ANTERIOR VITRECTOMY:

Concepts From a Retina Specialist

The key is not to cause vitreous traction.

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Despite extraordinary advances in cataract surgery techniques and technology, rupture of the posterior capsule, posterior dislocation of lens material, and anterior vitrectomy still occur at substantial rates. Relatively speaking, the incidence of capsular rupture is low; this can have the unintended consequence of decreasing a cataract surgeon's preparation for and skill at managing this complication, potentially leading to acute vitreoretinal traction.

Many, if not most, retinal detachments after cataract surgery are caused by the incorrect surgical management of vitreous—meaning they are preventable. This article presents several concepts in anterior vitrectomy that should be helpful to cataract surgeons when managing vitreous, and it outlines steps to be taken after the posterior capsule ruptures.

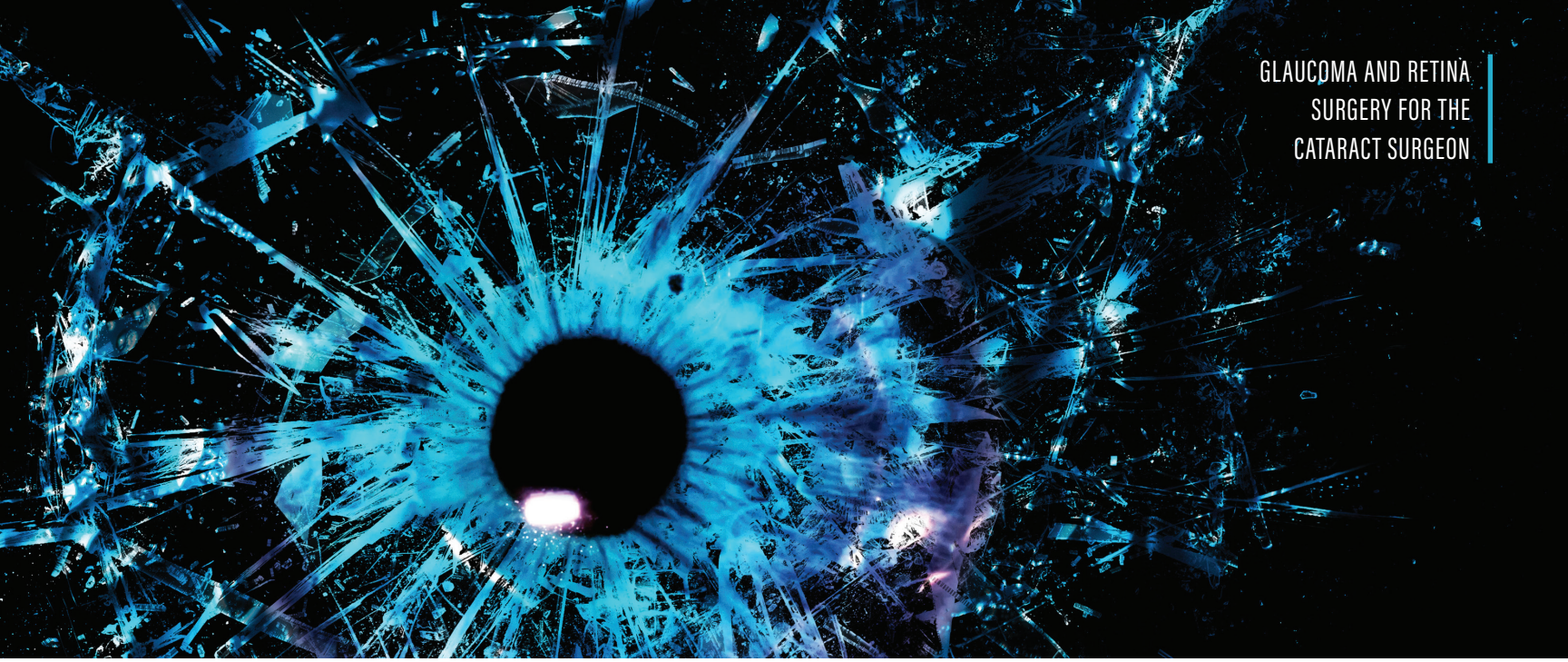
CONCEPTS

First, let's take a look at some of the helpful concepts in anterior vitrectomy.

▸ Concept No. 1: Avoid the use of cellulose sponges and be cautious with spatulas. Anterior vitrectomy began with the pioneering work of David Kasner, MD, in the late 1960s. He introduced the use of cellulose sponges and scissors to remove anterior vitreous. This approach addressed vitreous incarceration in the cataract wound, which was thought to cause cystoid macular edema (CME) and retinal detachment. It was not understood at the time, however, that anterior vitrectomy performed with a cellulose sponge causes marked intraoperative vitreoretinal traction. Lifting the sponge and vitreous that has adhered to it in order to make cuts with scissors causes marked, acute vitreoretinal traction.

Today, many anterior segment surgeons mistakenly believe that vitrectomy causes CME. In reality, after rupture of the posterior capsule and vitrectomy during cataract surgery, CME is caused by trauma to the iris from cellulose sponges, iris retractors, and surgical manipulation. As cellulose sponges imbibe infusion fluid and liquid vitreous, they swell and can traumatize the iris as they are lifted out of the vitreous cavity. Direct iris trauma can also occur when sponges are used to test for vitreous. Sweeping the wound with a spatula is another dangerous maneuver; it can produce acute vitreoretinal traction (see *Watch It Now*).

▸ Concept No. 2: Always use the highest possible cutting rates during vitrectomy. Anterior vitrectomy is never simple. The procedure is performed near the vitreous base, a zone of permanent vitreous adherence to the peripheral retina with 1/100th the tensile strength of more posteriorly located retina. Most retinal breaks after cataract surgery occur at the posterior edge of the vitreous base.



Vitrectomy methods using vitreous cutters are far safer than those that use cellulose sponges. Using the highest possible cutting rates minimizes pulsatile vitreoretinal traction. I coined the term *pulse flow* to describe the volume of vitreous that passes through the cutter port with each open/close cycle. High cutting rates produce lower pulse flows and therefore less acceleration force on the vitreous. High cutting rates also confine energy to regions near the port, whereas low cutting rates produce remote effects that can result in retinal breaks. Using the lowest effective aspiration flow rate or vacuum helps to reduce nonpulsatile vitreoretinal traction.

It is important to avoid pulling back the vitreous cutter while vitreous is engaged. The safest technique is *continuous engage and advance*, another term I coined.

▸ Concept No. 3: Always use infusion during anterior vitrectomy and always separate the infusion from the vitreous cutter. A so-called dry vitrectomy without infusion can produce hypotony, scleral infolding (often misinterpreted as choroidal effusion), miosis, and, occasionally, catastrophic suprachoroidal hemorrhage.

Separating the infusion from the vitreous cutter reduces turbulence, endothelial damage, and iris trauma. It also increases the efficiency of vitreous removal. (A coaxial infusion sleeve, on the other hand, causes fluid turbulence, reduces vitrectomy efficiency, and may produce damage to the corneal endothelium.) The vitreous cutter is placed through one sideport incision or the pars plana, and a 23-gauge angulated infusion cannula or anterior chamber maintainer is placed through a second sideport incision. The vitreous cutter should never be placed through the phaco incision except to remove vitreous incarcerated therein.

▸ Concept No. 4: Get comfortable performing a pars plana anterior vitrectomy. Many cataract surgeons are not comfortable performing a pars plana anterior vitrectomy, but this technique offers several advantages:

- It removes all vitreous from the anterior segment with minimal damage to the corneal endothelium or iris;
- It eliminates vitreous to the wounds; and
- It is effective at removing residual cortex.

Care must be taken, however, to avoid damaging the posterior capsule. Moreover, if a pars plana vitrectomy approach is used, it is absolutely necessary to suture the phaco incision to prevent iris prolapse.

Although trocar-cannula systems have revolutionized sutureless transconjunctival posterior vitreoretinal surgery, they are unnecessary for pars plana approaches to anterior vitrectomy. The primary purpose of a trocar-cannula system is to maintain misalignment of the conjunctiva that was intentionally displaced from the sclerotomy site to allow instrument exchange without wound damage. This is largely irrelevant during anterior vitrectomy.

I like to make a small circumferential conjunctival incision 3.5 mm posterior to the limbus and to enter the eye with a 25-gauge microvitreoretinal blade. I advise against using a scleral tunnel; creating a scleral tunnel in a soft eye can result in suprachoroidal or subretinal introduction of the cutter.

Some manufacturers advocate for a 27-gauge vitrectomy, but I consider a 25-gauge to be a better choice. In short, this is because of greater shaft stiffness in the context of topical anesthesia and the high force and amplitude of saccadic eye movement.

▸ Concept No. 5: Create proper visualization. Visualization of the vitreous is essential for safe, effective anterior vitrectomy. Triamcinolone particulate marking is ideal for this purpose. Unlike Kenalog (Bristol-Myers Squibb), Triesence (Alcon) is preservative-free, and sterile

inflammation has not been reported with this agent.

AFTER A POSTERIOR CAPSULE RUPTURE

Now, let's outline the appropriate steps after the posterior capsule ruptures.

▶ **Step No. 1: Inject an OVD.** The first step is to inject an OVD. This must be done before removing the phaco tip to stabilize the anterior chamber and prevent lens material from moving posteriorly. Further, an OVD barrier prevents vitreous from prolapsing through the capsular defect toward the phaco wound as lens material is removed and the IOL is implanted.

▶ **Step No. 2: Do not cause vitreous traction while removing lens material.** It is dangerous to use a phaco probe in attempt to aspirate lens material and prevent it from falling posteriorly when vitreous is present; hard, jagged nuclear fragments will damage the retina as they descend only if they are manipulated by the surgeon. I also recommend against the use of a lens loop in the vitreous because vitreoretinal traction is inevitable with this technique. Some surgeons have advocated irrigating posterior dislocated lens material in an attempt to mobilize it anteriorly. What this advice fails to take into account is that forceful irrigation is used to create retinal detachments in experimental models. If lens material becomes dislocated into the vitreous cavity, an anterior vitrectomy can be performed followed by the anterior removal of residual cortex; this technique should not produce vitreoretinal traction.

If lens material has descended posteriorly, the cataract wound should be sutured after vitreous and cortical cleanup to prevent the iris from prolapsing when a posterior vitrectomy is subsequently performed. Only under special circumstances should a pars plana vitrectomy and removal of the posterior lens material be performed simultaneously. Successful posterior vitrectomy and removal of retained lens material require endoillumination, a fundus contact lens or wide-angle viewing system, a cutter that operates at 5,000 to 10,000 cuts/min, and a fragmenter. The surgeon's view posterior to the equator may be inadequate without endoillumination and wide-angle retinal visualization optical systems or wide-angle contact lenses.

Completing a core vitrectomy with the fragmenter before removing lens material helps to prevent vitreoretinal traction. I use suction-only mode to lift lens material away from the retinal surface. On the Constellation Vision System (Alcon), the first arc of pedal travel controls the vacuum level, and the second arc proportionally controls ultrasound power. Continuous aspiration and ultrasound energy ensure cooling luminal fluid flow and help to prevent scleral burns and plugging. Ultrasound power should be stopped instantly if lens *milk* appears. The presence of lens milk indicates plugging of the aspiration conduit, and scleral burns will occur rapidly in the absence of fluid flow. To clear the blockage, the fragmenter must be back-flushed outside the eye while ultrasound power is applied. A careful examination of the retinal periphery is required to find retinal breaks that are amenable to endolaser retinopexy and SF_6 fluid-gas exchange. Liquid perfluorocarbon is unnecessary in most of these cases but can be used to float a rock-hard, black nucleus into the anterior chamber after a core vitrectomy has been performed.

▶ **Step No. 3: Secure the IOL in place.** Many use sutured IOLs in the absence of capsular fixation; however, I urge caution. Late weakening and breakage of sutures, endophthalmitis from erosion of the suture through a scleral flap and the conjunctiva, and suprachoroidal hemorrhage from suture passage through the pars plicata have been reported. Iris suturing can lead to uveitis, glaucoma, hyphema, and CME. A better option is to use the Yamane technique to fixate a posterior chamber IOL and carefully avoid decentration and tilt.

WATCH IT NOW

Dr. Charles provides pearls, including proper management of vitreous, to help reduce retinal complications during cataract surgery.

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▶ **Step No. 4: Implant a secondary IOL if necessary.** If secondary IOL implantation is being performed, minimizing intraoperative vitreoretinal traction must be top of mind. Vitreous is cut away from the haptics, capsular remnants, or posttraumatic areas of fibrosis, and it should be removed before a subluxated IOL is repositioned or sutured. The vitreous cutter or fine vitrectomy scissors should be used in order to avoid aspiration or tugging with forceps or cellulose sponges. Instead of drawing vitreous toward the cutter port using high flow rates and vacuum levels, the key principle is to cut vitreous in its original position.

CONCLUSION

The low incidence of capsular rupture during cataract surgery should not preclude anterior segment surgeons from learning the skills necessary to successfully manage this complication. If performed poorly, certain maneuvers in anterior vitrectomy can cause further complications like acute vitreoretinal traction. Learning several basic concepts of this procedure and the necessary steps to take after the posterior capsule ruptures will help to improve outcomes and promote safer surgery. ■

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- Financial disclosure: Consultant and royalty payments (Alcon)