Two Different Approaches, Posterior and Anterior, During Pars Plana Vitrectomy for Retained Lens Fragments after Cataract Surgery

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ABSTRACT

Purpose: The purpose of this study is to compare two distinct approaches during pars plana vitrectomy (PPV) for dropped nucleus (DN) after complicated cataract surgery.

Materials and Methods: This retrospective case series study comprised 62 eyes from 62 patients who presented with DN. During PPV for DN, the posterior approach (PA) was conducted using a fragmatome in 39 eyes and the anterior approach (AA) was performed in 23 eyes utilizing a phacoemulsification handpiece in the pupil plane with the assistance of liquid perfluorocarbon. Five patients with severe comorbidities were excluded from the PA group. Visual outcomes of both groups were compared after at least 6 months of follow-up.

Results: There was no significant difference between the two groups in age and gender (0.61 and 0.10, respectively). The final best-corrected visual acuity (BCVA) was 0.24±0.17 logMAR in the PA group and 0.15±0.15 in the AA group (P=0.065). The BCVA increase was 0.32±0.18 logMAR in the PA group, while it was 0.22±0.15 logMAR in the AA group (P=0.06). In the PA group, 22 (64.7%) eyes had a final BCVA of ≥6/12 (median), whereas, in the AA group, 20 (87.0%) eyes had a final BCVA of ≥6/12. The complication rate in the PA group was found to be higher than in the AA group (P=0.004).

Conclusion: Visual outcomes were unaffected by the PA and AA techniques in PPV for DN. On the other hand, the AA technique appears to have a lower complication rate. In such instances, surgeons may prefer the AA technique.

Keywords: Fragmatome, Pars plana vitrectomy, Perfluorocarbon, Phacoemulsification, Retained lens fragments.

INTRODUCTION

Dislocation of crystalline lens fragments to the vitreal cavity during cataract surgery is a serious complication that occurs at a rate of 0.2 to 1.5 percent.[1,2] Lens fragments or dropped nuclei that fall into the vitreous as a result of posterior capsule rupture or trauma can cause a variety of serious ocular pathologies, including prolonged uveitis, vitreous hemorrhage, cystoid macular edema, secondary glaucoma, retinal detachment, and endophthalmitis all of which can result in poor visual acuity.[3-6] Dislocated small lens materials can be followed, but large pieces must be removed to avoid mentioned complications. The gold standard technique for this in recent years has been pars plana vitrectomy (PPV) with lensectomy.[7-10]

During PPV with lensectomy, vitreous cutters alone can frequently enough for soft lens materials. However, there are a variety of methods that may be employed for dense lens materials. Pars plana incision is an established technique for using a fragmatome.[11-15] The alternative is to eat the lens nucleus elevated with liquid perfluorocarbon through the corneal incision with a phacoemulsification handpiece in the pupil plane.[16] An entirely new "kebab technique," has also appeared in the literature that does not need the use of perfluorocarbon.[17]

We conducted a research to examine two different methods of cleaning the lens material following lens dislocation. The posterior approach (PA) in the vitreous cavity using fragmatome or the anterior approach (AA) in the pupil plane utilizing liquid perfluorocarbon with phacoemulsification handpiece.

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MATERIAL AND METHODS

Study Design

In this retrospective, case-series study, the medical records of 62 patients who presented with drop lens material in the vitreal cavity after cataract surgery were evaluated. Between January 2015 and December 2020, 23 gauge transconjunctival PPV was applied to all patients by the same experienced surgeon (Dr. M.G.) at Ordu University Training and Research Hospital and Private Atanur Eye Hospital. The procedures were carried out in accordance with the Declaration of Helsinki and written informed consent was obtained from the patients. Demographic data and ocular histories of the patients were recorded at the time of admission. Pre-cataract surgery, pre- and post-PPV; detailed eye examinations including best-corrected visual acuity (BCVA), anterior segment examination, intraocular pressure (IOP) measurement, and fundus examination were performed. The dislocated lens material was ½ of the initial crystalline lens or larger in all patients. In one group, the lens material was removed in the vitreal cavity with the help of a fragmatome (PA group), and in the other group, using liquid perfluorocarbon, the lens material was removed with a phacoemulsification handpiece in the pupil plane (AA group). Final BCVA, complication rate, time to reach final BCVA, increase in BCVA, time from cataract surgery to PPV surgery (time between two surgeries) were compared between the groups. BCVA was converted to Logmar for statistical analysis.

Surgical Technique

PPV surgery was performed 3-10 days after cataract surgery in all patients. All procedures were subjected to conventional 3-port PPV using the Alcon 23G system (Alcon Constellation, Alcon, Fort Worth, TX, USA). After core vitrectomy, the vitreous bands around the lens material were carefully cleaned. Posterior hyaloid was cleared in patients who developed posterior hyaloid detachment following PPV. In the continuation, in the PA group; one of the 23 G trocars is removed and replaced with a 20 G trocar with a larger incision. After the nuclear material is cleaned with the fragmatome, the 20 G trocar is removed and the wound site is reduced with 7-0 vicryl. A 23 G trocar is inserted again and the remaining soft materials are eaten with a vitreous cutter.

In the AA group; the dislocated nucleus is floated to the pupil plane by administering liquid perfluorocarbon. The lens is eaten using the phacoemulsification handpiece through the original corneal incision. The liquid perfluorocarbon is taken from the posterior pole with the help of a flute. The remaining materials are cleaned with a vitreous cutter. After all procedures, peripheral retinal controls are performed and trocars are removed and leaking is checked. Leaky wound accesses are sealed with 7-0 vicryl.

Depending on the condition of the capsule support, the intraocular lens (IOL) was placed either in the sulcus or with the sutured technique in all of the patients. All patients received topical antibiotics and steroids 4 times a day for 4 weeks. After the postoperative 1st day, 1st week and 1st month control, the final visit was made at least 6 months.

Statistical Analysis

Data statistics were created using the SPSS version 22 package software (IBM SPSS for Windows, v 22.0, IBM-SPSS, Chicago, Illinois, USA). The Saphiro-Wilk test was used to determine the normality distribution of the data before it was statistically analyzed. As a result, it was discovered that the data did not follow the normal distribution. To compare categorical variables between groups, the Chi-square test was utilized. The Mann-Whitney U test was used to compare data between pairwise independent groups. To compare two distinct data sets in the same group, the Wilcoxon signed rank test was employed. The Spearman's rho test was used to assess data correlation analysis. The data was given as the mean ± standard deviation. For statistical significance, a value of $p \leq 0.05$ was accepted.

RESULTS

There were 39 patients in the PA group, with 16 females and 23 males (mean age 68.79 ± 9.49 years) and 23 patients in the AA group, with 14 women and 9 men (mean age 70.17±8.91years). There was no significant difference between the groups with regard to the distribution of age and gender ($p > 0.05$). Table 1 shows the demographic data of the patients.

In the PA group, prior branch inferior temporal vein occlusion, central retinal vein occlusion, ocular surface defect, surgical retinal detachment, and diabetic macular edema were present in one patient each as comorbid factors. Diabetic macular edema in one patient and non-neovascular age-related macular degeneration in another patient were found in the AA group.

Corneal decompensation developed in four eyes, IOL decrease in two eyes in the early postoperative period, and epiretinal membrane (ERM) in one eye in the postoperative 5th month, in the PA group. Successful surgical techniques were used to treat patients who had IOL drop, and ERM. Therefore, the complication rate in the PA group was found to be significantly higher than in the AA group (Table 1).

To establish an objective comparison of visual acuity, five patients in the PA group who experienced severe complications or had severe comorbid conditions that would significantly compromise the final BCVA were

Table 1. *Demographic characteristics of individuals.*

	Posterior approach n=39	Anterior approach n=23	P
Age	68.79 ± 9.49	70.17 ± 8.91	0.610
Sex (Female/Male)	16/23	14/9	0.100
Comorbidity (yes/no)	5/34 2 retinal vein occlusion 1 history of retinal detachment surgery 1 diabetic macular edema 1 ocular surface defect	2/21 1 diabetic macular edema 1 non-neovascular macular degeneration	0.425
Complication (yes/no)	7/32 4 Corneal decompensation 2 IOL dislocation 1 ERM	0/23	0.004
Follow-up time (month)	11.51± 2.51	10.82 ± 1.97	0.494

IOL; intraocular lens, ERM; epiretinal membran

eliminated. Despite the fact that the AA group's final BCVA and BCVA increase were higher than the PA group's, the difference was not statistically significant. Table 2 shows a comparison of participants' clinical data. In the PA group, 22 (64.7%) of the 34 eyes had a final BCVA of ≥6/12 median, whereas in the AA group, 20 (87.0%) of the 23 eyes had a final BCVA of ≥6/12 median. There was no significant difference between the mean follow-up times of both groups.

Final BCVA was significantly higher than baseline in both groups ($p<0.001$). While the time between both operations had no effect on the final BCVA in the PA group ($p=0.465$), the final BCVA in the AA group declined as the time for PPV increased in the Spearmen's rho test ($p=0.034$).

DISCUSSION

In this study, we found that the final BCVA and the increase in BCVA for patients with dropped nuclei who underwent PPV surgery, in the AA group, which used hand-piece phacoemulsification assisted liquid perfluorocarbon, were slightly higher but not statistically significant when compared to the PA group, which used an fragmatome.

A large case series with an incidence of 0.19% -0.28% of nucleus dislocation to the vitreous cavity during cataract surgery was previously reported.[18] The likelihood of nucleus dislocation is increased by age-related zonullar weakening, pseudoexfoliation, a tiny pupil, and a history of vitrectomy. In the instance of a dropped nucleus, the gold standard option for the time being is excision of the nucleus from the vitreous with PPV. Despite the fact that this surgical technique has been in use for many years, it is still evolving and being developed. The goal is to reduce the negative consequences of this inconvenient complication. For a long time, successful PPV surgeries performed with PA have been reported. Lashgari et al. found a final BCVA of ≥6/12 in 43% of eyes that underwent PPV with the PA for dropped nuclei.[8] In our study, the final BCVA was ≥6/12 in 65% of 34 eyes. Other reports have also reported a final BCVA ≥6/12 in 44-82.6% of eyes.[9-15,19-21] However, with the reported successful results, surgeons were concerned about ultrasound energy-induced retinal damage in the PA technique. Indeed, experimental animal investigations by Bopp et al.[22] have shown that damage to the retinal pigment epithelium, Bruch's membrane, and choroidal capillaries

Table 2. *Comparison of clinical data between both groups.*

	Posterior approach n=34	**Anterior approach n=23**	**P***
Initial BCVA (LogMAR)	1.71 ± 0.88	1.54 ± 0.83	0.553
Final BCVA (logMar)	0.24 ± 0.17	0.15 ± 0.15	0.065
BCVA increase (logMAR)	0.32 ± 0.18	0.22 ± 0.15	0.060
Time of arrival at final BCVA (week)	5.44 ± 2.66	4.38 ± 1.19	0.252
Time between cataract surgery and PPV (day)	3.02 ± 3.36	6.44 ± 5.42	0.086

BCVA; best corrected visual acuity, PPV; pars plana vitrectomy, IOL; intraocular lens, ERM; epiretinal membran
*Mann-Whitney U test

start in the outer retinal segments and advances to the inner segments depending on the strength of the ultrasonic radiation. In order to keep acoustic energy away from the retina, the researchers used perfluorocarbon liquids in the PA technique. Perfluorocarbon fluids remove lens components from critical regions of visual acuity while also providing comfort during surgery. Previous clinical trials, however, have indicated that utilizing perfluorocarbon fluids in PA patients had no favorable effect on final BCVA.[7,23,24] Although we did not employ liquid perfluorocarbon in the PA group, we did not encounter any acute retinal problems.

Another way to remove acoustic energy from the retina is to float the lens material in the vitreous with the help of liquid perfluorocarbon to bring it to the pupil plane and emulsify it there. Millar et al.[16] obtained a mean final BCVA of 0.24 logMAR at 3 months in 13 eyes operated with this technique. 11 of 13 eyes (85%) reported that their final postoperative BCVA was ≥6/12. They also reported that to develop cystoid macular edema, which was successfully treated in one patient. Jang et al.[25] achieved a final BCVA of ≥6/12 in 11 (85%) of 13 eyes, just as in the cited study. They reported light perception (-) due to optic neuropathy in 2 patients. Other than that, they did not experience any complications. In our study, however, we did not experience complications in any of the 23 patients with the AA technique. Final BCVA after at least 6 months of follow-up was a mean of 0.15 logMAR (median 6/8). Twenty of 23 patients (87.0%) had a final BCVA of ≥6/12. Our research demonstrates that PPV procedures with AA technique for retained lens materials are effective, with minimal complication rates, as in prior studies.

We were unable to locate a study that compared PPV procedures related to PA and AA for dropped nuclei. In our study, there was no statistical significant difference between the two approaches for final BCVA and BCVA increase, however we did not have any complications with AA. In the PA technique, corneal decompensation developed in 4 eyes, IOL dislocation in 2 eyes, and ERM in 1 eye. The IOL dislocations experienced in our study were thought to be independent of the technique. ERM up to 0.08% has been observed in previous studies on operations with PA.[8,26,27] We found no ERM reported in research on surgeries done with AA. One reason for this might be the scarcity of research regarding AA. However, further studies are needed to determine whether the PA technique causes more ERMs. Corneal decompensation has been reported up to 6.25% in previous studies using the PA technique.[28,29] In our study, we also experienced corneal decompensation in 4 (10.2%) of 39 eyes with PA. No corneal decompensation has been reported with AA. This could be because there is no sleeve with the fragmatome and the infusion (cooling) is delivered through the infusion cannula rather than inside the fragmatome, resulting in increased acoustic energy and a thermal influence on the corneal endothelial cells. With the AA technique, the infusion (cooling) passes through the handpiece and the sleeve reduced direct effects of acoustic energy. However, further experimental studies are needed to elucidate this issue. Furthermore, in our investigation, as the interval between the two procedures grew in the AA group, the final BCVA decreased. Complications such as retinal detachment and glaucoma are known to increase when the time the retained lens material remains in the eye exceeds one week.[30] This research found that the time between two procedures with AA to be longer than PA. While the AA group may have been affected by the interval between two procedures, the PA group may not have been.

This study has some limitations. First of all, limitations specific to a retrospective study are also present in this study. Second, because we did not employ perfluorocarbons in the PA group, we had to disregard any potential good or harmful effects of perfluorocarbons when comparing the two groups.

In conclusion, both approaches produced successful results in this study, in which we compared operations performed with PA using a fragmatome and with AA using a phacoemulsification handpiece in the pupil plane with the help of liquid perfluorocarbon in drop nucleus cases, but the possibility of complications with the AA technique appears to be much lower. As a result, surgeons may prefer the AA technique more in such cases.

Author Contributions

Mustafa Gok contributed to material preparation, data collection, prepared a study draft. Burak Erdem collected data, data analysis and wrote manuscript. All authors have read and approved the final version of the manuscript.

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Conflicts of Interest

No author has any possible conflict of interest. The authors alone are responsible for the content and preparation of the paper.

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Informed consent

Informed consent was obtained from all individual participants included in the study.

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