The Rock-Hard Nucleus

Surgeons must overcome a host of potential problems.

BY DAVID F. CHANG, MD

Virtually every step of the cataract procedure is more difficult in the setting of a mature, brunescent nucleus. This article offers strategies for successfully managing this surgical challenge.

VISUALIZATION

A poor red reflex impedes visualization of the capsulorhexis and makes the surgeon more likely to tear its edge with the chopper or phaco tip. Fortunately, trypan blue dye persists long enough to make the edge of the capsulorhexis visible during nuclear emulsification. For ophthalmologists using the OPMI Lumera microscope (Carl Zeiss Meditec, Inc., Dublin, CA), turning off the oblique illuminating beam and using only the stereo coaxial beam for the capsulorhexis can dramatically enhance the red reflex, thereby rendering capsular staining unnecessary in many cases.

CAPSULAR/LENTICULAR BLOCK

During hydrodissection, a rising brunescent nucleus is more likely to seal the capsulorhexis from below and thus cause a capsular/lenticular block. Any additional fluid injected at this point will be trapped within the bag, where it will distend and eventually rupture the posterior capsule. The nucleus will then suddenly descend through the torn posterior capsule after the unsuspecting surgeon's first sculpting stroke.

To avoid capsular/lenticular block, surgeons should terminate hydrodissection as soon as the solid nucleus rises against the capsulorhexis. They should avoid the temptation to continue injecting balanced salt solution until the migrating posterior fluid wave completely crosses behind the nucleus. Instead, they can tap the center of the elevated nucleus to dislodge it posteriorly before resuming hydrodissection from the opposite quadrant.

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WOUND BURN

Incisional burns are most likely to occur with brunescent nuclei. If not initially aspirated away, any overlying dispersive ophthalmic viscosurgical device (OVD) can combine with the brunescent nuclear emulsate to clog the phaco tip. Because no gravity-fed irrigation can flow in if no fluid exits, a wound burn will occur as soon as ultrasound commences. Surgeons therefore first must aspirate the OVD directly overlying the central anterior nucleus prior to starting phacoemulsification. Introduced with Whitestar Technology (Abbott Medical Optics Inc., Santa Ana, CA) but now also available on the Infiniti Vision System (Alcon Laboratories, Inc., Fort Worth, TX) and Stellaris Vision Enhancement System (Bausch & Lomb, Rochester, NY), hyperpulse technology decreases the ultrasonic duty cycle in order to dramatically reduce the generation of heat. Warning signs that the phaco tip has become partially or fully clogged include the sudden appearance of white, milky emulsate or a need to chase after fragments that do not come to the tip.

ENDOTHELIAL TRAUMA

As evidenced by increased corneal edema on the first postoperative day, endothelial cell loss and trauma are much greater with 4+ nuclei. The increased density and volume of brunescent nuclear material necessitate greater ultrasonic power and time. With the prolonged

Figure 1. The author uses a horizontal chopper to subdivide a brunescent nuclear fragment in order to improve followability and reduce chatter and turbulence.

operative times, OVD washout is a far more significant problem than in typical cases. Used properly, dispersive (Viscoat; Alcon Laboratories, Inc.) or viscoadaptive (Healon5; Abbott Medical Optics Inc.) OVDs can coat and protect the endothelium for longer periods than their cohesive counterparts. Because all OVDs eventually wash away, surgeons should stop to replenish the protective endothelial layer midway through nuclear removal.

Rigid nuclear fragments do not mold well into the phaco tip, which leads to poor followability and increased chatter at the tip. The result is excessive particulate turbulence within the anterior chamber, which traumatizes the endothelium. Both Ozil torsional (Alcon Laboratories, Inc.) and Ellips transversal (Abbott Medical Optics Inc.) power modulations replace axial strokes with nonlongitudinal movement of the phaco tip. Along with hyperpulse, these innovations significantly reduce the chatter and spraying of brunescent particles at the phaco tip. Regardless of whether the initial nuclear fragmentation is accomplished by divide and conquer, stop and chop, or pure chopping, the resultant fragments are much larger and denser than those encountered with typical nuclei. Using horizontal chopping to subdivide these large fragments also reduces the tendency for oversized fragments to be deflected away from the vibrating phaco tip (Figure 1).

POSTERIOR CAPSULAR RUPTURE

Posterior capsular rupture is more likely with rock-hard versus softer nuclei for several reasons. First,

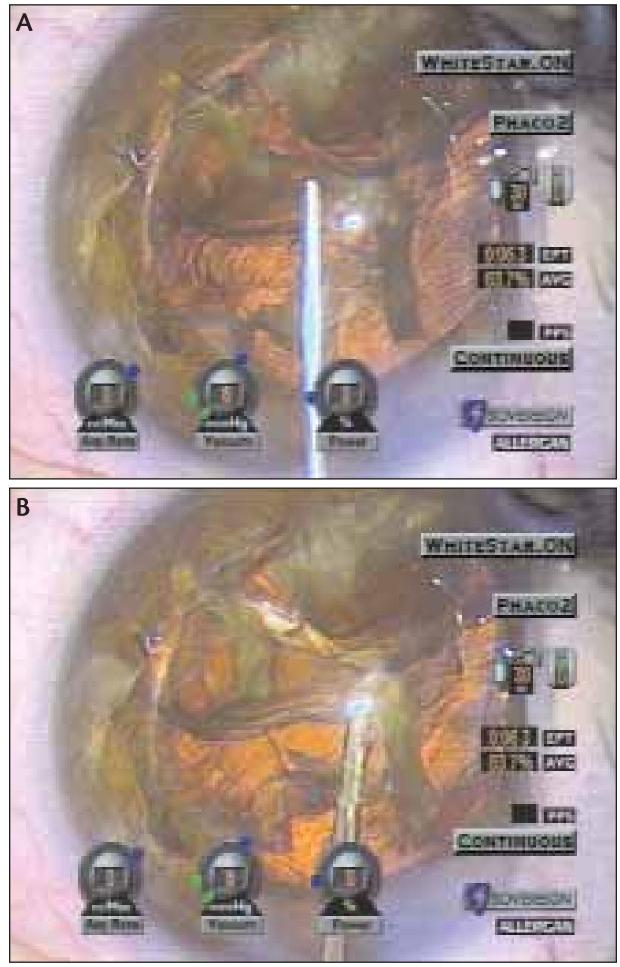

Figure 2. After pausing prior to emulsifying the last remaining fragment, the author injects a dispersive OVD (Viscoat) both in front of (A) and behind (B) the fragment to afford maximal endothelial and capsular protection.

brunescent cataracts have proportionally more endonucleus and less epinucleus, which can double the volume of solid material requiring emulsification. As a result, the phaco tip must work much closer to the peripheral and posterior capsule, particularly when the surgeon is sculpting a deep central trough. A soft nucleus absorbs the pressure from instruments like a pillow. A dense nucleus, in contrast, is as rigid as a wooden board. As such, it more directly transmits all forces of the instrumentation directly to the posterior or peripheral capsule. By using manual energy to fragment the nucleus, phaco chop can significantly reduce ultrasonic energy and zonular stress.

Many ultrabrunescent nuclei are associated with weak zonules, a particular problem because of the thinner epinucleus. Normally, the soft epinuclear shell restrains a lax posterior capsule from “trampolining”

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toward the phaco tip as the last nuclear fragment is removed. The sharp edges of the brunescent fragments and the greater capsular laxity caused by weakened zonules further increase the risk of capsular puncture. If surgeons react defensively by emulsifying the last fragment closer to the cornea, then they further heighten the risk of endothelial cell loss.

Roger Steinert, MD, has described using a dispersive OVD as an artificial epinucleus for the brunescent nucleus. In cases where the epinucleus is scant or absent, surgeons should suspend phacoemulsification before removing the last remaining fragments. The next step is to inject a generous amount of a dispersive OVD in front of and behind the fragments to partially fill the capsular bag (Figure 2). Because a dispersive OVD better resists aspiration by the phaco tip than a cohesive agent, the former will more effectively restrain the lax, exposed posterior capsule from trampolining toward the phaco tip. Provided with this greater margin of safety, the surgeon is less likely to phacoemulsify the last fragment too close to the endothelium. The denser the nucleus is, the more likely tiny retained nuclear fragments are to become trapped, either at the sideport incision or behind the iris, particularly with a dispersive OVD. Surgeons should scrutinize the paracentesis sites, and they must be particularly thorough in evacuating the OVD.

CONCLUSION

Although the strategies described herein are helpful, individual surgeons must assess their personal limit in terms of how brunescent a lens they can safely emulsify. It is far better to accept the larger incision of standard manual extracapsular cataract extraction than to have a dropped nucleus or decompensated cornea. ■

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