Bimanual Microincisional Phacoemulsification for Brunescent Nuclei

A safer procedure than conventional phacoemulsification.

BY HIROSHI TSUNEOKA, MD

In bimanual phacoemulsification, the phaco tip comes into direct contact with tissue at the incision site during ultrasound operation. At one time, I considered this procedure difficult to implement for a very hard nucleus. However, I have found that the advent of the Whitestar Technology (Advanced Medical Optics, Inc., Santa Ana, CA) and the new irrigating chopper produced by Microsurgical Technology, Inc. (MST; Redmond, WA), allows me to use bimanual phacoemulsification to emulsify even dense nuclei more safely than conventional phacoemulsification.

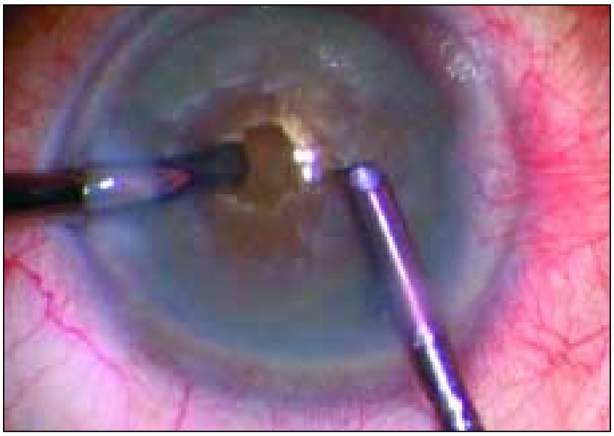

Figure 1. The author digs a deep, large crater with a 20-gauge sleeveless phaco tip. At this stage (mode 1), the aspiration flow rate and pressure are set low, and the hard section of the nucleus is emulsified without the phaco tip's being completely occluded. Incomplete occlusion prevents thermal burn, despite the high ultrasound power setting.

HOW TO PREVENT COMPLICATIONS

When using bimanual phacoemulsification to emulsify and aspirate a hard nucleus, I have found the following points helpful for avoiding complications during surgery.

Because emulsifying a hard nucleus requires operating ultrasound at a higher power and for a longer duration than with ordinary nuclei, ophthalmologists need special technology, such as Whitestar Technology, to prevent thermal burns and other injuries at the incision site. For a clean incision even after the emulsification and aspiration of a hard nucleus, surgeons must choose the optimal incision size for that procedure.

In my experience, posterior capsular rupture is primarily due to destabilization of the anterior chamber because of an inadequate flow of infusion solution through the sideport. In particular, during the final stage of nucleofractis, the posterior capsule tends to rise and can accidentally be aspirated by the phaco tip. It is necessary to ensure an adequate flow of infusion solution through the sideport to stabilize the anterior chamber during surgery. Also, aspiration flow and pressure should be set at lower levels than during ordinary surgery in order to prevent postocclusion surge.

Because this procedure requires the use of a large-gauged irrigating chopper for nucleofractis, surgeons need to select the best possible nucleofractis technique for hard nuclei. The technique should (1) cause little dispersion of hard nuclear fragments, (2) make it easy to avoid posterior capsular rupture, and (3) be simple to perform, even with a large-gauged chopper.

TABLE 1. ASPIRATION FLOW RATES AND PRESSURE SETTINGS FOR A VERY HARD NUCLEUS

	Aspiration Flow Rate (mL/min)	Maximum Aspiration Pressure (mm Hg)	Bottle Height (cm)
Mode 1 (Crater)	20	60	75
Mode 2 (Vertical Chop)	25	250	75 to 85
Mode 3 (Divided Nuclei)	22	140	80 to 90

Tip No. 1. To prevent injury at the incision site, use the appropriate incision size (1.4 mm). Reducing the incision to 1.2 mm in order to stabilize the anterior chamber depth and prevent posterior capsular rupture increases the risk of thermal burn at the incision site, even with ultrasound oscillation in Whitestar mode. A smaller incision means an increased risk of hydration of the tissue around the incision, because friction between the tip and the incision wall irritates the corneal tissue and produces hydration. Also, the circular deformation of the incision persists even after the surgeon withdraws the phaco tip, a problem that makes the incision less likely to self-seal.

Widening the incision to 1.4 mm, however, allows fluid to leak through the incision to cool the tissue and the phaco tip and therefore prevent a thermal burn. The extra space between the tip and tissue also increases clearance so that, even when the tip is moving from side to side during the procedure, less pressure is applied to the surrounding corneal tissue. This in turn reduces the deformation and hydration of the incision site.

Tip No. 2. Use an irrigating chopper to ensure adequate infusion flow. In order to improve the stability of the anterior chamber, it is necessary to increase the flow of the infusion solution through the sideport incision. The Duet irrigating chopper (Microsurgical Technology, Inc.) has a wide opening at the front end of the cannula that permits an infusion flow rate of 50 mL/min with the infusion bottle at a height of 85 cm. Also, the strong outflow of the infusion solution from the chopper's tip can be used to blow back the posterior capsule. Surge-induced posterior capsular rupture during the final stage of phacoemulsification can be avoided by directing the chopper's aperture toward the posterior capsule.

Tip No. 3. The best surgical technique is the crater and vertical chop. In using bimanual phacoemulsification to emulsify and aspirate a brunescent nucleus, the surgical procedure must (1) provide prolonged ultrasound operation without thermal burn at the incision site, (2) avoid injury to the corneal endothelium resulting from the dispersion of small, hard nuclear fragments into the anterior chamber, (3) divide the nucleus easily, even when the surgeon uses a large-gauged chopper, and (4) be unlikely to cause posterior capsular rupture. After comparing a variety of techniques for emulsification and aspiration, I have concluded that the crater and vertical chop method is best for brunescent nuclei.

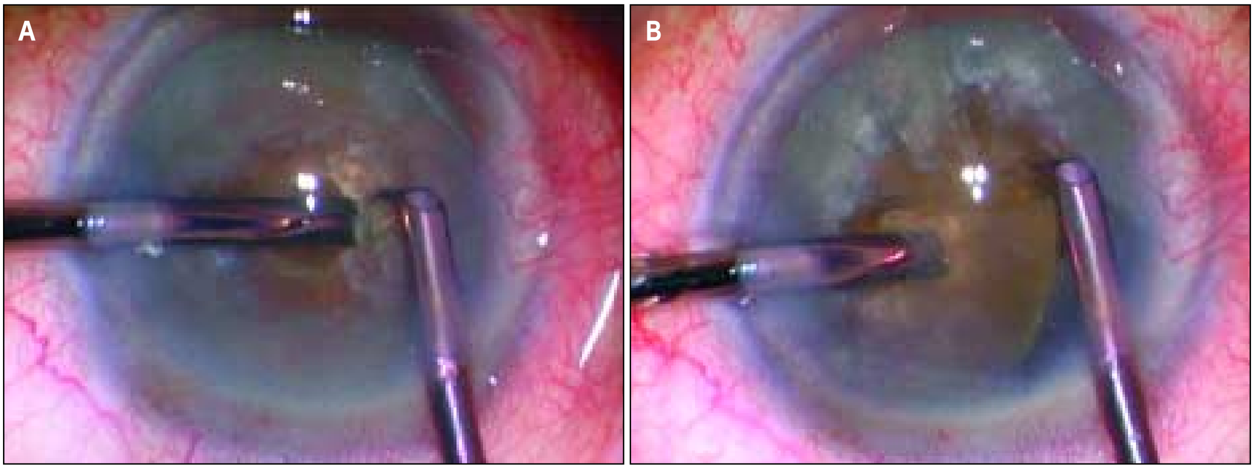

Figure 2. When the crater is sufficiently deep , the author presses and digs the phaco tip firmly into the crater wall. At this stage (mode 2), it is important to raise the setting of aspiration pressure to high so as to occlude the phaco tip completely and operate ultrasound in Whitestar mode or a similar pulse mode. After the author divides the nucleus into several fragments using the vertical chop technique (A), he draws the fragments into the center (B). This process also requires high aspiration pressure.

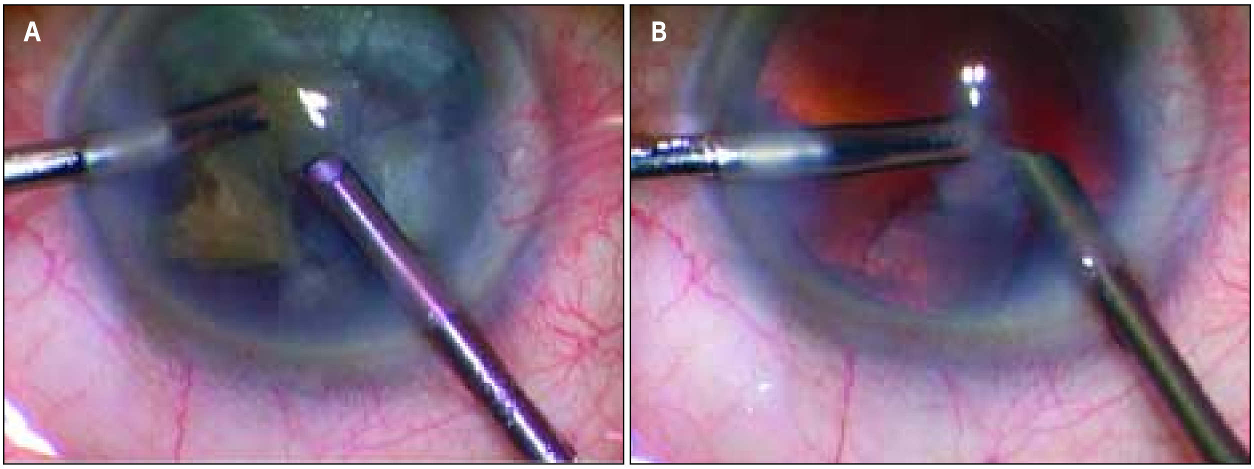

Figure 3. After the author draws the divided fragments into the center (A), he reduces the high aspiration pressure to 140 mm Hg. Once he emulsifies and aspirates the free nuclear fragments and epinucleus, he uses the strong flow of irrigating solution to press against the posterior capsule near the phaco tip by directing the opening of the irrigating chopper toward the posterior capsule (B).

First, I emulsify and aspirate as much of the hard, central portion of the nucleus as possible without fully occluding the phaco tip (Figure 1). This approach prevents heating of the phaco tip and also reduces the likelihood of hard nuclear fragments' dispersing into the anterior chamber. Crater and vertical chop allow nucleofractis with minimal movement of the large irrigating chopper, so the sideport incision is less traumatized. I consider this technique to be more useful than the original phaco chop method.

Tip No. 4. Avoid posterior capsular rupture by lowering the aspiration settings (Table 1). Recently, it has become popular in phaco surgery to elevate the infusion bottle and use high settings for the aspiration flow rate and pressure in order to perform the surgery quickly. Such high settings, however, can elevate IOP and produce turbulence and surge within the anterior chamber. To minimize the invasiveness of bimanual phaco surgery, surgeons need to reduce these settings and emulsify and aspirate the nucleus without disturbing the anterior chamber.

In bimanual phacoemulsification, I have found it possible to achieve the same level of efficiency as in traditional phacoemulsification with lower settings of aspiration pressure. For an ordinary nucleus, I now set the infusion bottle at between 75 and 80 cm, the aspiration flow rate at 24 mL/min, and the maximum aspiration pressure at 160 mm Hg in mode 2. For a brunescent nucleus, I set the infusion bottle at 75 to 85 cm, the aspiration flow rate at 25 mL/min, and the maximum aspiration pressure at 250 mm Hg in mode 2 (Figure 2). During the final stage of phacoemulsification, the posterior capsule is prone to elevation and rupture, so during mode 3 I reduce the aspiration flow rate and maximum aspiration pressure and slightly elevate the infusion bottle (Figure 3). I also direct the opening of the irrigating chopper downward so that the infusion flow presses down on the posterior capsule and helps prevent posterior capsular rupture. This feature is one advantage of bimanual phaco surgery.

RECENT RESULTS WITH BRUNESCENT NUCLEI

Since May 2003, I have used the procedures mentioned earlier (a 1.4-mm incision, the Duet irrigating chopper, low aspiration settings, and the crater and vertical chop methods) in bimanual phacoemulsification on 48 eyes with brunescent nuclei. My mean rate of endothelial cell loss is 9.8%, and I have had no instances of posterior capsular rupture. I attribute these results to my maintaining a sufficient volume of infusion solution through the sideport incision and to the strong flow of infusion solution from the irrigating chopper. The solution can be used to press down on the posterior capsule near the phaco tip.

In particular, because I have seen no instances of thermal burn at the incision site in bimanual phacoemulsification, I believe that this procedure is safer than conventional phaco surgery in cases of very hard nuclei. ■

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