techniques

Posterior assisted levitation for nucleus retrieval using Viscoat after posterior capsule rupture

David F. Chang, MD, Richard B. Packard, MD

A pars plana injection of Viscoat® (sodium hyaluronate 3%–chondroitin sulfate 4%) was used to stabilize and elevate a descending nucleus in 8 patients with posterior capsule rupture. The nucleus or nuclear remnants were successfully removed in all 8 patients.

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Posterior capsule rupture is a complication that is especially difficult 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. A subsequent 3-port pars plana vitrectomy should be used to extract the descended lens material if indicated.[1–8] Although cortex and small nuclear remnants may be carefully observed without surgery, retained nuclear fragments frequently cause sight-threatening complications.[1–12]

Attempts to impale or aspirate a partially descended nucleus with the phaco tip can be extremely hazardous.[12] 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.

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From private practices in Los Altos, California, USA (Chang), and London, United Kingdom (Packard).

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Reprint requests to David F. Chang, MD, 762 Altos Oaks Drive, Suite 1, Los Altos, California 94024, USA.

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A technique for lifting a descending nucleus with a cyclodialysis spatula inserted through a pars plana sclerotomy was described by 1 of us in 1991.[13] Kelman named this technique posterior assisted levitation (PAL) and advocated it as a means to more easily position an instrument tip posterior to the nucleus (C. Kelman, MD, "New PAL Method May Save Difficult Cataract Cases," Ophthalmology Times, November 1994, page 51).

We propose using a pars plana injection of Viscoat® (sodium hyaluronate 3%–chondroitin sulfate 4%) instead of a spatula to levitate the nucleus. We describe this procedure and present clinical results in 8 consecutive eyes of 8 patients. The age, risk factors, and clinical characteristics of the eyes are shown in Table 1. All 8 eyes had preexisting risk factors for posterior capsule rupture such as brunescent nuclei or small pupils.[14]

Surgical Technique

Upon recognition of a posterior capsule rupture, Viscoat was used to fill the anterior chamber via the side-port incision before the phaco tip was removed. This prevented or minimized forward prolapse of vitreous into the anterior chamber, which would have otherwise emptied upon withdrawal of the phaco tip. When possible, the case was videotaped. If the patient had received only topical anesthesia, a posterior sub-Tenon's injection of 2.0 to 3.0 mL of lidocaine 2% was administered by a curved Simcoe cannula inserted

Table 1. Patient preoperative characteristics.

Patient	Age (Y)	Preoperative Visual Acuity	Nuclear Density	Risk Factors
1	96	CF	Hard	PXE
2	84	CF	Hard	—
3	82	CF	Hard	—
4	78	HM	Hard	—
5	83	HM	Hard	—
6	87	CF	Hard	—
7	79	20/50	Medium	PXE
8	66	20/50	Medium	Small pupil

CF = counting fingers; HM = hand motions; PXE = pseudoexfoliation

through an inferior fornix conjunctival/Tenon's buttonhole incision.

If the nucleus was displaced posteriorly into the anterior vitreous, a pars plana injection of Viscoat was given using 1 of 2 methods. An immediate injection was performed by placing a short, disposable 25-gauge needle onto the Viscoat syringe and penetrating the conjunctiva and pars plana 3.5 mm behind the limbus. If time allowed, a conjunctival cut-down and cautery at the desired sclerotomy site were performed first. A disposable 19- or 20-gauge MVR blade (Alcon) was used to make a pars plana sclerotomy 3.5 mm posterior to the limbus (Figure 1). The Viscoat cannula was inserted through the sclerotomy, after which the cannula tip could usually be visualized behind the nucleus.

Viscoat was first slowly injected downward well behind the nuclear piece(s) to provide supplemental support. The nucleus was then elevated into the anterior chamber through a combination of additional Viscoat injection and manipulation of the cannula tip (Figure 2). Blind or random searching motions of the cannula tip were avoided. Care was taken to avoid excessive Viscoat injection, which would create an overly firm globe or cause iris prolapse.

Upon levitation of the nuclear fragment(s) into the anterior chamber, the Viscoat cannula was withdrawn. The nucleus was removed using 1 of 2 techniques. If the pieces were soft and small enough, the phaco tip was reinserted above a trimmed Sheet's glide through a widened incision, as described by Michelson.[15] With low aspiration flow, vacuum, and infusion rates, careful emulsification of the remaining lens remnants was performed (Figure 3). The second instrument was used to position pieces directly in front of the phaco tip to minimize the need to move the tip. The Sheet's glide was positioned over the pupil to prevent fragments from dropping posteriorly and vitreous from prolapsing forward.

If the nucleus was dense or large, it was extracted through an enlarged corneoscleral incision. The self-sealing clear corneal temporal incision was abandoned. The microscope was repositioned for a superior surgical approach. A 4-0 silk bridle suture was placed through a superior rectus insertion. A standard extracapsular cata-

Figure 1. (Chang) A disposable #20 MVR blade is used to make a pars plana sclerotomy 3.5 mm posterior to the limbus in the inferotemporal quadrant.

Figure 2. (Chang) A Viscoat cannula is inserted through the pars plana sclerotomy to elevate nuclear fragments into the anterior chamber using a combination of viscoelastic material injection and manipulation with the cannula tip.

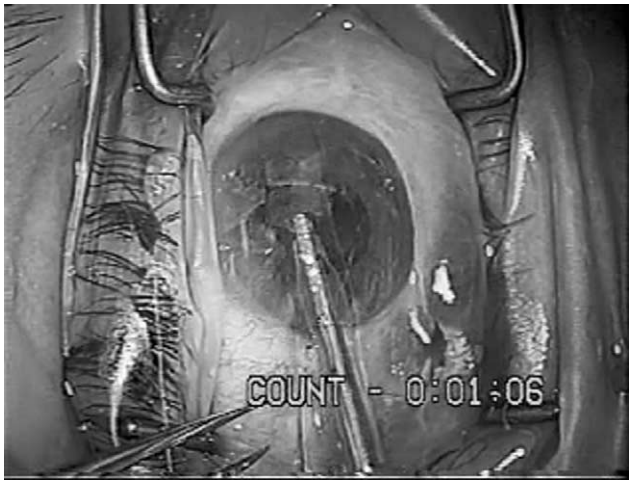

Figure 3. (Chang) Following elevation, nuclear fragments are emulsified with the #20 phaco tip placed above a trimmed Sheet's glide.

ract extraction (ECCE) incision was fashioned in the usual manner, ensuring that the opening was large enough. Additional viscoelastic material was placed anterior to the nucleus. Because bimanual expression was contraindicated, an irrigating lens loop was used to extract the nucleus.

The Viscoat PAL maneuver was repeated if additional nuclear or epinuclear components were still present in the posterior chamber. Epinucleus and cortex were removed with a single or 2-port irrigation/aspiration instrument. Bimanual, 2-port anterior vitrectomy was performed in either case. The vitrectomy cutter was inserted through the limbus or the pars plana sclerotomy. In the latter case, the sclerotomy was closed with a single interrupted 8-0 polyglactin (Vicryl®) suture.

A posterior chamber intraocular lens (IOL) was placed in the ciliary sulcus if the capsulorhexis remained intact or there was enough remaining anterior or posterior capsule to support it. An anterior chamber IOL was implanted if support was inadequate.

Postoperative follow-up varied by patient but included careful dilated fundus examinations.

Results

Surgery was performed by 1 of the 2 surgeons (R.P., 6 cases; D.C., 2 cases). In some cases, a large nuclear piece was present at the time of posterior capsule rupture. In other instances, the nucleus had been divided or chopped into multiple fragments. In every case, the fragments of nucleus were brought into the anterior chamber using the Viscoat PAL technique. In 4 eyes, large-incision ECCE was performed to manually extract the nucleus. In 4 cases, the remaining nucleus was removed by phacoemulsification performed over a Sheet's glide. Seven patients received a posterior chamber IOL in the ciliary sulcus. One patient received an anterior chamber IOL. The operative data are summarized in Table 2.

No major postoperative complications were observed. The final visual acuities are listed in Table 3. With the exception of 1 eye with macular degeneration that had a visual acuity of 20/60, all eyes regained at least 20/40 best corrected visual acuity postoperatively. Post-

Table 2. Operative findings in 8 Viscoat PAL patients.

Patient	Stage When PC Ruptured	Post-Levitation Technique	IOL Position
1	Cracking	ECCE + vitrectomy	Sulcus
2	Cracking	ECCE + vitrectomy	Sulcus
3	Sculpting	ECCE + vitrectomy	AC
4	Quadrant removal	Phaco + vitrectomy	Sulcus
5	Sculpting	Phaco + vitrectomy	Sulcus
6	Sculpting	Phaco + vitrectomy	Sulcus
7	Chopping	ECCE + vitrectomy	Sulcus
8	Fragment aspiration	Phaco + vitrectomy	Sulcus

AC = anterior chamber; ECCE = extracapsular cataract extraction; PC = posterior chamber

Table 3. Postoperative findings.

Patient	Final BCVA	Comments	Follow-up
1	20/40	AMD	>2 y
2	20/30	—	>2 y
3	20/30	—	>2 y
4	20/30	—	>2 y
5	20/40	—	>2 y
6	20/60	AMD	>2 y
7	20/40	AMD	>18 mo
8*	20/25	—	>18 mo

AMD = advanced macular degeneration; BCVA = best corrected visual acuity

*Patient had elevated IOP 1 day postoperatively that resolved with topical medication.

operative follow-up was more than 2 years in 6 patients, and at least 18 months in all 8 patients. There were no instances of retained nuclear fragments. Variable but small residual amounts of posteriorly retained cortex were common but spontaneously and rapidly reabsorbed in all cases. Vitreous incarceration in the anterior chamber or sclerotomy site did not occur. No patient required additional surgery.

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.[4,12] Vitreous loss increases the risk for postoperative retinal detachment, cystoid macular edema, inflammation, and elevated intraocular pressure (IOP).[16] A retained nucleus further elevates the risk for postoperative inflammation, secondary glaucoma, and corneal decompensation.[1–12]

Subsequent posterior segment surgery to retrieve the dropped nucleus generally improves the clinical outcome.[1–12] Although observation may be appropriate for small amounts of cortex or nuclear fragments,[8,11] excessive delay in performing the necessary surgery may worsen the prognosis.[1,5,8,10,12]

Following the intraoperative recognition of posterior capsule rupture, the surgeon's first objective is the safe removal of the nucleus, epinucleus, and cortex.[17] The next priority is the appropriate excision of anteriorly prolapsed vitreous using an automated vitreous cutter with a high cutting rate. A final but secondary objective is preservation of enough anterior or posterior capsule for implantation of a posterior chamber IOL.

If the nucleus dislocates into the posterior vitreous or onto the retina, the anterior segment surgeon lacks the visualization and expertise to levitate it forward. However, a nucleus that can be visualized as it is suspended in the posterior chamber or anterior vitreous could be brought forward into the anterior chamber. Once in this location, the nucleus can be extracted using 1 of 2 options. Depending on the circumstances, phacoemulsification can be continued[14] or the incision can be enlarged for manual extraction with a lens loop.[12,17] An anterior vitrectomy is performed after the nucleus is removed.

Complicating the first objective are several factors. Prolapse or loss of supporting vitreous can cause the nucleus to suddenly sink. Attempting to spear the nucleus with the phaco tip may propel it posteriorly through a widening tear because of the posteriorly directed infusion. Unintentional aspiration of vitreous by the phaco tip may cause a retinal tear.

Several conditions may make it difficult to levitate the nucleus upward with viscoelastic material. Instruments inserted through the phaco incision are approaching a posteriorly dislocated nucleus from a difficult angle. A small pupil or capsulorhexis may impede levitation of the nucleus and pose additional obstacles to positioning instruments behind the nucleus. Nuclear fragments that are suspended in vitreous resist aspiration and tend to bob away from an approaching instrument tip.

To overcome these difficulties, Kelman popularized the concept of PAL using a metal spatula inserted through a pars plana sclerotomy. Rao and coauthors[18] report using this technique in 8 cases but do not present clinical details. This report outlines a different approach whereby Viscoat is injected through a pars plana incision to levitate the nucleus up into the anterior chamber. Clinical findings and follow-up with a series of patients in whom a PAL technique was performed has been unreported.

As a levitating agent, Viscoat has several potential advantages over a metal spatula. Injection of viscoelastic material behind the nucleus provides immediate support to prevent further descent. This is important if there is vitreous loss because formed vitreous is all that remains to prop up the nucleus in the absence of an intact posterior capsule. Multiple small, chopped fragments of nucleus can be difficult to levitate with a spatula tip if they are suspended in vitreous. A carefully directed wave of viscoelastic material, however, can carry these pieces forward more easily.

Finally, because the iris obscures much of the vitreous cavity, fishing maneuvers with the metal spatula tip may be perilous. Aiming viscoelastic material behind a peripherally or posteriorly positioned nucleus can manipulate it into a more anterior and central location. Further repositioning and levitating the nucleus with the cannula tip can then proceed under direct visualization. Care must be taken to inject the viscoelastic material slowly and to avoid overinflating the globe.

Viscoat has theoretical advantages over other viscoelastic materials in these cases. Given that some posteriorly injected viscoelastic material will remain after the anterior vitrectomy, low-molecular-weight dispersive agents should be less likely to produce a protracted IOP spike than high-molecular-weight cohesive products.[19–21] This may explain why there were no problematic instances of early postoperative IOP elevation in our series of patients. Second, once the Viscoat is used to levitate the nucleus forward, it is more likely to remain in place during subsequent phaco or manual extraction maneuvers. That dispersive agents better resist removal is an advantage in this situation because this Viscoat partition supports the nucleus and blocks further vitreous prolapse.

Using the Viscoat PAL maneuver, the nucleus or nuclear fragments were successfully retrieved and removed in all 8 eyes in our series. All eyes had implantation of an IOL. Despite the need for a vitrectomy, no eye developed a retinal detachment or required additional surgery over a minimum of 18 months follow-up.

The Viscoat PAL technique is not recommended if a dropped nucleus has reached the retina. However, it may be considered for a partially descended nucleus after posterior capsule rupture. Following pars plana sclerotomy, the nucleus can be elevated with a combination of a posteriorly directed Viscoat injection and manipulation with the Viscoat cannula tip. If successful, this can help prevent a retained nucleus or subsequent posterior segment surgery to retrieve it.

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