The case presented is a challenge where using phacoemulsification to remove a cataract. When a nuclear fragment became impaled onto the phaco needle, complete occlusion of the tip would result in a rise in vacuum to a preset maximum. If non-compliant aspiration tubing was used, the high vacuum would cause the tubing to collapse. As the fragment was emulsified, eventually a break in the occlusion would occur, the high vacuum and the expansion of the tubing would result in rapid aspiration of the fluid from the anterior chamber, which usually was not replaced by inflow, and shallowing of the chamber would occur. It was a common occurrence for the phaco tip to then engage the posterior capsule and to cause a rent and vitreous loss.

In order to minimize post-occlusion surge, numerous strategies were employed. One technique was to maintain a high flow into the eye by using an anterior chamber maintainer and/or raising the infusion bottle as high as possible; even extension poles were utilized. Another strategy was to employ a second instrument in the eye, such as a Sinskey hook or cyclodialysis spatula, to hold the posterior capsule away from the phaco tip. Also, phacoemulsification in the anterior chamber was used, but this ran the risk of damage to the iris and endothelium. The introduction of pulse modulation of phacoemulsification decreased post-occlusion surge as the nuclear fragment was maintained near the tip without occlusion. An ABS phaco tip (Alcon, Fort Worth, Texas) was another innovation that prevented surge by allowing flow through a bypass (drilled into the side of the phaco needle) once it was occluded at the tip.

Fortunately, post-occlusion breaks resulting in surge and shallowing of anterior chamber are less of a problem with recent innovations in phacoemulsification machines. These innovations have included software modifications that monitor chamber stability, micropulse modifications of phacoemulsification energy, low-compliance tubing, and mechanical flow restrictors in the aspiration tubing. Despite these innovations, I still use a second instrument in the eye during phacoemulsification. My preferred instrument is a custom made irrigation handpiece, 19 G, with a Sinskey hook at the tip. I routinely use bimanual small incision surgery with the irrigation handpiece in my left hand and the sleeveless phaco needle in the right hand. The irrigation handpiece is placed posterior to the fragment being emulsified, with the irrigation inflow directed toward the posterior capsule. If surge or chamber instability occurs, the inflow of fluid keeps the capsule from coming forward and the Sinskey hook provides a mechanical barrier to contact with the posterior capsule by the phaco tip.

The case presented is a challenge; the goal is to remove the remaining nuclear remnant without further compromising the posterior capsule. The Malyugin ring would be left in place and mobilized with a Sinskey hook, as needed, to get visualization of the lens fragment during the procedure. Initially, the vitreous prolapse into the anterior chamber should be addressed. A dry vitrectomy with frequent rellift of the anterior chamber with balanced salt solution would be my approach, as I am comfortable with this. Once the vitreous was removed, a dispersive OVD would be placed into the region of the posterior capsular tear and under the cornea to copiously coat the endothelium. I would then use a cohesive OVD to viscodissect the remaining fragment from the posterior capsule and to elevate it into the anterior chamber.

The next step is to prevent the fragment from dislocating into the vitreous cavity and the vitreous from coming forward. Ideally, if the anterior capsulorhexis is still intact, I would place a three-piece intraocular lens (Sensa or Clariflex, Abbott Medical Optics, Santa Ana, Calif.) into the sulcus to accomplish this. If there was compromise of the anterior capsule and a lens could not be placed, I would use a Sheet’s glide cut to size, placed anterior to the iris and behind the elevated nuclear fragment. Low flow, low vacuum parameters would be used to emulsify the fragment.

Then, cortical cleanup would be performed using bimanual anterior vitrectomy. If a Sheet’s glide was used, this would be removed. If a sulcus intraocular lens was used, it would be elevated into the anterior chamber. I have my vitrectomy foot pedal set for irrigation in position one, aspiration in two, and vitrectomy in three. The custom irrigation Sinskey hook handpiece (described above) would be used to manipulate the Malyugin ring for visualization and to keep the IOL away from the vitreous cavity. The cortex would be removed by using a combination of aspiration to peel it away from the capsule and vitrectomy to cut it. Since I use a bimanual technique, subincisional cortex is usually not an issue.

Once the capsule was cleaned of cortex, triamcinolone injected into the anterior chamber would be used to ensure that no further vitreous was present. If any was present, a vitrectomy would be performed. Intraocular lens placement would be dependent on the state of the capsule. A three-piece intraocular lens would be my choice for most outcomes in the type of case presented for discussion. If only a small portion of the posterior capsule has been violated, the intraocular lens could be placed into the bag and rotated so that the haptics are supported by the intact capsule. Alternatively, the lens could be placed into the sulcus with optic capture by the anterior capsulorrhesis. If a significant loss of the capsule is
present, the three-piece lens can be sutured to the iris or it can be scleral-fixated, either with sutures or fibrin glue.

Prior to removal of the OVD, which would be done with the vitrectomy tip, the Malyugin ring would be removed. I place non-preserved moxifloxacin into the anterior chamber in complicated cases. I also have a low threshold for suturing corneal wounds in such cases.

Alex W. Cohen, M.D.
Assistant professor of ophthalmology,
University of Oklahoma,
Dean McGee Eye Institute, Oklahoma City

Dr. Cohen: This is a tough but unfortunately not uncommon situation to be in while training residents. Post-occlusion surge occurs when a nuclear fragment blocks aspiration of fluid from the anterior chamber while vacuum pressure is building up in the line. Despite advances in microprocessors, hand-piece resistance valves, and vacuum line tubing compliance, when the occlusion breaks free a rapid efflux of fluid occurs that will shallow the anterior chamber and can bring the posterior capsule toward the phaco needle. Some surge is unavoidable. The question then becomes where is your phaco needle pointing when the surge occurs. Often times I witness trainees chasing after nuclear fragments or attempting to phaco out in the periphery under the edge of the rhexis. Obviously these are not safe maneuvers, and it is best to keep the needle in the center of the eye at or above the iris plane while engaging the ultrasound function. In this manner, if a surge occurs, the needle will not meet the posterior capsule.

In this case, given that there is a large posterior capsular tear, vitreous prolapse to the wound, and a large amount of dense nuclear material still in the eye, I feel that options are relatively limited. One of the first things I would recommend here is to place a dispersive viscoelastic in the eye to act as a tamponade against further vitreous prolapse and prevent chamber shallowing. Dilute, preservative-free triamcinolone (1:10) can then be injected into the eye to stain the vitreous. While this is not necessary, it does help define the scope of the problem. In a residency training situation I have found it invaluable to demonstrate the presence and dynamics of the vitreous to the less experienced surgeon. If there is a large amount of vitreous prolapse anterior to the capsular rupture or up to the wound, the next order of business is to begin vitreous cleanup. It is important to suture the main wound and then perform an anterior vitrectomy via watertight paracentesis ports. I would do this until there appeared to be no further vitreous anterior to the capsular rupture, and I would confirm this during the vitrectomy by placing triamcinolone in the eye again. In this case, the posterior capsular rupture appears to involve one-third to one-half of the capsule, and I would be very concerned about losing nuclear pieces. The surgeon can inject a dispersive viscoelastic in the area of the tear as well as under the lens material and prepare to convert to an extracapsular technique. The initial incision can be enlarged with a crescent blade and brought back toward the limbus, or a new scleral tunnel can be created in another portion of the globe, i.e., superiorly. The Malyugin ring may get in the way of the lens loop during nuclear removal, and therefore it may be necessary to switch to iris hooks at this point. This is dependent upon the size of the nuclear fragments that remain, the size of the Malyugin ring, and the apparent stability of the Malyugin ring as it is engaged to the iris. Once the appropriate size wound is created, the lens loop can be used to remove the remaining nuclear material. This main incision should then be promptly closed and a thorough anterior vitrectomy performed with the aid of triamcinolone again.

The next issue is what to do about placing a lens. If there is good anterior capsular support, a lens can be placed in the sulcus. If there is no capsular support, a posterior chamber lens can be placed via a variety of techniques. Of late, I have become fond of the “scleral glue” or “haptic tuck” technique that has been popularized by Amar Agarwal, F.R.C.S. Another option is to suture a CZ70BD (Alcon) or similar lens with eyelets along the haptics to the sclera under a scleral flap. A lens can also be secured to the iris, depending upon surgeon preference. A more straightforward and perhaps quicker option is placing an anterior chamber lens. There is already a large incision from the extracapsular wound. Whatever the choice, the viscoelastic should be removed using the vitrectomy unit at the end of the case, acetylcholine placed to bring down the pupil and check for any vitreous strands to the wounds, and the incisions should be sutured closed to ensure the eye is watertight.

Editors’ note: Drs. Beiko and Cohen have no financial interests related to this article.

Contact information
Beiko: george.beiko@sympatico.ca
Cohen: Alex-Cohen@dmem.org