.005$) and 2.35 to 1.4 in group B ($p < 0.005$).

Conclusion: Early PPV for retained lens fragments after cataract surgery can be useful for saving vision even in eyes with lower visual expectations.

Key Words: Retained lens fragments, cataract surgery, pars plana vitrectomy.

ÖZ

Amaç: Komplike katarakt cerrahisi sonrasında, vitreusa disloke olan nükleus fragmanlarının tedavisinde, erken dönemde uygulanan pars plana vitrektomi cerrahisinin vizüel prognoza etkisini araştırmak.

Gereç ve Yöntem: Mayıs 2007-Şubat 2011 tarihleri arasında Gazi Üniversitesi Göz Hastalıkları A.D.'nda tedavi edilen, vitreus boşluğuna disloke olmuş nükleus fragmanı nedeniyle pars plana vitrektomi cerrahisi (PPV) geçirmiş 38 hastanın 38 gözü çalışmaya dâhil edildi. Eşlik eden ek oküler hastalıklar, katarakt cerrahisi ile PPV arasında geçen süre ve bu parametrelerin vizüel prognoza olan etkisi değerlendirildi.

Bulgular: Ortalama takip süresi 6,3 aydı (3-36.5). 21 (%55) olguya 1 hafta içinde erken pars PPV uygulanırken (Grup A),17 (%45) hastaya 1 haftadan geç PPV (Grup B) uygulandığı gözlendi. Eşlik eden ek oküler hastalık Grup A'da 14 hastada (%66.6) mevcutken, grup B'deki hastaların sadece 3'ünde (%18) eşlik eden oküler hastalık olduğu saptandı. PPV'nin her iki grupta da görme keskinliklerinde anlamlı artışa neden olduğu izlendi. LogMAR cinsinden hesaplanan ortalama en iyi düzeltilmiş göme keskinliğinin Grup A'da 1.51'den 0.9'a ($p < 0.005$), Grup B de 2.35'ten 1.4'e ($p < 0.005$) çıktığı saptandı,

Sonuç: Komplike katarakt cerrahisi sonrasında vitreusa disloke olan nükleus fragmanlarının tedavisinde erken dönem uygulanan PPV görme beklentisi düşük olan gözlerde dahi fayda sağlayabilmektedir.

Anahtar Kelimeler: Disloke lens parçaları, katarakt cerrahisi, pars plana vitrektomi.

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Geliş Tarihi - Received: 31.10.2013
Kabul Tarihi - Accepted: 13.12.2013
Ret-Vit 2014;22:29-34

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INTRODUCTION

The incidence of retained lens fragments or dropped nuclei after cataract surgery (CS) is approximately 0.2% to 1.5%.[1-3] Intra-vitreal retained lens fragments are associated with various ocular complications. These well-known complications are corneal edema, intraocular inflammation, secondary glaucoma, vitreous hemorrhage, cystoid macular edema, retinal detachment and endophthalmitis.[2,4-6]

Pars plana vitrectomy (PPV) has reduced the incidence of these relatively common comorbidities.[5-8] However with the increasing use of phacoemulsification, there has been a concomitant rise in the incidence of lens fragment dislocation into the vitreous cavity, especially among surgeons who are learning the technique of phacoemulsification.

Optimal PPV timing in relation to the initial complicated CS is still not clear, and the effect of timing on outcomes is controversial. Some studies show statistically significant results indicating early PPV, as early as the same day, leads to better outcomes,[5,9-14] while others suggest no benefit from early PPV.[4,5,8,15-20] Nevertheless, there are many reports in the literature that showed a non-significant trend favoring early PPV.

The preferred clinical practice in our referral center is to perform PPV as early as possible. However, because of the delay in the referral of these patients from outpatient surgical centers to our clinic, a subset of a relatively late intervention group of patients has formed during the past years.

In the current study, we aimed to evaluate whether performing early PPV affects visual outcomes of patients with retained lens fragments after a complicated CS.

MATERIALS AND METHODS

The study protocol was approved by the Institutional Review Board/Ethics Board. The retrospective data of 38 patients who underwent PPV for retained lens fragments at Gazi University, Ophthalmology Department between 2007 and 2011 were reviewed. Patients who had undergone primary PPV for dislocated lens fragments during phacoemulsification surgery were included in the final analysis. Patients with traumatic or spontaneous dislocation of the lens before surgery, and those with a follow-up period of less than 3 months were excluded from the study.

Pre-operative, intra-operative and post-operative data were collected from the medical records. Demographic data including age and gender and clinical features at presentation were noted.

Recorded data included history of systemic diseases, preexisting ocular co-morbidities like proliferative diabetic retinopathy (PDR), severe non PDR, degenerative myopia, previous retinal detachment surgery, best corrected or pin-hole visual acuities, intraocular lens (IOL) status (aphakia, posterior chamber intraocular lens (PCIOL), anterior chamber intraocular lens (ACIOL), intraocular pressure (IOP), anterior chamber inflammation, corneal edema, and fundus findings. B-scan ultrasound (B-USG) was performed if media opacities precluded visualization of the posterior segment. The date of CS, and PPV, interval between CS and PPV, intraoperative details during PPV (retinal breaks/detachments, hemorrhages) were noted. Postoperative details, including length of follow-up (PPV to last visit), best corrected visual acuity (BCVA), anterior segment and posterior segment findings, postoperative complications including retinal detachments, cystoid macular edema (CME), raised IOP and postoperative ocular medications were also recorded. BCVA was converted to the logarithm of the minimal angle of resolution (logMAR) acuity for statistical analysis.

PPV was performed as soon as a vitreoretinal operating room became available. A standard three-port PPV is the procedure of choice after stability of the cataract wound is ensured. Any residual lens material in the anterior segment is carefully removed; special care is taken to avoid damaging the capsular remnants, which may be used for the final IOL implantation. A core PPV was performed followed by the removal of the soft cortical/nuclear lens materials and vitreous around the nucleus. A small volume of perfluorodecaline was injected over the optic nerve in order to protect the macular area. A pars plana phacofragmatome was used when necessary for hard nucleus fragments. Co-existing pathologies like retinal break or detachment were repaired at the time of PPV. The capsular remnants were assessed to see if adequate capsular support was present for IOL implantation. A PMMA or 3-piece foldable IOL was implanted in the presence of capsular support, and a transscleral sutured PCIOL was implanted otherwise. Patients were classified into two groups according to PPV timing. The early PPV group (group A) was defined as patients undergoing PPV within 1 week of their CS. The delayed PPV group (group B) was defined as patients undergoing PPV more than 1 week after their CS.

Statistical Analysis: Statistical analysis was performed using the SPSS statistical analysis package version 17.0 (SPSS Inc, Chicago, Illinois, USA). The change in logMAR BCVA was analyzed with the Mann Whitney U test between two groups. The Wilcoxon Rank Signed Test was used to determine the differences between each group in terms of initial and final visual acuities.

Table 1: *Preexisting ocular co-morbidities.*

Preexisting Eye Conditions	Group A Number of eyes/Percent	Group B Number of eyes/Percent
PDR	5 (24%)	1 (6%)
Severe non-PDR	5 (24%)	(-)
Degenerative myopia	1 (5%)	(-)
Glaucoma (controlled with single topical agent)	(-)	1 (6%)
Previous RRD surgery	2 (9.5%)	(-)
Cystoid macular edema	2 (9.5%)	(-)
Previous PPV	6 (29%)	(-)
Macular atrophy	1 (5%)	1(6%)
Senile macular degeneration	(-)	1(6%)

PDR; Proliferative Retinal Detachment, RRD; Rhegmatogenous Retinal Detachment, PPV; Pars Plana Vitrectomy.

The distribution differences of pre-existing ocular co-morbidities between the groups were evaluated by using-Fisher's exact test. A "p" value of less than 0.05 was considered statistically significant.

RESULTS

This study included 38 eyes of 38 patients with a median age of 68.6 (43–86), (group A: 67.52 vs. group B: 70.11, p=0.685) years. Mean follow-up of the 38 patients, consisting of 16 women (42%), and 22 men (58%), was 6.3 months (range 3-36.5 months) after PPV. 21 patients (55%) had PPV within 1 week of CS (group A, mean: 1.19 days), and 17 patients (45%) had PPV more than 1 week after CS (group B, mean: 27.52 days).

Proliferative diabetic retinopathy (PDR) (15.7%, n=6), severe non PDR (13% n=5), cystoid macular edema (5.2%, n=2), previous retinal detachment surgery (5.2%, n=2) and macular atrophy (5.2%, n=2) were the most frequent preexisting eye co-morbidities. Other ocular co-morbidities were glaucoma (3%, n=1), myopic macular degeneration (3%, n=1), and age-related macular degeneration (AMD), (3%, n=1), (Table 1).

In group A, 14 out of 21 (66.6%) patients had preexisting ocular co-morbidities whereas in group B only 3 patients (17.6%) had preexisting ocular co-morbidities. Six out of 38 (16%) eyes had undergone previous PPV for their pre-existing ocular conditions before CS and all of them were in group A.

There was a statistically significant distribution difference between Group A and Group B in terms of pre-existing ocular co-morbidities where Group A had significantly more preexisting ocular co-morbidities than Group B (p=0.05), (Table 1).

Eleven of 38 eyes (29%) had corneal edema before PPV. In group A, only 3 of 21(14%) eyes had corneal edema, while in group B, 8 of 17 eyes (47%) had corneal edema. The difference in presence of corneal edema was also statistically significant (p=0.03).

All patients in group B (100%) had mild to moderate intraocular inflammation whereas only 3 of 21(14%) patients had mild intraocular inflammation in group A (p=0.01).

In 23 of 38 eyes (61%), initial IOL implantation was performed at the time of CS. Among those lenses, 2 were ACIOL and 21 were PCIOL. In group A, all inserted lenses were PCIOL's (n=14), while 2 ACIOL insertions were performed in group B. In group B, 7 PCIOL's were inserted. Fifteen of 38 (39%) eyes were left aphakic at initial CS (6 out of 21 (28.5%) eyes in group A vs. 9 of 17 (53%) eyes in group B). In Group A, secondary IOL insertion was performed in 4 of 6 aphakic eyes. Two were implanted to sulcus, anterior to the adequate anterior capsular support, in the same session as PPV, and the remaining 2 were implanted with scleral fixation sutures at a later operation. In group B, 3 of 9 aphakic eyes underwent simultaneous PPV and secondary IOL insertion (1 sulcus, 2 scleral fixation). Two eyes from group A and 6 eyes from group B were left aphakic.

Retinal breaks/tears were observed in 4 eyes during PPV (2 eyes in group A, 2 eyes in group B) and were treated with intraoperative argon laser photocoagulation and gas tamponade. Intra-operatively, an inferior RD with inferiorly located tears was observed in one eye in group B. It was treated with PPV, argon laser photocoagulation and silicone oil tamponade. Despite additional surgeries, this case resulted in chronic inferior RD.

Table 2: *Final visual acuity related to the interval between CS and PPV.*

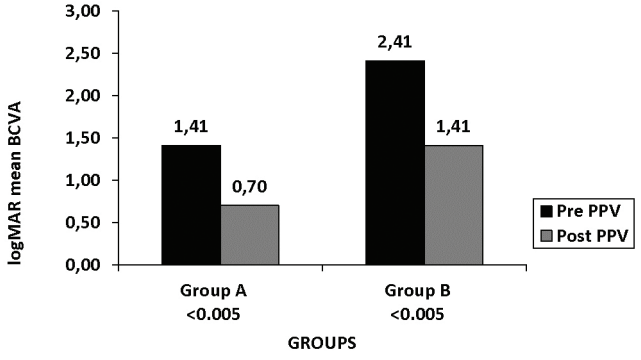
BCVA (decimal)	Group A	Group B	
		8-30 days	>30 days
≥0.5	9 (43%)	1 (8%)	-
0.4-0.05	7 (33%)	3 (25%)	2 (40%)
<0.05	5 (24%)	8 (67%)	3 (60%)

BCVA; Best Corrected Visual Acuity.

Postoperative RD was detected after PPV in one patient in group A. This patient underwent a second PPV for retinal detachment repair and achieved good visual and anatomical results. Increased intraocular pressure occurred in 4 eyes, three of them were well controlled with one anti-glaucomatous agent, while the pressure was controlled with non-penetrating glaucoma surgery (visco-canalostomy) in one patient who had persisted elevated IOP.

After PPV, new cystoid macular edema appeared in only 1 patient who had non PDR without macular edema prior to surgery. It was resolved with a single intavitreal triamcinolone acetonide (IVTA) injection. Two cases with pre-existing CME were also treated with PPV and IVTA injection, however, CME persisted after treatment in one of these eyes. Pre-operative and post-operative logMAR BCVA's were as shown in the graphic. The mean pre and postoperative logMAR BCVA in group A was statistically significantly better than group B (p=0.002, p=0.01 respectively). At the most recent postoperative examination, the mean logMAR BCVA had significantly improved in both groups (P<0.005), (Graphic).

Although the final BCVA was significantly better in group A, there was no significant difference in terms of postoperative increase in BCVA between two groups.



Graphic: *Pre and postoperative logMAR BCVA in group A and B.*

Table 3: *Final visual acuity in relation to final intraocular lens status.*

BCVA (decimal)	PCIOL + ACIOL	Aphakic
≥0.5	10 (33%)	-
0.4-0.05	11 (37%)	1 (13%)
<0.05	9 (30%)	7 (88%)

BCVA; Best Corrected Visual Acuity, PCIOL; Posterior Chamber Intraocular Lens, ACIOL; Anterior Chamber Intraocular Lens.

When we further analyzed the visual acuities of subgroups according to their PPV timing, 43% of patients in group A had a final visual acuity 5/10 or more, while only 5.9% of eyes in group B reached that level (Table 2).

When final BCVA's were further analyzed for all patients in relation to final intraocular lens status, likelihood to achieve better final BCVA's was higher when an anterior or posterior IOL implantation was done(p =0.05). This relation was particularly valid for early PPV group (p=0.04), (Table 3).

DISCUSSION

The timing of PPV for retained lens fragments after complicated CS depends on many factors such as; the availability of the operating room, availability of a vitreo-retinal surgeon, the patient's will, choice of anesthesia, and surgeon's preference for timing of PPV. In our study, the time interval between CS and PPV was influenced mainly by two factors. The first one was the time interval between CS and referral of those patients to our clinics. The other factor was the corneal edema caused by the initial CS which may not allow adequate viewing during PPV. Our preference is to perform PPV for retained lens fragments as early as the same day and if possible at the same session.

In our study, the frequency of ocular co-morbidities was higher in early PPV group. The reason for that was the fact that most of the patients in this group were being treated and/or under follow up at our tertiary referral center for their underlying ocular diseases and therefore had their cataract surgery at the same center. On the other hand, patients in group B were mostly without vision threatening ocular diseases and referred to our clinics from outpatient surgical centers after a complicated cataract surgery. This random group formation gave the opportunity to examine the effects of early PPV for retained lens fragments in eyes with pre-existing ocular co-morbidities. In previous studies, absence of preoperative eye disease was found to be one of the significant predictors for 20/40 vision or better.[9,21]

Furthermore, presence of preexisting eye disease was found to be a reason for final visual acuity 20/200 or worse. In our study, mean preoperative BCVA of the group A was significantly better than group B despite group A having more pre-existing ocular diseases. This may be explained with the high incidence of corneal edema (group A, 14% vs. group B, 47%) and increased intraocular inflammation in group B (group A, 14% vs. group B, 100%) Although both groups had similar statistically significant improvements in final BCVA's after PPV, final mean BCVA was still better in early PPV group despite having more pre-existing ocular comorbidities. It can be speculated that group A could have done even better with early PPV in terms of visual acuity if this antagonizing, uneven distribution of preexisting ocular conditions, was not present.

In our previous study[12] published in 2002 on 22 eyes with dislocated lens fragments, 42% of eyes in the early PPV group could achieve BCVA ≥ 0.5 while only 20% of the late PPV group had this VA. This findings are parallel to what we found in the present study; only 8% of the patients in the late PPV group and none of the patients who had been operated after 30 days or later had BCVA ≥ 0.5, whereas, 43% of patients in early PPV group had final BCVA ≥ 0.5.

Although some previously published reports did not find IOL status as a significant predictor of better visual outcomes,[9,22] the implantation of the IOL may probably be associated with better visual outcomes or it may just be a marker of better operative outcomes.[15,16] The placement of a PCIOL was found to be a predictor of 20/40 or better VA in a large, retrospective, multivariate analysis.[14] According to this study, better visual acuities could be achieved with a PCIOL compared to an ACIOL or aphakia. In the current study group, we found that patients with intraocular anterior or posterior chamber lens placement had better visual acuities than aphakic patients (p=0.05). This association was relevant for group A (p=0.04) However, in group B, placement of an IOL was not associated with better final BCVA (p=0.23). The reason for that may be that the prognosis of this delayed PPV group was already guarded because of ongoing inflammation.

One of the postoperative complications in our series was increased IOP that occurred in 4 patients; 2 in Group A (%9) and 2 in Group B (%11). Mild to moderate intraocular inflammation was present in 21 of 38 patients. In a clinicopathological study regarding retained intravitreal lens fragments after CS, Yeo et al.,[23] found significantly less inflammatory cell activity in eyes that underwent PPV within 1 week. Later removal was associated with persistently elevated intraocular pressure and poorer visual outcome.

Being in line with this study, most of the patients in our study with mild to moderate uveitis were also in group B. Blodi et al.,[24] also showed that early PPV within 3 weeks decreased the rate of chronic glaucoma. Although we did not find any difference between the two groups, prevention of development of the secondary glaucoma and limiting lens-induced intraocular inflammation by early PPV may be relevant, especially in eyes with pre-existing compromised outflow facility or various optic neuropathies and diabetic optic retinopathy.

Macula on RD was observed in 2 patients (5.2%), one in group A and one in group B. This rate of RD is within the range reported in other studies in which PPV was performed for retained lens fragments.[2,5,6,9,10,16,25] In a large retrospective study, the rate of RD was found to be 9.0%, with an even distribution of detachments diagnosed before or during PPV, compared with after PPV. In that study, a long interval between cataract surgery and PPV was also found to be a risk factor for retinal detachment.[26] Several authors[10,16] also reported a trend of increased incidence of retinal detachment associated with cases of delayed PPV. However, regardless of the PPV timing, minimal manipulation at the time of cataract surgery is also extremely important to avoid trauma and irreversible damage to the retina.

Margherio et al.,[16] found that 27% of patients developed postoperative cystoid macular edema after PPV as a late postoperative complication. Kageyama et al.,[2] reported a lower rate of postoperative cystoid macular edema (12%), when PPV was performed in the same setting as the cataract surgery. Early PPV may therefore have a role in reducing the incidence of postoperative cystoid macular edema by minimizing lens-induced inflammation. However in our study we observed a relatively low rate of cystoid macular edema in all groups. In Group A, 1 patient (%2) who had non-PDR without macular edema prior to surgery developed cystoid macular edema postoperatively. It was resolved with a single intravitreal triamcinalone acetonide injection. Preexisting diabetic macular edema in a patient in group A regressed after PPV-IVTA. Nevertheless, in our study, the low rate of macular edema in group A was in line with other studies favoring early PPV.[5,10]

In conclusion, results of early PPV for retained lens fragments seem to be superior to those of late PPV in spite of more prevalent pre-existing ocular co-morbidities in the early PPV group.

Our study had several limitations. The limitations were basically the relatively small sample size and the retrospective design of the study. These facts could be a source of bias in the interpretation of the results.

REFERENCES/KAYNAKLAR

1. Aasuri MK, Kompella VB, Majji AB. Risk factors for and management of dropped nucleus during phacoemulsification. Journal of cataract and refractive surgery 2001;27:1428-32.
2. Kageyama T, Ayaki M, Ogasawara M, et al. Results of vitrectomy performed at the time of phacoemulsification complicated by intravitreal lens fragments. BJ O 2001;85:1038-40.
3. Pande M, Dabbs TR. Incidence of lens matter dislocation during phacoemulsification. Cataract and Refractive Surgery 1996;22:737-42.
4. Gilliland GD, Hutton WL, Fuller DG. Retained intravitreal lens fragments after cataract surgery. Ophthalmology 1992;99:1263-7.
5. Kim IK, Miller JW. Management of dislocated lens material. SM Ophthalmology 2002;17:162-6.
6. Monshizadeh R, Samiy N, Haimovici R. Management of retained intravitreal lens fragments after cataract surgery. SV O 1999;43:397-404.
7. Lambrou FH, Jr., Stewart MW. Management of dislocated lens fragments during phacoemulsification. Ophthalmology 1992;99:1260-2.
8. Vilar NF, Flynn HW, Jr., Smiddy WE, et al. Removal of retained lens fragments after phacoemulsification reverses secondary glaucoma and restores visual acuity. Ophthalmology 1997;104:787-91
9. Al-Khaier A, Wong D, Lois N, et al. Determinants of visual outcome after pars plana vitrectomy for posteriorly dislocated lens fragments in phacoemulsification. Cataract and Refractive surgery 2001;27:1199-206.
10. Chen CL, Wang TY, Cheng JH, et al. Immediate pars plana vitrectomy improves outcome in retained intravitreal lens fragments after phacoemulsification. Ophthalmologica Journal international d'ophtalmologie International journal of ophthalmology Zeitschrift fur Augenheilkunde 2008;222:277-83.
11. Vanner EA, Stewart MW. Vitrectomy timing for retained lens fragments after surgery for age-related cataracts: a systematic review and meta-analysis. AJ O 2011 Sep;152:345-57.
12. Bahri A, Ozdek S, Gurelik G, ve ark. Surgical results for dropped nucleus during cataract surgeries. Ret-Vit 2002;10:76-82.
13. Stefaniotou M, Aspiotis M, Pappa C, et al. Timing of dislocated nuclear fragment management after cataract surgery. Cataract and Refractive Surgery 2003;29:1985-8.
14. Tommila P, Immonen I. Dislocated nuclear fragments after cataract surgery. Eye (Lond) 1995;9.
15. Scott IU, Flynn HW, Jr., Smiddy WE, et al. Clinical features and outcomes of pars plana vitrectomy in patients with retained lens fragments. Ophthalmology 2003;110:1567-72.
16. Margherio RR, Margherio AR, Pendergast SD, et al. Vitrectomy for retained lens fragments after phacoemulsification. Ophthalmology 1997;104:1426-32.
17. Colyer MH, Berinstein DM, Khan NJ, et al. Same-day versus delayed vitrectomy with lensectomy for the management of retained lens fragments. Retina 2011;31:1534-40.
18. Greven CM, Piccione K. Delayed visual loss after pars plana vitrectomy for retained lens fragments. Retina 2004;24:363-7.
19. Kwok AK, Li KK, Lai TY, Lam DS. Pars plana vitrectomy in the management of retained intravitreal lens fragments after cataract surgery. CE O 2002;30:399-403.
20. Murat Uyar O, Kapran Z, Akkan F, et al. Vitreoretinal surgery for retained lens fragments after phacoemulsification. EJ O 2003;13:69-73.
21. Ho LY, Doft BH, Wang L, Bunker CH. Clinical predictors and outcomes of pars plana vitrectomy for retained lens material after cataract extraction. AJ O 2009;147:587-94.
22. Borne MJ, Tasman W, Regillo C, et al. Outcomes of vitrectomy for retained lens fragments. Ophthalmology. 1996;103:971-6.
23. Yeo LM, Charteris DG, Bunce C, et al. Retained intravitreal lens fragments after phacoemulsification: a clinicopathological correlation. BJ O 1999;83:1135-8.
24. Blodi BA, Flynn HW, Jr., Blodi CF, et al. Retained nuclei after cataract surgery. Ophthalmology 1992;99:41-4.
25. Salam GA, Greene JM, Deramo VA, et al. Retinal tears and retinal detachment as factors affecting visual outcome after cataract extraction complicated by posteriorly dislocated lens material. Retina 2005;25:570-5.
26. Merani R, Hunyor AP, Playfair TJ, et al. Pars plana vitrectomy for the management of retained lens material after cataract surgery. AJ O 2007;144:364-70.