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Cataract

Under development

Bimanual microphacoemulsification: the next phase?

Technique may be another step to enhance surgical procedure for patients

Cataract Corner

By Richard S. Hoffman, MD, Mark Packer, MD, and I. Howard Fine, MD

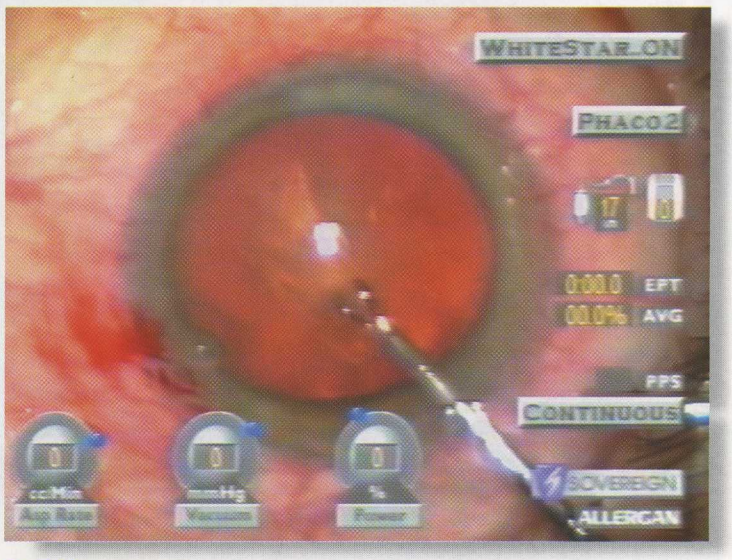

Figure 1 ASICO Capsulorhexis Forceps performing rhexis construction through the 1.2-mm clear corneal incision.

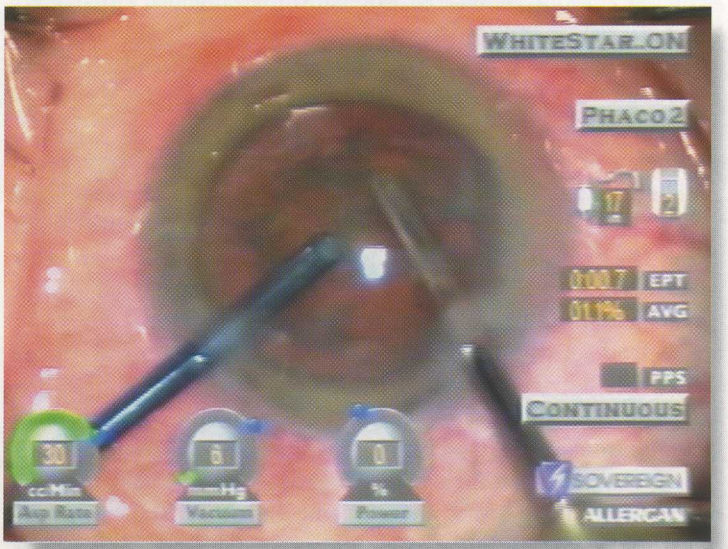

Figure 2 Bimanual phacoemulsification utilizing bare phacoemulsification needle (right) and Fine irrigating chopper (left).

Cataract removal by means of phacoemulsification has improved over the last 35 years in small, incremental steps. The sequential introductions of capsulorhexis, foldable IOLs, clear corneal incisions, and topical anesthesia have made small improvements in the safety and efficacy of cataract surgery and as a whole have taken us one giant leap forward. Bimanual phacoemulsification is just another one of these small steps that may ultimately enhance our ability to offer the best surgical procedure to our patients.

Bimanual phaco

The idea of removing the cataractous lens through two microincisions is not a new concept and has been attempted with varying degrees of success and failure since the 1970s.[1-5] With the development of new phacoemulsification technology and power modulations,[6] we are now able to emulsify and fragment lens material without the generation of significant thermal energy. Thus the removal of the cooling irrigation sleeve and separation of infusion and emulsification/aspiration through two separate incisions is now a viable alternative to traditional coaxial phacoemulsification. Machines such as the AMO WhiteStar, STAAR Sonic, Alcon NeoSoniX, and Dodick Nd:YAG Laser Photolysis systems offer the potential of offering relatively "cold" lens removal capabilities and the capacity for bimanual cataract surgery.[7-10]

A recent point/counterpoint discussion regarding bimanual phaco has exposed the potential benefits and limitations of this technique.[11] From a personal perspective, the transition to bimanual microincision surgery has permitted a glimpse regarding the advantages and disadvantages of this procedure and the pros may soon outweigh the cons—especially in light of newer lens and fluidic technology on the horizon.

Let us first look at the advantages. Why do we need to remove a lens through two 1- to 1.2-mm incisions rather than a 2.5- to 3-mm incision? While it is true that coaxial phaco is an excellent procedure

Figure 4 Duet bimanual irrigating chopper (top) and magnified view of the tip of the Fine irrigating vertical chopper (right). (Photos courtesy of MST MicroSurgical Technology)

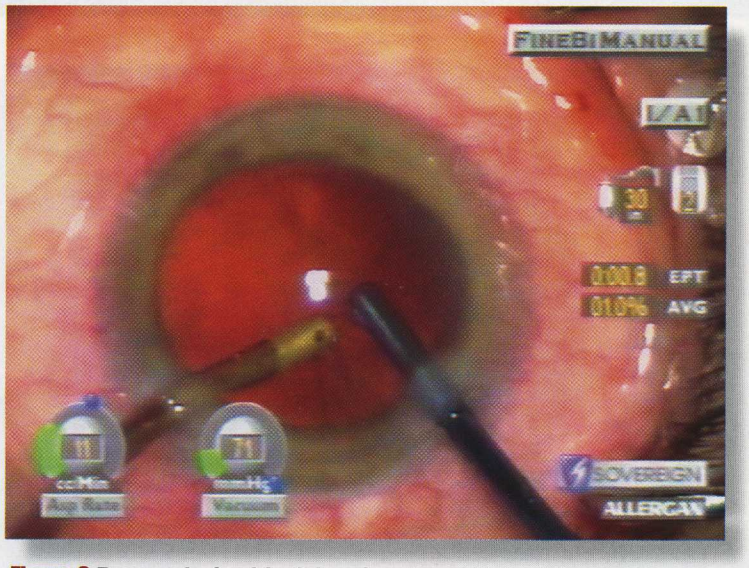

Figure 3 Removal of subincisional cortex utilizing bimanual irrigation/aspiration system. (Figures 1 to 3 courtesy of Richard S. Hoffman, MD)

with low amounts of induced astigmatism,[12] bimanual phaco offers the potential for truly astigmatic-neutral incisions. In addition, these microincisions should behave like a paracentesis incision with less likelihood for leakage and, theoretically, a lower incidence of endophthalmitis.

The major advantage we have seen from bimanual microincisions has been an improvement in control of most of the steps involved in endocapsular surgery (Figures 1 to 3). Since viscoelastics do not leave the eye easily through these small incisions, the anterior chamber is more stable during capsulorhexis construction and there is much less likelihood for an errant rhexis to develop.

Hydrodelineation and hydrodissection can be performed more efficiently by virtue of a higher level of pressure building in the anterior chamber prior to eventual prolapse of viscoelastic through the microincisions. In addition, separation of irrigation from aspiration allows for improved followability by avoiding competing currents at the tip of the phaco needle. In some instances, the irrigation flow from the second handpiece can be used as an adjunctive surgical device—flushing nuclear pieces from the angle or loosening epinuclear or cortical material from the capsular bag.

Perhaps the greatest advantage of the bimanual technique lies in its ability to remove subincisional cortex without difficulty. By switching infusion and aspiration handpieces between the two microincisions, 360° of the capsular fornices are easily reached and cortical clean-up can be performed quickly and safely (Figure 3).

We have found the learning curve in making the transition to this technique to be relatively short and safe. The same coaxial technique (either chopping or divide-and-conquer) can be performed bimanually, differing only in the need for an irrigating chopper for chopping methods (Figure 2). If difficulty arises during the procedure, conversion to a coaxial technique is simple and straightforward—accomplished by the placement of a standard clear corneal incision between the two bimanual incisions.

Disadvantages

The disadvantages of bimanual phacoemulsification are real but easy to overcome. Maneuvering through 1.2-mm incisions can be awkward early in the learning curve. Capsulorhexis construction requires the use of a bent capsulotomy needle or specially fashioned forceps that have been designed to perform through these small incisions (Figure 1). Although more time is initially required, with experience, these maneuvers become routine.

Also, additional equipment is necessary in the form of small-incision keratomes, rhexis forceps, irrigating choppers (Figure 4), and bimanual I/A handpieces (Figure 5). All of the major instrument companies are currently working on irrigating choppers and other microincision adjunctive devices. For the surgeon using the divide-and-conquer technique, irrigation can be accomplished with the bimanual irrigation handpiece that can also function as the second "side-port" instrument, negating the need for an irrigating chopper.

The greatest criticism of bimanual phaco lies in the fluidics and the current limitations in IOL technology that could be utilized through these microincisions. By nature of the size of these incisions, less fluid flows into the eye than occurs with coaxial techniques. Most current irrigating choppers integrate a 20-gauge lumen that limits fluid inflow. This can result in significant chamber instability when high vacuum levels are utilized and occlusion from nuclear material at the phaco tip is cleared. Thus, infusion needs to be maximized by placing the infusion bottle on a separate IV pole that is set as high as possible. Also, vacuum levels usually need to be lowered below 350 mm Hg to avoid significant surge flow.

Future advances

STAAR Surgical is currently developing its Cruise Control device that allows vacuum levels to be increased substantially without significant rises in surge flow. This device should allow for safer bimanual and coaxial phaco by allowing surgeons to utilize higher vacuum levels while maintaining better chamber stability. Current investigations of this device have been very promising.

At the conclusion of bimanual phaco, perhaps the greatest disappointment is the need to place a relatively large 2.5-mm incision between the two microincisions in order to implant a foldable IOL. An analogy is clear to the days when phaco was performed through 3-mm incisions that required widening to 6 mm for PMMA IOL implantation. It was not until the development of foldable IOLs that

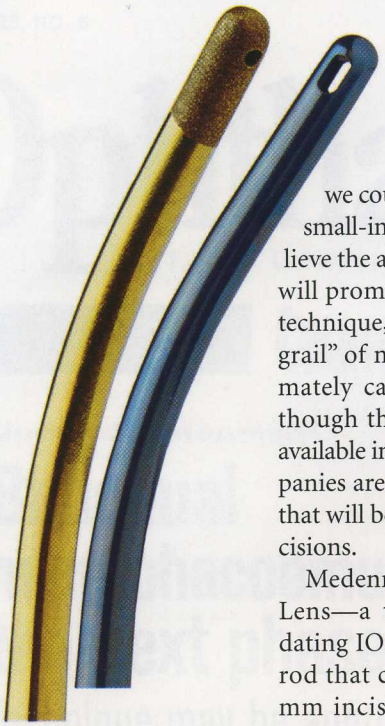

Figure 5 Magnified view of Duet aspiration tip (left) and irrigation tip utilized for bimanual I/A (right). (Photos courtesy of MST MicroSurgical Technology)

we could truly take full advantage of small-incision phaco. Similarly, we believe the advantages of bimanual phaco will prompt many surgeons to try this technique, with the hopes that the "holy grail" of microincision lenses will ultimately catch up with technique. Although these lenses are currently not available in the United States, many companies are developing lens technologies that will be able to employ these tiny incisions.

Medennium is developing its Smart Lens—a thermodynamic accommodating IOL. It is a hydrophobic acrylic rod that can be inserted through a 2-mm incision and expands to the dimensions of the natural crystalline lens (9.5 mm × 3.5 mm). A 1-mm version of this lens is also being developed. ThinOptX fresnel lenses will soon be under investigation in the United States and will also be able to be implanted through 1-mm incisions. Injectable polymer lenses are being researched by both Pharmacia and Calhoun Vision.[13,14] If viable, the Calhoun Vision injectable polymer offers the possibility of injecting a light-adjustable lens through a 1-mm incision that can then be fine-tuned postoperatively to eliminate both lower-order and higher-order optical aberrations.

Ultimately, it is the surgeons who will dictate how cataract technique will evolve. The hazards and prolonged recovery of large-incision intra- and extracapsular surgery eventually spurred the development of phacoemulsification. Surgeons comfortable with their extracapsular skills disparaged phaco until the advantages were too powerful to ignore. Similar inertia has been evident in the transition to foldable IOLs, clear corneal incisions, and topical anesthesia, yet the use of these practices is increasing yearly.[15] Whether bimanual phacoemulsification becomes the future procedure of choice or just a whim will eventually be decided by its potential advantages over traditional methods and by the collaboration of surgeons and industry to deliver safe and effective technology.

We look forward to improving our bimanual skills and await future developments with much anticipation. **OT**

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