Bimanual Versus Coaxial

Reexamining the controversy in light of emerging technology.

BY ARON D. ROSE, MD

Advances in technology have greatly improved ophthalmologists' ability to approach difficult cases with confidence. With the advent of capsular tension rings, iris and capsular hooks, and numerous viscoelastic devices, cataract surgery has become safer and more predictable. Among the most important recent technological advances, however, have been those refining the delivery of ultrasound energy and those stabilizing the anterior chamber during surgery.

Ultrasound delivery underwent an industry-wide revolution with the introduction of micropulse technology. With micropulsing, effective cavitation is maximized while the total use of energy is lowered. The result is improved surgical control, less intraocular inflammation, and clearer corneas. The more recent ability to "shape" the ultrasound pulse (Whitestar ICE Technology; Advanced Medical Optics, Inc., Santa Ana, CA) allows yet lower ultrasound times and energy levels with greater followability and hold. Chamber stability has been optimized through software modulations (CASE technology; Advanced Medical Optics, Inc.) that anticipate post-occlusion surge and reverse peristaltic flow through the tubing. The result is a virtually still intraoperative chamber. The usage per case of balanced salt solution has decreased, reflecting both improved surgical control and shorter case times.

Coaxial or single-handpiece phacoemulsification carries all of the advantages of a tried and true technique: peer acceptance; industry support; and the comfort of familiarity. With continually smaller coaxial phaco probes (Alcon Laboratories, Inc., Fort Worth, TX) that permit the lens' emulsification through incisions as short as 2.2mm, coaxial cataract surgery is becoming truly astigmatically neutral, and incisions are far less prone to postoperative leakage.

Bimanual phacoemulsification involves the use of one probe that emulsifies while aspirating and another that solely irrigates. These probes are placed through two watertight limbal incisions of 1.2 to 1.4mm. The creation of a larger incision is necessary until the FDA approves a rollable IOL that can be inserted through one of the original incisions.

So, why should surgeons consider adding the bimanual technique to their surgical armamentarium? Aren't two incisions preferable to the enlargement or addition of a third one? Are there specific patient groups or clinical scenarios for which bimanual surgery is advantageous?

FLUIDICS

Coaxial

In order to answer these questions, it is important to examine the differences between coaxial and the bimanual fluidics. Simply rejecting one technique for another is akin to a carpenter's rejecting a screwdriver or a chisel; each works best for a specific job. A coaxial probe has the intrinsic problem of generating adjacent and opposing attractive and repulsive forces within the narrow confines of the anterior chamber. This design handicap makes it difficult to avoid the pupillary margin in small-pupil cases, and it invites the nicking of iris tissue in cases of intraoperative floppy iris syndrome. The volume of balanced salt solution used is greater in coaxial cases due to wound leakage and the probe's gauge, which arguably predispose eyes to higher degrees of endothelial cell loss. Progressive zonular loss from "trampolining" and postocclusion surge—problems not encountered in a bimanual configuration—can also invite complications in eyes with weak or torn zonules.

Newer micropulse ultrasound delivery and chamber-stabilization technology reduce the vulnerabilities of the coaxial design. Micropulsing meaningfully lowers total ultrasound time and improves followability by allowing surgeons to adjust the ratio of "on" and "off" time during each pulse. Programming relatively longer periods of "off" as opposed to "on" time increases hold, whereas raising the ratio of "on" time maximizes cutting. Ultrasound delivery can thus be tailored to a divide-and-conquer or a chopping technique. The more recent ability to shape the micropulse of ultrasound is another important step forward. Whitestar ICE Technology delivers a 1-millisecond "kick" at the initiation of each microburst. A microvoid of bubbles between the phaco tip and nuclear material is created immediately after the kick. Balanced salt solution fills this void and interacts with ultrasound power to accelerate cavitational forces. The results are increased energy efficiency, a lower total use of energy, further maximized followability and hold, and less balanced salt solution used per case as a consequence of shorter case times.

Chamber-stabilization software (CASE; Advanced Medical Optics, Inc.) decreases the postocclusion surge that is far more likely with a coaxial configuration. When the software senses a fully occluded tip, the peristaltic pump briefly halts and then reverses to a lower preset maximum vacuum. When occlusion is cleared, postocclusion surge decreases substantially.

Although not directly addressing the problems arising from the opposing forces of adjacent irrigation and vacuum emerging from the coaxial tip, software improvements have ingeniously diminished some intrinsic design deficiencies and increased surgeons' control.

Bimanual

Given the improvements in coaxial phaco technology, are there still patients for whom bimanual surgery would be preferable? As mentioned previously, a bimanual configuration separates irrigation from phacoemulsification/aspiration so that each probe acts in an unopposed fashion. In my experience, several high-risk patient groups directly benefit from this design. They include individuals with poorly dilating pupils, corneal endothelial disease, pseudoexfoliation, and traumatic cataracts or other conditions associated with weak zonules. In addition, patients who have high myopia/elastic zonules, posterior polar cataracts/thin capsules, and a history of pars plana vitrectomy are better suited to bimanual phacoemulsification in my hands.

The existence of two separate handpieces facilitates atraumatic lens removal in riskier patient subgroups. Followability is unimpeded with the use of a probe dedicated to phacoemulsification and aspiration; no adjacent irrigation flow pushes away lenticular material. Zonular stress and lenticular manipulation are reduced. Surgeons can more easily avoid pupillary margins, floppy iris tissue, and areas of relative zonular or capsular weakness with a bimanual configuration.

Similarly, ophthalmologists can manage reverse pupillary block (or lens-iris diaphragm retropulsion syndrome) by directing irrigation between the pupillary margin and

MY BIMANUAL PHACO TECHNIQUE

- Create two incisions parallel to the iris, roughly 70º to 80º apart, with a disposable Stylus Whitestar blade (Advanced Medical Optics, Inc., Santa Ana, CA) or a trapezoidal diamond knife
- Make a 5-mm continuous curvilinear capsulorhexis with a 23-gauge microcapsulorhexis forceps
- Perform hydrodissection and hydrodelamination
- Mobilize the nucleus and rotate it within the epinuclear shell upon seeing the posterior wave of fluid but before initiating bimanual chopping
- Use a horizontal chopping technique for soft nuclei, vertical quick chop for hard nuclei, or a vertical chopping technique for eyes with small pupils or unstable zonules
- Insert the irrigating handpiece and then the phaco handpiece through their respective incisions
- Complete nuclear emulsification and then perform bimanual I/A to remove all residual cortex from the capsular bag
- Reinflate the bag with a cohesive viscoelastic, create a separate near-clear incison between the two bimanual incisions in the method described earlier, and insert the IOL
- Perform bimanual I/A to remove the viscoelastic anterior and posterior to the lens implant
- Hydrate the three incisions with a 27-gauge cannula and confirm that they are watertight
- Administer sequentially a few drops of a fourth-generation fluouroquinolone prior to removing the lid speculum

the anterior lens surface. A small capsular rent will be less likely to extend if (low) irrigating flow is directed away from the defect. Unopposed aspiration can facilitate the removal of small nuclear pieces, which the irrigation emerging from a coaxial tip tends to repel. Maintaining a rock-solid anterior chamber (through truly watertight incisions and the absence of postocclusion surge) results in a lower total use of balanced salt solution, thereby protecting the endothelium as well as discouraging progressive zonular loss due to trampolining.

WHY BIMANUAL?

Many surgeons express hesitation about adopting a bimanual cataract technique. They wonder why they should switch prior to the availability in the US of microincisional IOLs that can be inserted through a 1.2- to 1.4-mm incision. Many are concerned about the learning curve.

I believe that bimanual phaco incisions may be superior to coaxial incisions for two reasons. First, a bimanual incision seals more securely, because it is squarer in configuration and smaller in overall dimension than a coaxial incision. It is also subject to less rotational torque, because the bimanual surgeon must simply alternate the placement of instruments for 360º access to the chamber. Second, I believe that a single-pass incision (through which only an IOL is inserted) seals more reliably than a coaxial incision, which has been subjected to the repeated microtraumas of capsulorhexis, hydrodissection, phacoemulsification, I/A, the lens' insertion, and viscoelastic evacuation.

With respect to the learning curve, a bimanual technique is only a variation of the familiar coaxial approach. The learning curve is therefore short and easily mastered with current instrumentation. After learning to use a microcapsulorhexis forceps, the surgeon will come to appreciate the advantages of "unopposed" handpieces and to recognize bimanual versus coaxial phacoemulsification as a less encumbered way to remove tissue. Of course, any surgeon who has performed bimanual I/A or a bimanual vitrectomy will immediately appreciate the advantages of a similar approach to phacoemulsification.

CONCLUSION

Traditional coaxial phacoemulsification is the standard against which advances in this field are compared. Intrinsic problems persist, however, due to competing fluidic forces at the coaxial tip. Bimanual phacoemulsification offers increased safety as a result of both the incision's construction and fluidics. Although significant advances in ultrasound delivery and chamber-stabilization software have improved surgical control and energy efficiency for either a bimanual or coaxial technique, the former is still recommended for certain high-risk patient groups. ■

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