Pars Plana Vitrectomy and Intravitreal Phacoemulsification for Dropped Nuclei

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Purpose: To report the outcomes of pars plana vitrectomy (PPV) and intravitreal phacoemulsification in patients with dropped nuclei/nuclear fragments following complicated cataract surgery.

Methods: In this retrospective case series, charts of patients who had undergone PPV and intravitreal phacoemulsification for removal of dislocated nuclei/lens fragments were reviewed. After standard PPV, a conventional phacoemulsification probe with an amputated sleeve was used for grasping and emulsifying the nucleus/nuclear fragments in mid/anterior vitreous cavity. Pre- and postoperative visual acuity, and intra- and postoperative complications were recorded.

Results: A total of 22 patients with mean age of 71.1±8.2 years were studied. Mean interval between complicated cataract surgery and PPV was 26.6±36.5 (range: 0-120) days. Patients were followed for a mean of 105.5±57.5 days. Preoperatively, best corrected visual acuity was 2.4±0.6 logMAR which was improved to 1.4±0.6 logMAR at final follow-up (P<0.001). Intraoperative complications included iatrogenic peripheral retinal breaks in three eyes. Postoperative complications consisted of epiretinal membrane formation in one eye, hypotony in one eye, and medically-controlled glaucoma in 2 eyes.

Conclusion: In this series, PPV and intravitreal phacoemulsification using a conventional phacoemulsification probe in patients with dropped nuclei/nuclear fragments following complicated cataract surgery resulted in visual improvement without any complications directly attributable to the probe.

Keywords: Dislocated Nucleus; Intravitreal Phacoemulsification; Pars Plana Vitrectomy

INTRODUCTION

Phacoemulsification is the most prevalent technique of cataract surgery. Despite a high safety profile, phacoemulsification may be associated with serious complications.1 Dislocation of the whole nucleus or its fragments into the vitreous cavity is a relatively infrequent complication that may result in sight threatening outcomes due to elevated intraocular pressure (IOP), corneal edema, uveitis, rhegmatogenous retinal detachment (RRD), and other sequelae.2-4 Removal of the nucleus or nuclear fragments by pars plana vitrectomy (PPV) is often required, unless the fragments are small and elicit minimal
inflammation.\textsuperscript{4,5}

The usual approach for surgical intervention in eyes with dropped nuclei/nuclear fragments is standard 3 port PPV and release of vitreous adhesions to the dropped nucleus, followed by fragmentation and removal of nuclear material which is commonly achieved using a phacofragmatome.\textsuperscript{6}

The aim of the current study was to evaluate outcomes and complications of removal of dropped nuclei/nuclear fragments using PPV and intravitreal phacoemulsification.

\textbf{METHODS}

We reviewed charts of patients who had undergone PPV for retained nuclear material between April 2009 and January 2011. Patients in whom vitrectomy alone or the fragmatome probe were used for nucleus removal were excluded. Eyes with proliferative diabetic retinopathy or advanced proliferative vitreoretinopathy, and patients with less than one month of follow-up were also excluded. The Institutional Review Board and Ethics Committee of the Eye Research Center at Rassoul Akram Hospital approved the study.

Patient demographics including sex, age, interval between complicated cataract surgery and vitrectomy, together with preoperative parameters including best corrected visual acuity (BCVA), amount of nuclear material, presence of corneal edema, IOP, level of inflammation and RRD were recorded. Intraoperative complications including scleral wound burn, retinal breaks and detachment, and the use of tamponade were also recorded. Postoperative outcome measures were BCVA and anatomical results of surgery.

All procedures were performed by experienced vitreoretinal surgeons (KGF, MH, MM and HN). The surgical technique consisted of standard 20-gauge three-port PPV and complete removal of vitreous strands adherent to the dropped fragments. A 20 gauge phacoemulsification handpiece (Microvision Inc. NH, USA) with an amputated sleeve (Fig. 1) was used through the sclerotomy site, the lens nucleus/fragment was grasped by the phacoemulsification tip and phacoemulsification was performed in the mid/anterior vitreous cavity. The 20-gauge size of the sclerotomy was not changed, however the surgeon ensured that intraocular fluid supplied by the pars plana inflow, egressed through the sclerotomy to cool the tip. The phacoemulsification machine power and aspiration parameters were set at 40-45\% linear mode and 100 mmHg, respectively. Use of perfluorocarbon liquid (PFCL) for retinal protection and performing prophylactic 360-degree barrier laser photocoagulation at the end of the procedure was optional based on surgeons’ preference.

Postoperative treatment consisted of the following: betamethasone eye drops every 2 to 4 hours, tapered over one month, and ciprofloxacin eye drops every 4 hours for one week.

Data was analyzed using SPSS software (SPSS 15.0, SPSS Inc., Chicago, IL, USA) employing paired and student t tests; P values less than 0.05 were considered as significant.

\textbf{RESULTS}

Twenty-two patients including 12 male and 10 female subjects with mean age of 71.1±8.2 years were studied. Characteristics of the patients are shown in table 1. Mean interval between nucleus drop and PPV was 26.6±36.5 (range: 0-120) days, and the median interval was 7.5 days. Patients were followed for a mean duration of 105.5±57.5 days.

Before PPV, 6 patients had raised IOP and 4 had significant intraocular inflammation. RRD associated with proliferative vitreoretinopathy (retinal break with rolled edges) was present in one eye. A posterior chamber intraocular lens (IOL) had been implanted in 4 eyes at the time of cataract surgery and one eye had an anterior chamber IOL.
Mean preoperative BCVA was 2.4±0.6 logMAR which improved to 1.4±0.6 logMAR at final visit (P<0.001). Visual acuity increased after surgery in all eyes. Preoperative BCVA ranged from hand motions to 20/120. Final postoperative BCVA ranged from counting fingers to 20/60. Of 11 eyes that underwent surgery earlier than 1 week after complicated phacoemulsification, final BCVA was 20/200 or better in 5 eyes (45.4%). In the other 11 eyes having vitrectomy later than 1 week, 4 (36.3%) achieved BCVA of 20/200 or better. BCVA changes were comparable in cases with early or late intervention (1.1±0.8 versus 0.95±0.8 logMAR, respectively, P=0.6).

An IOL was implanted at the time of surgery in 12 eyes. PFCL was used in 10 eyes and 360-degree endolaser photocoagulation was performed in 16 eyes. Intraoperative complications were noted in 4 eyes. Three eyes developed peripheral retinal breaks; one of these eyes had a small localized retinal detachment around the break and the

### Table 1. Clinical features of the patients

| Patient | Age | Sex | Interval between Phaco and PPV (days) | Nucleus Size | Complications before PPV | BCVA before PPV | Final BCVA | Intraoperative Complications | IOL Insertion at PPV | Postoperative Complications | Follow-up (days) |
|---------|-----|-----|--------------------------------------|--------------|--------------------------|----------------|-----------|-------------------------------|----------------------|--------------------------|------------------|
| 1       | 67  | M   | 2                                    | Total        | Mild corneal edema       | CF             | CF        | None                          | PC IOL               | None                     | 180              |
| 2       | 66  | F   | 110                                  | Total        | Uveitis                  | CF             | 20/120    | None                          | -                    | None                     | 180              |
| 3       | 73  | F   | 30                                   | Total        | Mild corneal edema       | CF             | 20/120    | None                          | Iris supported IOL  | None                     | 180              |
| 4       | 82  | M   | 7                                     | Total        | IOP rise                 | HM             | 20/160    | None                          | Iris supported IOL  | None                     | 180              |
| 5       | 59  | F   | 3                                     | Total        | Mild corneal edema       | CF             | 20/120    | None                          | PC IOL               | Glaucoma                 | 180              |
| 6       | 74  | M   | 7                                     | Total        | IOP rise                 | HM             | CF        | Retinal break                  | -                    | None                     | 90               |
| 7       | 72  | F   | 23                                   | Total        | Mild corneal edema       | CF             | CF        | Retinal break                  | -                    | None                     | 103              |
| 8       | 65  | M   | 14                                   | Total        | IOP rise, RRD, PVR       | HM             | 20/120    | None                          | -                    | ERM                      | 90               |
| 9       | 61  | F   | 0                                     | Total        | None                     | 20/120         | 20/60     | None                          | SF IOL               | None                     | 120              |
| 10      | 84  | F   | 90                                   | 1/2          | Uveitis                  | HM             | CF        | None                          | -                    | None                     | 45               |
| 11      | 80  | M   | 2                                     | Total        | IOP rise                 | HM             | CF        | None                          | SF IOL               | None                     | 45               |
| 12      | 73  | F   | 8                                     | 3/4          | IOP rise                 | CF             | CF        | None                          | -                    | None                     | 45               |
| 13      | 69  | M   | 4                                     | Total        | Mild corneal edema       | HM             | 20/60     | None                          | Angle supported IOL | Glaucoma                 | 90               |
| 14      | 78  | M   | 36                                   | Total        | Mild corneal edema       | CF             | CF        | None                          | PC IOL               | None                     | 60               |
| 15      | 70  | F   | 60                                   | Total        | IOP rise                 | CF             | 20/120    | None                          | Iris supported IOL  | None                     | 60               |
| 16      | 56  | M   | 120                                  | Total        | Uveitis                  | HM             | CF        | None                          | -                    | None                     | 180              |
| 17      | 76  | M   | 33                                   | Total        | Uveitis                  | HM             | CF        | None                          | -                    | None                     | 60               |
| 18      | 86  | M   | 25                                   | Total        | Mild corneal edema       | HM             | 20/60     | None                          | -                    | None                     | 180              |
| 19      | 76  | M   | 5                                     | Total        | Mild corneal edema       | HM             | CF        | None                          | PC IOL               | None                     | 60               |
| 20      | 58  | F   | 1                                     | Total        | None                     | CF             | CF        | None                          | Iris supported IOL  | None                     | 60               |
| 21      | 73  | M   | 0                                     | Total        | None                     | HM             | CF        | Cyclodialysis                  | -                    | Hypotony                 | 120              |
| 22      | 73  | F   | 7                                     | Total        | Mild corneal edema       | HM             | 20/120    | Retinal break                  | Iris supported IOL  | None                     | 60               |

M, male; F, female; PPV, pars plana vitrectomy; IOP, intraocular pressure; RRD, rhegmatogenous retinal detachment PVR, proliferative vitreoretinopathy; BCVA, best corrected visual acuity; CF, counting fingers; HM, hand motions IOL, intraocular lens; PC, posterior chamber; SF, scleral fixation; ERM, epiretinal membrane
surgeon performed fluid/gas exchange together with endolaser photoagulation at the break margins. Cyclodivision was observed in another eye which had developed before PPV; repair was not attempted at the time of surgery. No instance of scleral wound burn was observed. Postoperative complications included medically-controlled glaucoma in 2 eyes and hypotony in one eye. At the final visit, the retina was attached in all eyes. Reasons for poor BCVA at final follow up included high myopic macular abnormalities in 2 eyes, hypotony maculopathy in one eye, epiretinal membrane in one eye, and dry-type age related macular degeneration and disciform scar in 14 other eyes.

DISCUSSION

The primary goal of vitrectomy for retained nuclear material following complicated cataract surgery is thorough posterior vitreous removal to avoid traction during lens fragment removal. Extraction of the nucleus is commonly performed using a fragmentome with or without perfluorocarbon liquid injection. The fragmentome is the conventional ultrasound instrument for pars plana lensectomy; however, it needs a special handpiece and software which may not always be available.

Ruiz-Moreno et al used vitrectomy and phacoemulsification using a conventional phacoemulsification probe devoid of its silicone sleeve for removal of dislocated nucleus/lens fragments in 18 eyes.7 Complications included 2 cases of retinal tears at the time of surgery and one instance of retinal detachment after the operation. Soliman Mahdy et al8 reported the results of intravitreal phacoemulsification using a sleeveless microtip for removal of dislocated nuclei/lens fragments at the same session as phacoemulsification in 23 eyes. The only intraoperative complication was a case of retinal tear; after the procedure RRD occurred in two patients. The authors concluded that posteriorly dislocated lens nuclei/fragments can effectively be managed using pars plana vitrectomy and intravitreal phacoemulsification without the use of perfluorocarbon liquids.

In the present study, we observed no complication secondary to the use of a standard phacoemulsification tip. Fluid egression from the sclerotomy during nucleus emulsification may be the main reason for the absence of wound burns in our series. If the tip is used with its sleeve, one should enlarge the sclerotomy. On the other hand if a sleeveless tip is used, the surgical field and vitrectomy lenses may become covered by fluid dispersed by stroke movements of the phacoemulsification tip. We therefore cut the sleeve from its hub, so there was no need to enlarge the sclerotomy and at the same time fluid splashing was minimal. Ordinary phacoemulsification tips have different lengths, some are shorter than the others. The tip we use for routine phacoemulsification, which was the same type we employed in the current study, has the same length as a fragmentome, therefore no problems were encountered with nucleus removal in our study. With any tip length, nucleus removal may be facilitated by PFCL injection and bringing the nucleus into the mid-vitreous cavity. Characteristics of phacoemulsification tips were not described in previous studies.7,8

The recommended technique for employing ultrasound energy in the vitreous cavity is to lift the nucleus fragment away from the retinal surface by aspiration and perform phacoemulsification only in the mid/anterior vitreous cavity, thereby limiting exposure of the posterior pole to ultrasound energy.6 Using this technique, we observed no retinal tears posterior to the equator. The rate of intraoperative retinal tears in our study was nearly the same as those reported by Ruiz-Moreno et al and Soliman Mahdy et al, however, we did not observe postoperative RRD in our patients.7,8

The optimal time for PPV for retained lens fragments is undetermined. Some studies have suggested that outcomes are better if PPV is performed within two weeks of nucleus drop.9,10 Our results showed a trend toward better visual results in the early intervention group, however, the difference was not statistically significant. This is in accordance with other studies demonstrating that timing of PPV is not significantly associated with visual outcomes.2,4 We believe that timing for PPV depends on the
patient’s clinical condition. Nevertheless, early PPV (within 2 weeks of complicated cataract surgery) may avoid chronic glaucoma, and break the cycle of progressive lens-associated inflammation.

Previous studies have reported final BCVA of 20/40 or better in 44.4% to 82.6%. In our study, no patient gained visual acuity better than 20/60. Poor visual outcome in our series resulted from a variety of macular problems including high myopia, epiretinal membranes and macular degeneration. It has also been shown that poor presenting visual acuity is associated with worse final vision. Our series included 9 patients with follow up less than three months. It is likely that their vision would have continued to improve after the early postoperative period.

In conclusion, PPV and intravitreal phacoemulsification using a conventional tip with an amputated sleeve is effective for removal of retained nuclear material and is associated with visual improvement. This method may not be the standard of care in the presence of a fragmatome. Future studies with larger sample size and longer follow up are required to confirm our results.

Conflicts of Interest
None.

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