

# PAL of a Dropped Nucleus

Anterior segment surgeons should learn this relatively simple and noninvasive technique to prevent an otherwise difficult cataract surgical complication.

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**T**he most feared complication in modern cataract surgery is a dropped nucleus. Early recognition of a posterior capsule rupture (PCR) and stabilization of the remaining nucleus may prevent its disappearance into the vitreous cavity.

PCR may occur during different stages of surgery (ie, prior to, during, or after nucleus removal). Generally, a breach of the posterior capsule at the initial stages of surgery is associated with a larger residual nuclear fragment than if it occurred later. Early signs of PCR include:

- Altered fluid dynamics in the anterior chamber;
- Pupil dilatation, followed by constriction (ie, intraoperative hippus);
- Sudden deepening of the anterior chamber;
- Lens fragments being blown out of the capsular bag;
- Sudden appearance of a clear red reflex;
- Sudden difficulty to attract the nucleus toward the phaco tip, holding onto the fragment, or performing phaco (ie, because of vitreous incarcerated in the phaco tip);
- Appearance of a bounce when the posterior chamber is phacoed and damaged;
- Suspicious curvilinear posterior chamber lines;
- When fragments seem to have extra room or move to one side;
- During I/A, star fold may appear when the posterior capsule is engaged; and
- The posterior chamber IOL cannot be centered within the capsular bag.

Intraoperative capsular block syndrome,<sup>1</sup> resulting from hydrodissection performed forcefully using a large volume of fluid (especially in the presence of a small capsulorrhexis), may result in rapid fluid build-up posterior to the nucleus within the capsular bag and subsequent hydrorupture of the posterior capsule. At this time, the surgeon may observe a pupil-snap sign,<sup>2</sup> in which the pupil transiently dilates then rapidly constricts. The nucleus tumbles into the vitreous cavity, when the surgeon unwittingly inserts the phaco probe and infuses the

anterior chamber. Fortunately, this is uncommon.

PCR occurs most frequently during segment removal. The surgeon may phaco the posterior capsule, pushing the phaco tip through the capsule, especially when troughing a soft cataract. Aspirating the posterior chamber may occur when emulsifying the last fragment. At this time, surge occurs, and the anterior chamber suddenly shallows. To avoid this, gradually lower the vacuum and aspiration flow rates, and progressively remove the nucleus. The anterior chamber may collapse when the probe is inadvertently withdrawn, and the irrigation sleeve slips out of the anterior chamber, especially when attempting subincisional cortex removal.

Rarely, rapidly unfolding an IOL against a bulging posterior chamber may induce a rent, resulting in a dropped IOL.

When PCR is observed, surgery should be stopped and the infusion bottle lowered. The surgeon must avoid pulling instruments out of the eye until (1) the vitreous is tamponaded by introducing a dispersive ophthalmic viscoelastic device (OVD) via the sideport, over the capsular defect, and (2) the anterior chamber space is stabilized. Where possible, OVD should be used to trap the residual nuclear fragment to prevent its descent into the vitreous cavity. The surgeon should quickly assess the situation and determine the feasibility of attempting posterior-assisted levitation (PAL) of the nuclear fragment, if it descended through the capsular rent.

## PAL PROCEDURE

Before performing PAL, ensure that the nucleus is still visible under the operating microscope (Figure 1). Moving the eye around—toward the direction of the fragment—with conjunctival forceps may improve visualization. Vitrectomy should be delayed until after the nucleus has been retrieved; this prevents further descent of the fragment.

If only topical anesthesia was used during surgery, a small subconjunctival injection of local anesthetic should be administered at the site of the intended PAL. The anterior chamber is filled with dispersive OVD, avoiding posterior



**Figure 1.** Descending and tilting the entire nucleus secondary to intraoperative capsular block syndrome, still within view of the operating microscope. The dropping nucleus is observed to be at the 2-o'clock position of the eye.



**Figure 2.** Site of needle sclerostomy is 3.5 mm posterior to the limbus at the position closest to the dropping nucleus. The needle enters the eye bevel-up.

displacement of the dislocated nucleus or posterior chamber IOL. The distal shaft of the needle should be curved slightly forward and mounted on an empty syringe or one containing dispersive OVD.

The best position to introduce the needle (ie, 1-inch and 25-gauge) must be carefully determined. One important step is to study the three-dimensional position of the descended nucleus, as the success of the procedure hinges upon selecting the appropriate location and angle to introduce the needle. The ideal place to insert the needle is 3.5 mm posterior to the limbus, with the bevel facing up, at the clock position nearest to the fragment (Figure 2). The tip of the needle is brought to a position just posterior to the descended nucleus, maneuvering it toward the cornea and elevating the fragment into the anterior chamber (Figure 3). This should be done in one sweep. Injecting OVD must be avoided when the needle tip is within the vitreous cavity; it may only be injected once it has been safely levitated into the anterior chamber. This will support the nucleus.

A Sinsky hook may be introduced via the main incision.

Move the fragment to a safe and stable position in the anterior chamber, so that it is trapped and supported by OVD. The 25-gauge needle is carefully withdrawn from the eye. A leisurely decision regarding the safest way to deal with the nuclear fragment (Figure 4) and prolapsed vitreous must then be made. There should be minimal delay in performing PAL when indicated to reduce the risk of a dropped fragment.

This technique may similarly be applied to retrieve a posterior chamber IOL from the vitreous cavity that has either subluxated through a PCR or within the capsular bag due to zonulysis. Posterior chamber IOLs that appear wobbly and are clearly visualized at the slit-lamp should always be reexamined in the supine position with a handheld slit-lamp. The posterior chamber IOL may be hinged by a limited number of zonules, which keep part of the lens in a relatively anterior position. Alternatively, the IOL may freely descend onto the anterior vitreous face, although retaining a relatively anterior position. Only IOLs visualized on the operating microscope that are not freely floating on the retina are candidates for PAL. Surgery in these patients should

#### PEARLS FOR PERFORMING POSTERIOR-ASSISTED LEVITATION

- The nuclear fragment or IOL must be visible under operating microscope.
- Fill the anterior chamber with dispersive OVD.
- Insert a 1-inch, 25-gauge, slightly bent needle via pars plana at site closest to the fragment or IOL.
- The needle tip should be positioned behind the nuclear fragment and then maneuvered toward the cornea.
- OVD should not be injected, unless the cannula tip is in the anterior chamber.
- A Sinsky hook is used to stabilize the fragment or IOL into the anterior chamber, before withdrawing the needle.
- Only attempt a PAL procedure once.



**Figure 3.** The needle is aimed in a direction that will place the tip just posterior to the subluxated nucleus. The tip is brought forward in a single sweep, lifting the dropped nucleus into the OVD-filled anterior chamber with the aid of a Sinsky hook.

not be delayed. The remaining IOL support may be lost relatively quickly, resulting in a situation inaccessible to retrieval by PAL. (See Pearls for Performing Posterior-Assisted Levitation for more information.)

After PAL, it is prudent to obtain a vitreoretinal consult to examine for retinal breaks. Additionally, advise the patient on the symptoms of retinal breaks and detachment.

We conducted a retrospective review of 14 patients who underwent PAL for retrieval of nuclear fragments and posterior chamber IOLs from 1999 through 2006 at the Singapore National Eye Centre.<sup>3</sup> A 21-gauge needle was used on initial cases, however, the needle was subsequently switched to the 1-inch 25-gauge. Four patients had intraoperative posterior capsule rupture with immediate descent of the nuclear fragment or posterior chamber IOL into the vitreous.

Remaining patients had late posterior chamber IOL subluxation that occurred 2 months to 18 years after cataract surgery. Vision improved in all but one patient who developed an inferior macular off-retinal detachment with proliferative vitreoretinopathy 20 months after the initial PAL procedure. No retinal breaks were detected preoperatively or intraoperatively at vitrectomy, in keeping with a retinal detachment associated with pseudophakia. A second PAL procedure was attempted in this patient.

Other complications included one minor spontaneously resolving vitreous hemorrhage, arising from the sclerostomy site, and cystoid macular edema in one patient with a history of recurrent acute anterior uveitis. Posterior chamber IOLs were implanted in the ciliary sulcus if intact anterior capsule rim and zonules were present (ie, four eyes with dropped nucleus or posterior chamber IOL); nine eyes had



**Figure 4.** The nucleus is removed with a vectis.

iris fixation of the dislocated posterior chamber IOLs. In one patient, the dislocated posterior chamber IOL was removed and exchanged for an angle-fixated anterior chamber IOL.

PAL appears to be an effective method for retrieval of dislocated nuclear fragments or anteriorly positioned posterior chamber IOLs, with few complications.

This useful and effective technique manages a dropping nuclear fragment or posterior chamber IOL. Do not attempt a PAL procedure if the fragment or IOL cannot be visualized intraoperatively—including those lying freely on the retina. To reduce the risk of retinal detachment, PAL should be carefully planned and only executed once. The surgeon should also avoid injecting OVD for levitation while the needle tip is within the vitreous cavity. We believe that PAL is a relatively simple and noninvasive technique for managing a dropping nuclear fragment or posterior chamber IOL. All anterior segment surgeons should learn this technique to prevent an otherwise difficult cataract surgical complication. ■

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