

Dense Cataract

Advice on approaching the dense, brunescient nucleus.

By Roger F. Steinert, MD



A darkly brunescient nucleus, with the color of molasses or a cola drink, presents special surgical challenges. First, the ophthalmologist must select a basic surgical strategy. Depending on his or her experience, the details of the patient's pathologic condition, and the goals of treatment, the patient may be best served by phacoemulsification, extracapsular cataract extraction, or a referral to a surgeon with a long track record of successful outcomes in cases of dense nuclei.

Paradoxically, patients with strong indications for small-incision phacoemulsification often present with these advanced, technically challenging cataracts. A common clinical scenario involves an individual with one functional eye who was told by a physician decades earlier, "Don't let anyone touch your good eye." Today, such a patient is often better served by small-incision phaco surgery under topical anesthesia so that he or she retains the use of the seeing eye immediately after surgery. Other patients with a particular indication for small-incision cataract surgery include high myopes, who are at risk of scleral collapse or who have liquefied vitreous inhibiting nuclear expression in extracapsular extraction. A third group is high hyperopes, who may have microphthalmos or nanophthalmos, with an increased risk for positive pressure vitreous loss and/or choroidal effusion.

If the ophthalmologist believes that phacoemulsification is the best alternative for the lens' extraction, several aspects of cataract surgery will maximize the probability of a successful outcome in the presence of a densely brunescient cataract.

ANTERIOR CAPSULAR STAINING

When the red reflex is insufficient to allow adequate visualization of the anterior capsular edge, staining the

"Protecting the corneal endothelium is especially important during the phacoemulsification of dense nuclei, because the surgery is prolonged."

anterior capsule is a critical step in performing successful cataract surgery. A stained peripheral anterior capsule also facilitates later phacoemulsification. The surgeon who can see the anterior capsular edge is less likely to nick it with the ultrasound tip or misplace a phaco chopping instrument on top of the anterior capsule.

Trypan blue dye is the most commonly employed stain. Properly formulated, it is safe for the endothelium and other ocular structures. Although some formulating pharmacies will provide trypan blue on physician order, surgeons must exercise caution with this source (vs commercial trypan blue) because of the potential for contamination, which could lead to endophthalmitis or toxic anterior segment syndrome. Trypan blue can be injected directly into the anterior chamber. Some dilution will occur, resulting in less intense capsular staining and the potential staining of endothelial defects such as guttae. Surgeons have long used the technique of filling the anterior chamber with air, but it has the disadvantage of driving the stain away from the anterior capsule into the angle. The third alternative is to fill the anterior chamber with a high-density cohesive ophthalmic viscosurgical device (OVD) and then create a layer of trypan blue under the OVD. This method results in intense capsular staining. With all techniques, the surgeon irrigates excess stain out of the anterior chamber before proceeding with the capsulorhexis.

An alternative to trypan blue is indocyanine green. This stain is supplied dry and must be dissolved with a mixture of balanced salt solution and the supplied diluent, then filtered to eliminate particles. Because trypan blue slightly weakens the anterior capsule and gives it a

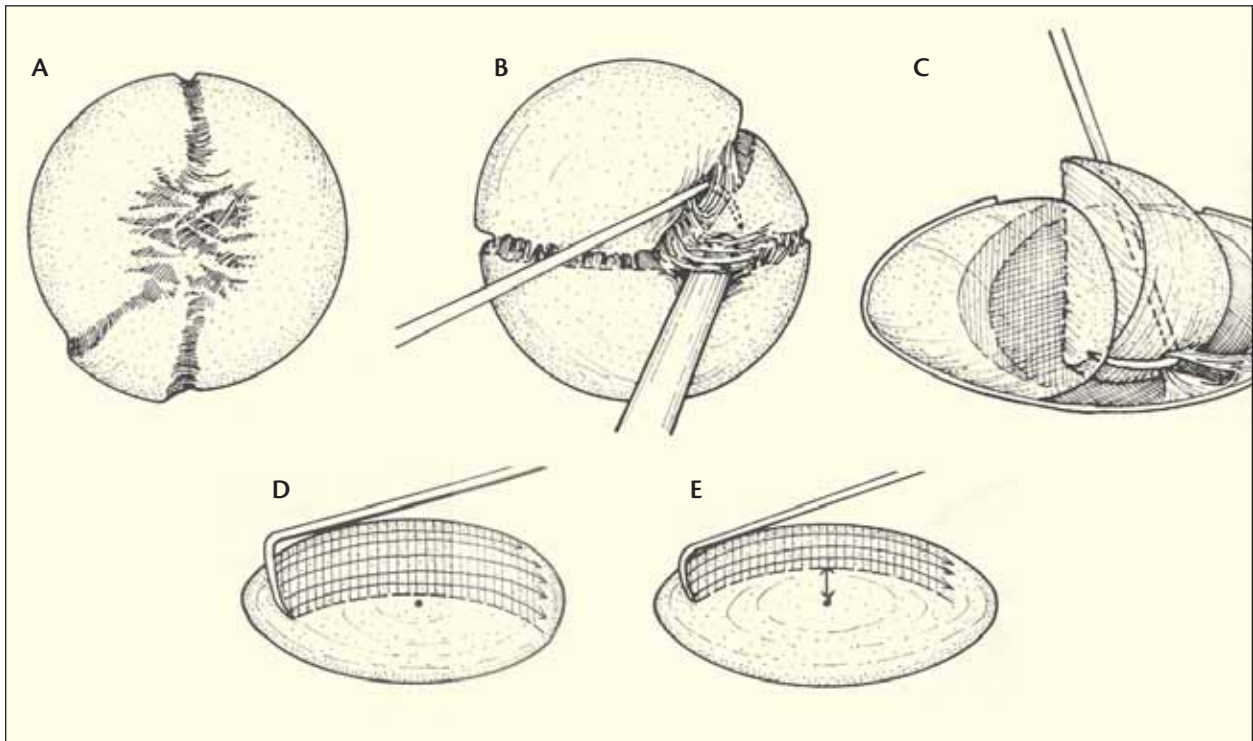


Figure 1. When viewed from the posterior side (optic nerve view), strands of lens material interconnect the divided segments of the cataract (A). A chopping instrument, rotated so that it is parallel to the posterior capsule, is used to transect the bridging posterior fibers (B). When seen from the perspective of the lens equator, the action of the chopping instrument hooks across the posterior, leathery strands (C). Chopping a dense, 4+ nucleus is facilitated by a longer chopping tip, such as 1.75 mm (D), compared with the more common 1.5-mm chopping tip used for average-sized nuclei (E). (Reproduced with permission from Steinert RF, ed. *Cataract Surgery*. 3rd ed. Philadelphia, PA: Elsevier; 2010.)

brittle quality, some surgeons prefer indocyanine green despite the awkward dissolving steps. Other stains such as methylene blue and gentian violet are toxic and should not be used.

PROTECTION OF THE ENDOTHELIUM AND POSTERIOR CAPSULE

Protecting the corneal endothelium is especially important during the phacoemulsification of dense nuclei, because the surgery is prolonged and requires more manipulation and ultrasound power. In these cases, the corneal endothelium is often clinically “stressed” on the first postoperative day, with striae of Descemet’s membrane and stromal edema.

In addition to meticulous surgical technique, ophthalmologists can best protect the endothelium with a dispersive, retentive OVD. Cohesive OVDs—typically high-molecular-weight hyaluronic acid—are often flushed out of the anterior chamber within several seconds of phacoemulsification’s initiation. The dispersive agents (most commonly Viscoat [Alcon Laboratories, Inc., Fort Worth,

TX] and Vitrac II [Abbott Medical Optics Inc., Santa Ana, CA]) are more likely to be retained as a protective layer against the endothelium.

Dispersive, retentive OVDs can also be used to create an artificial epinucleus to protect the posterior capsule. A dense brunescient cataract usually has little-to-no epinucleus, because it has stiffened and become a part of the nucleus. The posterior capsule therefore has no protective layer to guard it against laceration by sharp, bulky nuclear fragments. In addition, the posterior capsule is usually thinner and more vulnerable, because the capsule has stretched as the advanced cataract expanded.

A helpful maneuver is to pause the phacoemulsification after removing enough of the nucleus to expose a small portion of the posterior capsule, heralded by the appearance of a “window” of bright red reflex. The surgeon injects the dispersive OVD between the posterior capsule and remaining nucleus to create an artificial epinucleus, thereby physically separating the posterior capsule from the nucleus undergoing phacoemulsification. I

call this maneuver the *visco vault*, because the OVD acts like a protective wall or vault for the posterior capsule.

In addition, the viscoadaptive agent stabilizes the remaining nucleus and reduces tumbling of the nuclear fragments. By elevating the remaining nuclear fragments toward the phaco tip, the OVD will also facilitate the instrument's access to a favorable edge of nucleus that can then be engaged and removed.

THE LEATHERY POSTERIOR NUCLEUS

During the phacoemulsification of a dense, brunescient nucleus—whether by quadrant cracking or a phaco chop technique—split fragments will frequently resist being drawn into the midanterior chamber for complete destruction and aspiration by the ultrasound needle. The reason is that tough elastic strands connect the split nuclear fragments on their posterior surface (Figure 1A). These strands emanate from the epinuclear layer, which, in advanced brunescence, is stiffening and becoming more tightly adherent to the nucleus.

This problem will challenge the surgeon attempting to mobilize nuclear pieces in a controlled manner. The best technique is to transect these leathery strands with an instrument. The nuclear fragment is engaged and stabilized by the vacuum of the phaco tip. While the nuclear fragment is partially drawn anteriorly, but not to the point of breaking the vacuum hold, the surgeon uses a second instrument to cut the strands. The author prefers the phaco chopper for this step. The handle is rotated so that the chopper is parallel to the posterior capsule, and the chopper is drawn across the strands. As long as the chopper is parallel to the posterior capsule and the surgeon maintains infusion of balanced salt solution (phaco foot position 1 or higher), the posterior capsule will not be endangered (Figure 1B and C). The surgeon must be patient when dealing with these many strands, but ultimately, the nucleus can be successfully divided and emulsified.

When the remaining nucleus is small enough, sometimes, the surgeon can safely flip it within the capsular bag. If so, the remaining leathery strands will be anterior, where the surgeon can visualize and directly emulsify them. The author, however, does not recommend using a phaco flip technique, wherein the large nucleus is delivered above the capsule. The great amount of ultrasound power that will be employed combined with the proximity to the endothelium increases the risk of corneal edema.

SPECIAL INSTRUMENTS

When confronted with a particularly challenging case, the surgeon generally should not attempt a new, unfamiliar

technique. For those who routinely employ phaco chop, however, a small adjustment can be helpful. Having the tip of the chopper reach the middle of the nucleus is important to achieving a reliable chop. Most phaco chopping instruments have a distal tip length of 1.25 to 1.50 mm, which is sufficient to reach the middle of an average nucleus. Some choppers have a longer tip for use with dense nuclei. Elongating the tip to only 1.75 mm is enough to dramatically improve the reliability of successfully transecting a dense nucleus (Figure 1D and E). Although such an instrument will look large inside the eye, the nuclear thickness that often approaches 4 mm or more means that the posterior capsule is not endangered. Alternatively, creating a preparatory groove will reduce the nuclear thickness and create a weak zone more likely to crack.

Manufacturers have increased their attention to the modulated delivery of ultrasound energy and control of fluidics. The latter reduces the problem of surge under conditions of high vacuum. The use of lateral as well as longitudinal ultrasound also appears to increase the efficacy of the ultrasound energy (torsional [Alcon Laboratories, Inc.] and transversal [Abbott Medical Optics Inc.]), especially in conjunction with an aggressively bent phaco needle such as the 22° bend of the Kelman tip. These advances enhance the surgeon's ability to deal with challenging dense nuclei as well as more routine cataracts.

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Advice on approaching the dense, white nucleus.

By Y. Ralph Chu, MD



Dense white cataracts not only present a surgical challenge in terms of the difficulty visualizing ocular structures, but they may also be associated with etiologies such as trauma that can weaken or damage the eye. A thoughtful approach to surgery will help ophthalmologists manage these complex cases.

PREOPERATIVE PLANNING

Understanding the potential causes of the dense, white cataract is important for preoperative planning. Oftentimes, these cataracts coexist with other ocular conditions such as pseudoexfoliation or trauma, which can loosen the zonule. Patients who have a history of ocular trauma may also have pupillary irregularities. If unable to view to the posterior pole, surgeons should consider obtaining a B-scan ultrasound in order to rule out malignancy and assess the eye's gross retinal status. Patients may be using medications that can shrink the pupil (eg, tamsulosin). Phacodonesis, vitreous prolapse, pupillary irregularities, and deepening or shallowing of the anterior chamber provide clues as to what the surgeon may encounter during the cataract procedure.

SURGERY

Intraoperatively, one of the most difficult parts of managing a dense, white cataract is performing the capsulorhexis. Staining the capsule with trypan blue provides essential guidance. Even if unable to create an intact capsulorhexis, the surgeon will find that trypan blue dye can help him or her visualize the potential areas of capsular or zonular weakness. Many times, the dense cataract is intumescent, and the lenticular contents are under pressure. When punctured during the surgeon's attempt to create the capsulorhexis, the capsule occasionally splits in what has been described as an Argentinean flag sign.

Decompressing the contents of the lens with a 30-gauge needle prior to creating the capsulorhexis can sometimes prevent the capsule from splitting. The surgeon passes a 30-gauge needle through the incision and uses it to make a small puncture in the center of the anterior capsule prior to the capsulorhexis. This opening allows the liquefied cortex to exit from the capsular bag into the anterior chamber. Clearing the cloudy cortex from the anterior chamber with viscoelastic will allow the surgeon to perform the capsulorhexis more safely.

Before operating on an eye with a dense, white cataract, it is wise to plan different lens options. For example, a three-piece IOL that may be fixed safely in the sulcus and/or an ACIOL can be implanted in eyes with inadequate capsular or zonular support. If the patient has a history of ocular trauma, it is important to have a suture available to secure the IOL to the iris or the sclera if need be. Obviously, having suturing material available to secure the wound at the conclusion of surgery is critical. In addition, it is helpful to have on hand iris hooks or a Malyugin Ring (MicroSurgical Technology, Redmond, WA) to manage a small pupil and capsular tension rings to support a loose zonule.

Although cataract surgeons try to avoid performing a vitrectomy, it is essential to be prepared to execute one and/or to clean the vitreous from the anterior chamber in order to implant the IOL in eyes with a dense white cataract.

POSTOPERATIVE CONSIDERATIONS

Patients may be at greater risk for increased inflammation and/or IOP than individuals undergoing routine cataract surgery. Surgeons should be ready to institute therapy with high-dose steroids or IOP-lowering medication.

CONCLUSION

Careful, thoughtful preparation is the key to successfully handling a dense, white cataract. The procedure can go smoothly if the surgeon conducts a careful preoperative assessment, creates a checklist of equipment and devices that may be needed, and determines the appropriate therapeutic options for postoperative care. ■

Y. Ralph Chu, MD, is the founder and medical director of the Chu Vision Institute in Bloomington, Minnesota. He acknowledged no financial interest in the product or company mentioned herein. Dr. Chu may be reached at (952) 835-0965; yrchu@chuvision.com.

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