Management of **Posterior Capsular Tear** During Phacoemulsification

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Usually, posterior capsular tears occur during phacoemulsification or irrigation aspiration (I/A). Clearly, the earlier the tear happens, the more challenging the case becomes.

Prevention is always better than treatment, so techniques that keep you away from the capsule are preferable, and anticipation and preparation can be a manageable crisis. After posterior capsule rupture, removal of residual lens material is a challenging but important goal. Indeed, retained nuclear fragments in the posterior segment greatly increase the risk of postoperative complications.

The keys to catching a small posterior capsular tear before it becomes a larger rupture are: recognizing it, stopping it, stabilizing it. In addition, the principles of management include preventing lens material from descending into the vitreous, preventing vitreous prolapse into the anterior chamber and securely fixating the IOL.

The First Step is to Recognize the Tear Immediately

Some clues that the posterior capsule is torn are a deepening of the eye during the cataract removal and a change in the fluid patterns and dynamics in the anterior chamber. Sometimes, it is clear that the capsule is torn, because a large quadrant of the nucleus can no longer be seen through the pupil and is viewed peripherally through the tear or in the anterior vitreous.

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Then Stop and Stabilize

When a tear in the posterior capsule is suspected, one tried-and-true method is to halt first all aspiration and ultrasound. A key tip is to keep the instruments in the eye to avoid a collapses of the anterior chamber which could lead to an enlargement of the tear. Furthermore the vitreous will come through, considerably complicating the situation. When possible, first remove the second side port instrument while leaving the phaco hand piece in the eye without irrigation. Next, an ophthalmic viscosurgical device (OVD) is injected posteriorly behind the lenticular material to create space and a cushion for the cataract material to rest on. The OVD may even plug the hole in the posterior capsule. This maintains a deep anterior chamber, and no positive net flow from the vitreous moving forward. It is advisable to use a dispersive ophthalmic viscoelastic because firstly, it tends to resist aspiration and is less likely to ooze out of the eye, and secondly, if it is left behind in the posterior segment, it will cause fewer problems with postoperative IOP than a cohesive viscoelastic would.

A limited irrigation can be manually delivered with a cannula to flush and loosen any cortical adhesions. Then a cohesive viscoelastic is used to deepen the anterior chamber, push the posterior capsule and prevent vitreous prolapse into the anterior chamber.

Surgical Strategy

Once the situation is stable, you have the opportunity to assess the situation and decide your next step. The surgical strategy depends on the severity of the rupture.

Posterior Capsulorhexis

If the rupture is very small and clearly visible with no large linear extensions and if no vitreous was aspirated, the tear can be converted into a posterior capsulorhexis. In many cases, a posterior capsulorhexis makes it possible to implant the IOLs in the bag, especially single-piece acrylic lenses, which are more easily manipulated between the anterior capsule and the remaining posterior capsule.

Retrieving the Nucleus

- If there is no vitreous prolapse, and the nucleus is still well supported within the capsular bag, the option of continuing phacoemulsification can be considered. This is a reasonable alternative if the capsular defect is small and localized, if the nucleus is soft, or if only a small amount of residual nucleus remains. The primary objective becomes extracting the remaining nucleus without aspirating vitreous. In order to do that, the retrocapsular space behind the defect must be filled with an ophthalmic viscodevice (OVD). The

dispersive viscoelastic serves as an effective barrier to vitreous prolapse while preventing posterior dislocation of lens material. The remaining lens material is moved up out of the remaining capsule and into the anterior chamber, where it can be safely emulsified and aspirated after readjustment of the phaco machine parameters: Lowering the irrigating bottle height, and reducing the aspiration flow rate (e.g., to 20–22 mL/min) will slow the pace down **(Figure 1)**. The vacuum should be decreased (e.g., 100–125 mm Hg) to eliminate any possibility of post occlusion surge. An effort should be made to confine the use of phacoemulsification and aspiration to zones away from the problem area and it is preferable to avoid sculpting or rotating the nucleus.

- If you have a **very large rupture** and think you may lose the nucleus, consider extending the phaco incision and getting the nucleus out before you do a vitrectomy.

Posterior Assisted Levitation with Viscoelastic Device

- In cases where the **nucleus is partially descended**, chasing it with the phaco is to be avoided. The Viscodevice posterior assisted levitation method must be preferred. Supplementary supporting viscoelastic is injected behind the nucleus through a pars plana sclerotomy and then the cannula tip nudges the nuclear fragments forward through the pupil, under direct microscopic visualization. Once the nucleus is in the anterior chamber, it can be extracted through a larger limbal incision. To pull out the cortex by irrigating and aspirating, proceed cautiously at a low flow rate, keeping well away from the rupture and start out as far away as possible from the tear. It is necessary to replace loss of viscoelastic with new injections.

- **When nucleus segments are deeper** in the vitreous cavity, only surgeons with significant experience should attempt to retrieve them. Eventually, the surgery can be continued with an anterior vitrectomy, and perhaps implantation of the appropriate IOL, before referring the patient to a vitreoretinal surgeon for completion of lens fragment removal and the implantation if it has not already been done.

Vitrectomy

- If vitreous is present in the anterior chamber, a **limited coaxial or bimanual anterior vitrectomy** must be performed: remove all of the vitreous from the anterior chamber, from the level of the tear to free up any strands, and preferably go slightly deeper to remove the anterior part of the vitreous. Once there is no more vitreous anteriorly, the nuclear material can be removed from the anterior chamber as previously described. Continued applications of an OVD can be used to trap nuclear particles in the angle and in the anterior chamber to prevent them from prolapsing posteriorly. It is hoped that a low bottle level, somewhere around 60 to 80 cm, will reduce the risk of the particles being blown posteriorly. If a nuclear particle does inadvertently drop into the posterior segment, conventional wisdom advises against retrieving that particle or even attempting to irrigate it up into the anterior chamber.

- A **pars plana vitrectomy** is the best option to remove prolapsed vitreous:
  - It provides a better angle for positioning instrument tips behind the nucleus, so it enables a smaller vitrectomy.
  - It pulls the vitreous back, rather than forward toward the main incision, so the risk of stretching vitreous strands is decreased as well as that of retinal detachment or cystoid macular edema.
  - It prevents evacuation of the partitioning Viscoat layer, which is supporting the mobile lens material in the absence of the vitreous.
  - It avoids the hydration of the vitreous.

The pars plana anterior vitrectomy can only be started if all remaining nucleus are completely stabilized and supported **(Figure 2)**. The following parameters are appropriate for efficient removal of vitreous:

- vitrectomy tip cutting rate of at least 800 cuts per minute, the cutter port would normally be set to the maximally open position;
- vacuum pressure of approximately 100 to 150 mmHg;
- aspiration flow rate of 15 to 25 cc/minute;

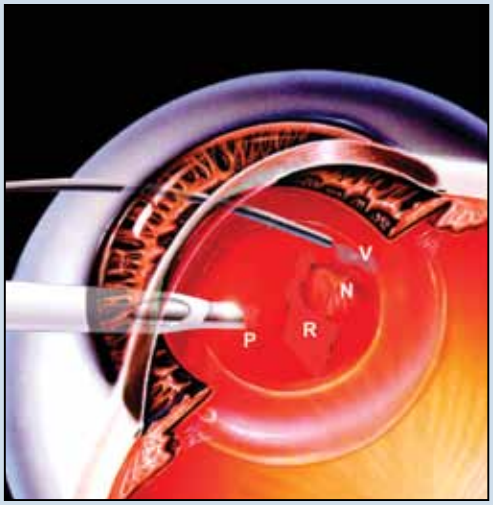

Figure 1:
Phacoemulsification During a Posterior Capsular Tear. The phaco procedure (P) may continue carefully once the anterior chamber be well formed with the aid of viscoelastic (V) allowing the nucleus fragments (N) to remain within the capsule and away from the capsular rupture (R) and vitreous.
(Art from Jaypee-Highlights Medical Publishers)

- the infusion bottle must be elevated to at least 90 to 100 centimeters. For most of the really small stab incisions, a 23 or 25-gauge are better irrigators.

However, you do have some time to adjust the vitrector fluidics and cutting speeds according to the type of expulsate being removed.

The tried-and-true points are:

- Removing all prolapsed vitreous from the anterior segment, and well behind the plane of the posterior capsule.
- Cutting and cleaning all the vitreous in the area of the pars plana incision: it is advisable to continue cutting on your way out of the eye.
- Checking the waterproofness of the incisions and, if needed, closing the pars plana sclerectomy with a single stitch and covering that stitch with the conjunctival flap.

Irrigation Aspiration I/A

The cortical material is detached when there is no more vitreous in the anterior chamber and when the nuclear material has been removed. This step is often challenging because the entire posterior capsule may be completely torn and folding upon itself. Therefore, gentle and careful I/A must be performed to prevent further damage to the capsule, and switching back and forth between vitrectomy and I/A is necessary.

IOL Choice

The choice of the IOL depends on the size of the capsular tear.

- If the tear can be transformed in a small posterior capsulorhexis, the IOL can be inserted in the capsular bag **(Figure 3)**.
- If it is a larger tear, the lens must be placed in the ciliary sulcus after maintaining the anterior chamber with plenty of dispersive viscoelastic. If the capsulorhexis is small enough to cover the edge of the optic (4.5 to 5.5 mm for a 6 mm optic) the optic is captured under the anterior rim of the capsulorhexis in the capsular bag. This provides 3 advantages: ensures a centered lens, stabilizes the IOL if a non continuous or large posterior capsule defect occurs after implanting the lens, and avoids postoperative iris chaffing against the edge of the implant or pupillary block. A three-piece IOL with an overall length greater than 13 mm is best suited for the sulcus space.

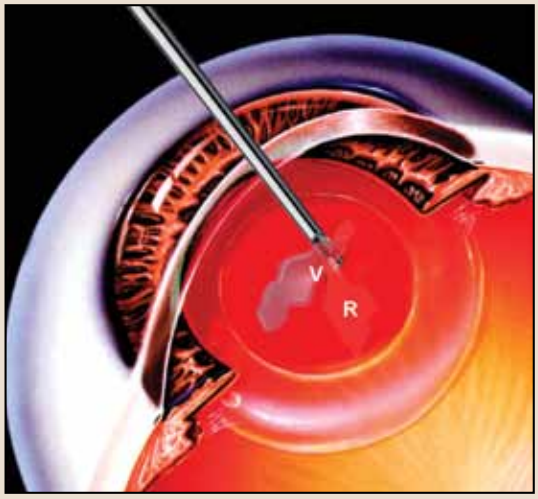

Figure 2: Anterior Vitrectomy During Phaco. The nucleus fragments should be kept away from the capsular tear (R) in order to avoid vitreous traction during anterior vitrectomy (V). *(Art from Jaypee-Highlights Medical Publishers)*

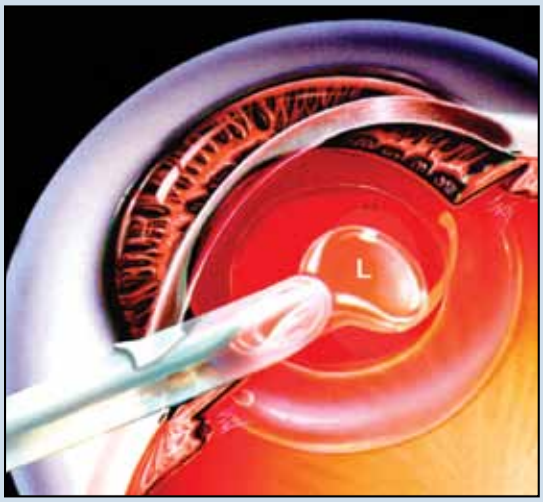

Figure 3: Insertion of a Foldable IOL over a Posterior Central Capsular Tear. If the tear is not too large and with round edges there is the possibility to accommodate the IOL (L) within the bag with no consequences. *(Art from Jaypee-Highlights Medical Publishers)*

Inserting the IOL

The IOL must be carefully inserted into the sulcus. To make sure that the IOL goes under the iris and into the sulcus, it is better to use a two-handed technique: one hand rotates the optic, the other compresses the haptic. Once the IOL is in the right position in the sulcus, the optic is pushed inside the anterior capsulorhexis with a Sinskey hook.

IOL Power

The IOL power must be adjusted depending on its position at the end of the surgery. Some formulas are complex to calculate the final power but a general and easy rule can be used: the power is dropped by 1 diopter if the posterior chamber lens is fully in the ciliary sulcus, by a half diopter if it is captured in the anterior capsulorhexis. But in this last case, if the IOL power is more than 23 or 24 diopters, it must be dropped by one full diopter.

Removal of the Viscoelastic

The viscoelastic is removed from front and to back, stopping at the lens. Most of the viscoelastic can be removed by applying a little pressure on the lens and aspirating right near the center. It is not necessary to aspirate the viscoelastic behind the capsule.

Checking for Residual Vitreous Strands

At this stage, an intraocular miotic agent helps to keep the optic of the lens posterior to the iris and to detect any peaking of the pupil where vitreous is still present. Injection in the anterior chamber of triamcinolone can also be very useful to stain residual vitreous strands which must be removed by vitrectomy. The incisions are checked with a Seidel test to ensure their ability to self-seal.

Finishing Touches

The wounds must be sutured for 2 weeks to stabilize the eye, prevent any postoperative collapse or leakage, and avoid further vitreous prolapse.

Postoperatively, the patient is given steroid eye drops for at least 6 weeks and watched closely for IOP spikes. A careful retinal inspection should be performed within a couple of days of surgery to ensure that no retinal detachment or retinal tear has been induced by the vitrectomy.

Conclusion

With patience, caution, and meticulous attention to the details of the procedure, surgeons can successfully manage an inadvertent capsular tear.

Bibliography

1. Aasuri MK, Kompella VB, Majji AB. Risk factors for and management of dropped nucleus during phacoemulsification. J Cataract Refract Surg. 2001;27:1428–1432.
2. Akura J, Hatta S, Kaneda S, et al. Management of posterior capsule rupture during phacoemulsification using the dry technique. J Cataract Refract Surg. 2000;27:982–989.
3. Chang DF, Packard RB. Posterior assisted levitation for nucleus retrieval using Viscoat after posterior capsule rupture. J Cataract Refract Surg. 2003;29:1860–1865.
4. Chang, D. F. "Strategies for Managing Posterior Capsular Rupture in Phaco Chop," in Mastering Techniques, Optimizing Technology, and Avoiding Complications (Thorofare, N.J.: Slack Inc., 2004).
5. Hansson LJ, Larsson J. Vitrectomy for retained lens fragments in the vitreous after phacoemulsification. J Cataract Refract Surg. 2002;28:1007–1011.
6. Rao SK, Chan WM, Leung AT, et al. Impending dropped nucleus during phacoemulsification [Letter]. J Cataract Refract Surg. 1999;25:1311–1312.
7. Rongé L Posterior Capsular Rupture during Cataract Surgery
8. Rossetti A, Doro D. Retained intravitreal lens fragments after phacoemulsification: Complications and visual outcome in vitrectomized and non vitrectomized eyes. J Cataract Refract Surg. 2002;28:310–315.
9. Yung CW, Packer M, Rosenthal K. Posterior Capsular Rupture. Cataract & Refractive Surgery Today July 2004