Combined Instrument and Posterior-Assisted Levitation of Nuclear Fragments During Phacoemulsification after Posterior Capsule Rupture

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Abstract

Introduction: Rupture of posterior capsule is a challenging complication especially when the nucleus is still present in the eye. Retained nuclear fragments frequently cause sight threatening complications.

Objective: To report the outcomes of a technique that implies the use of instruments in the anterior chamber and through pars plana to help delivery of fragments outside the eye together with the known posterior assisted levitation technique.

Design: In a retrospective series, the case notes of consecutive 15 surgeries performed by 4 surgeons between 2007 and 2008 were reviewed.

Patients and Methods: The study comprised fifteen eyes of 15 patients; 10 were females and 5 were males (age ranged between 50-73 yrs, Mean 65 years, STD 9 years). Subjects had rupture of posterior capsule during phacoemulsification. Dislocation of whole nucleus or nuclear fragments into the anterior or mid vitreous cavity occurred. Immediately after this event, dispersive viscoelastic was used to fill the anterior chamber before the phaco tip was removed. Either the MVR knife 19G or the needle of insulin syringe was used, 3.5 mm from the limbus, to levitate the dropped nucleus or fragments into the anterior chamber. Then other instruments (a spatula, a push pull) were used through the side-port incisions to help deliver the fragments through the main incision. The body of a keratome 3 or 5 mm could be used as a guide to carry large and cheesy semi soft pieces from the anterior chamber to the exterior of the eye through the main incision. Widening the main incision and using scoop and hook were used to deliver whole nucleus or large pieces. The technique was concluded with limited anterior vitrectomy and in sulcus implantation of PMMA IOL.

Results: This method was successful in 13 out of 15 eyes (87%) that had hard fragments and could be removed from the eyes safely. Post-operative corneal edema occurred in 2 eyes (13%) that improved over one month. Intraocular pressure was elevated to 25 mmHg in two eyes (13%) for 2 weeks. In one eye (6.7%) the technique failed to deliver nuclear pieces because they were fragmented inside the vitreous cavity during posterior assisted levitation. In another eye (6.7%), whole nucleus dropped posteriorly. Vitrectomy was needed for these two cases (13%).

Conclusions: Instrument assisted removal of dropped fragments during phacoemulsification is a safe procedure that could be used to remove nuclear fragments. It succeeded in most of the cases (87%); minimizing the need for vitrectomy.

Key Words: Complications of phacoemulsification – Posterior capsule rupture – Dropped fragments – Posterior assisted levitation – Instrument assisted levitation.

Introduction

GIVEN the variety of pathology presented by the human eye, even the best surgeons will have some complications. Despite the application of vigilant maneuvers during cataract surgery, broken capsules still occur at a rate between 0.45% for very experienced surgeons [1] and up to 14.7% for residents in training [2]. The frequency of retained lens fragments is estimated at 0.3% to 1.1% [3,4]. Estimated incidence of Displaced Nuclear Fragments into the Vitreous (DNFV) during phacoemulsification surgery in the UK is two or three per 1000 operations. Risk factors have been identified that should help to guide case selection for phacoemulsification surgery and modify techniques [5].

The challenge of cataract surgery is to minimize the risk of complications and to optimally manage complications that do occur.
Rupture of posterior capsule is a challenging complication especially when the nucleus is still present in the eye. Nuclear or cortical material that has already descended into the posterior vitreous or onto the retina cannot be safely retrieved via an anterior segment surgical approach. Although cortex and small nuclear remnants may be carefully observed without surgery, retained nuclear fragments frequently cause sight threatening complications [6-17].

Attempts to impale or aspirate a partially descended nucleus with the phaco tip can be extremely hazardous [17]. The downwardly directed infusion can repel the nucleus further, and aspiration of vitreous with the large diameter of the phaco tip becomes both likely and dangerous.

For these reasons, such attempts are not advisable. Elevating the nucleus with an instrument inserted through the phaco incision is often difficult because of the steep and anterior angle of the approach. A technique for lifting a descending nucleus with a cyclodialysis spatula inserted through a pars plana sclerotomy was described by Packard in 1991 [18]. Kelman named this technique posterior assisted levitation (PAL) and advocated it as a mean to more easily position an instrument tip posterior to the nucleus [19]. We adapted introducing instruments through pars plana to levitate the nucleus. We describe this procedure and present clinical results in 15 consecutive eyes of 15 patients. The age, risk factors, and clinical characteristics of the eyes are shown in Table (1). All 15 eyes had preexisting risk factors for posterior capsule rupture such as brunescent nuclei or small pupils [20].

Surgical Technique

This was a retrospective study of 15 eyes (Table 1 shows their preoperative characteristics) with dislocation of whole nuclei or nuclear fragments into the vitreous cavity during phacoemulsification, after a rent in the posterior capsule.

Upon recognition of a posterior capsule rupture, dispersive viscoelastic was used to fill the anterior chamber via the side-port incision before the phaco tip was removed. This was to prevent or minimize forward prolation of vitreous into the anterior chamber, which would have otherwise emptied upon withdrawal of the phaco tip. The nucleus or a part of it was displaced posteriorly into the anterior or mid-vitreous. In two eyes, there was a dislocation of whole nuclei. In another two eyes there was a dislocation of one half of the nucleus and in the remaining eleven eyes, there was a dislocation of a single or more than one quadrant.

Then we introduced a 19 G knife (MVR), or an insulin syringe needle through an incision 3.5 mm from the limbus into the mid-vitreous cavity to lie behind the fragment. This was used to force fragments into the anterior chamber. Then other instruments (a spatula, a push pull) were used through the side-port incisions to help deliver small hard fragments through the main incision. The blade of a 3.0 mm keratome or the body of a spatula were placed behind the cheesy semisoft fragments to support and guide them, helped by milking from above the cornea or by a side port second instrument. Care is taken to fill again the AC with a dispersive viscoelastic to protect the endothelium. Fragments were forced out through the main incision, which may be widened. In all cases, anterior vitrectomy was done to clear the anterior chamber from any prolapsed vitreous.

A Poly Methyl Metha-Acrylate (PMMA) Intra Ocular Lens was implanted in the posterior chamber. It was placed in the ciliary sulcus above capsular remains. Postoperative follow-up lasted 6 months and included careful slit lamp and dilated fundus examinations.

Table (1): Patient preoperative characteristics.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (Y)</th>
<th>Preoperative visual acuity</th>
<th>Nuclear density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>4</td>
<td>78</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>6</td>
<td>65</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>8</td>
<td>55</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>CF</td>
<td>Fairly dense</td>
</tr>
<tr>
<td>10</td>
<td>53</td>
<td>CF</td>
<td>Fairly dense</td>
</tr>
<tr>
<td>11</td>
<td>60</td>
<td>CF</td>
<td>Hard</td>
</tr>
<tr>
<td>12</td>
<td>72</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>13</td>
<td>73</td>
<td>HM</td>
<td>Hard</td>
</tr>
<tr>
<td>14</td>
<td>80</td>
<td>HM</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>59</td>
<td>CF</td>
<td></td>
</tr>
</tbody>
</table>

CF : Counting fingers.
HM : Hand motions.
Fig. (1): MVR at 3.5 mm from limbus. Nucleus was levitated to the AC, then a scope gets it out.

Fig. (2): Role of the scope and the hook.

Fig. (3): Insulin syringe might be safer (its shoulder prevents further travel) then a side port spatula and a scope completed the job.
Fig. (4): The blade of keratome 3 or 5 mm and the help of a side port instrument to push hard fragments. Milking above the cornea for the soft (as well as the hard) fragments.

Fig. (5): Manipulations through the side port incisions and widening the main incision.
Table 2: Postoperative findings.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Final BCVA</th>
<th>Comment</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6/12</td>
<td>–</td>
<td>6 months</td>
</tr>
<tr>
<td>2</td>
<td>6/24</td>
<td>Vitrectomy</td>
<td>1 Year</td>
</tr>
<tr>
<td>3</td>
<td>6/9</td>
<td>–</td>
<td>1 Year</td>
</tr>
<tr>
<td>4</td>
<td>6/18</td>
<td>ECCE</td>
<td>1 Year</td>
</tr>
<tr>
<td>5</td>
<td>6/18</td>
<td>ECCE</td>
<td>1 Year</td>
</tr>
<tr>
<td>6</td>
<td>6/12</td>
<td>–</td>
<td>1.5 Year</td>
</tr>
<tr>
<td>7</td>
<td>6/36</td>
<td>Vitrectomy</td>
<td>9 months</td>
</tr>
<tr>
<td>8</td>
<td>6/24</td>
<td>Elevated IOP</td>
<td>18 months</td>
</tr>
<tr>
<td>9</td>
<td>6/12</td>
<td>Elevated IOP</td>
<td>1 Year</td>
</tr>
<tr>
<td>10</td>
<td>6/12</td>
<td>Corneal edema</td>
<td>1 Year</td>
</tr>
<tr>
<td>11</td>
<td>6/18</td>
<td>Corneal edema</td>
<td>1 Year</td>
</tr>
<tr>
<td>12</td>
<td>6/18</td>
<td>ECCE</td>
<td>1 Year</td>
</tr>
<tr>
<td>13</td>
<td>6/9</td>
<td>–</td>
<td>9 months</td>
</tr>
<tr>
<td>14</td>
<td>6/12</td>
<td>–</td>
<td>1 Year</td>
</tr>
<tr>
<td>15</td>
<td>6/12</td>
<td>–</td>
<td>1 Year</td>
</tr>
</tbody>
</table>

BCVA = Best corrected visual acuity.
IOP = Intraocular pressure.

Results

Clinical results of cases postoperatively are summarized in (Table 2).

This method was successful in (13 out of 15) eyes (87%) that had hard fragments and could be removed from the eyes safely. It failed only in two eyes (2 out of 15, 13%) where whole nucleus dropped posteriorly in one eye and the other eye had multiple fragments in the vitreous cavity. Posterior vitrectomy was needed for these two eyes. In three eye of these 15 eyes (20%), we had to widen the main incision (converting to ECCE) to deliver large fragments because their diameter was wider than the main incision. Post-operative corneal edema occurred in 2 eyes (13%) that improved over one month period. Intraocular pressure was elevated to 25 mmhg in two eyes (13%). It was stabilized over 2 weeks period. Vitreous incarceration in the side port incisions or the sclerotomy sites did not occur in any of the cases due to the anterior vitrectomy that was done. Post-operative vision (Table 2) improved to 6/36 in 1 eye (6.7%), to 6/24 in 2 eyes (13.3%) and to >6/18 in 12 eyes (80%).

Discussion

Posterior descent of the nucleus after posterior capsule rupture is a serious complication. Attempting to chase the dropped nucleus with the phaco tip can result in giant retinal tears and retinal detachment, and the temptation to do so should be avoided [9,17]. Vitreous loss increases the risk for postoperative retinal detachment, cystoid macular edema, inflammation, and elevated intraocular pressure (IOP) [18,21]. A retained nucleus further elevates the risk for postoperative inflammation, secondary glaucoma, and corneal decompensation [7-18]. Subsequent posterior segment surgery to retrieve the dropped nucleus generally improves the clinical outcome [6-17].

Although observation may be appropriate for small amounts of cortex or nuclear fragments [13,16] excessive delay in performing the necessary surgery may worsen the prognosis [6,10,13,15,17-24].

In this paper we introduced our method of using bimanual instruments and keratomes to support extraction of dropped fragments. The posterior
dislocation of lens fragments is an infrequent but well-known complication of cataract surgery. Its incidence, reported as between 0.3% to 1.0% [67], is higher with phacoemulsification than with extracapsular cataract extraction.

To retrieve dislocated nuclear material during surgery, Charles Kelman, MD, introduced the concept of using a pars plana incision to lift dislocated lens fragments anteriorly in order to safely remove them, thus coining the term posterior-assisted levitation, or the PAL technique [19]. Our technique offered diversity of methodology, using the keratomes, the spatula, the push-pull and milking above the cornea, and offered meticulous removal of visco-elastic, which if was left inside the eye, may elevate postoperative IOP [25,26].

Literature discussing levitation of nuclear fragments is scarce. No many articles are available. However, Por YM and Chee SP, 2007 [27] used the PAL technique for 14 eyes. They reported complications that included 1 case of retinal detachment occurring 20 months after PAL and 1 case of cystoid macular edema in a patient with previous anterior uveitis. In their series, best corrected visual acuity was 20/40 or better in all except 3 patients (1 retinal detachment, 1 corneal edema/scarring, 1 unspecified). In our study, we used a diverse technique that could be suited for wider range of cases. Cases of dropped fragments are variable if we consider the size and consistency and number of fragments and the consistency of vitreous. The above mentioned study used the known PAL technique with a cyclodialysis spatula only.

Michela Cimberle [28] presented a technique called Viscoat PAL, where Viscoat® (Chondroitin Sulphate and Sodium Hyaluronate, Alcon) was injected into the midvitreous cavity to levitate dropped fragments into the AC. Also, once in the AC, fragments were trapped by Viscoat trap till they are removed over a sheet glide by the phaco tip. Again In this technique, still it is not clear how should the surgeon complete the jobs of removing different fragments to the exterior of the eye.

Lifshitz T and Levy J, 2005 [29] used the PAL technique in 7 eyes. They did not describe how they got the fragments outside the eye after levitating them to the anterior chamber.

In such papers, limitation of technique to a single instrument (pars plana cyclodialysis spatula or a cannula injecting viscoat) is noted. No detailed discussions of how to remove the variable fragments. However, they report similar visual acuity levels like our cases.

Our work shows a detailed illustrative gallery for the different technical steps and instruments.

Conclusion:
This work presents a new diverse methodology that proved useful in a very terrible intraoperative complication during phaco surgery. It stressed the value of using the bimanual incisions to manage dropped fragments. It also showed using the possibility of using the needle of the insulin syringe as well as the MVR 19G knives. It showed how we could use variable instruments to remove different sized and different consistency dropped nuclear fragments.

The combined use of bimanual instruments from the side port incisions together with the PAL technique, and milking above the cornea, with the aid of viscodispensive, helped surgeons to manage dropped fragments and the need for vitrectomy was minimized. An illustrative gallery (abstracted from videos of surgeries) is attached.

This work was presented at the following conferences:
2- And after modifications was presented at the Annual Summer meeting of the European Society of Cataract and Refractive Surgeons (ESCRS), at Berlin, September 2008.

References


28- MICHELA CIMBERLE: Viscoat PAL, the Viscoat "trap," bimanual pars plana vitrectomy and bimanual I&A can prevent dropped lens material. OCULAR SURGERY NEWS EUROPE/ASIA-PACIFIC EDITION October, 2002.