

# Making Phacoemulsification Safer

Three surgeons discuss how advances in phaco equipment have improved their results and the procedure's safety.

## KERRY D. SOLOMON, MD



Advances in phaco machine modalities have made the procedure much safer. For example, whether you are using a bimanual or coaxial technique, smaller incisions reduce the amount of fluid in the eye, making the chamber more of a closed system. Smaller incisions also decrease the amount of surgically induced astigmatism and reduce its variability.

The use of less fluid in the eye led to the second advance in phaco technology: more efficient fluidics systems. Additionally, a more stable anterior minimizes the chance that the posterior capsule will move forward, which increases safety. A deep, stable chamber also gives ophthalmologists more room for surgical manipulations in long and short eyes. Current phaco technology now uses energy more efficiently. Today's platforms allow surgeons to use strategic movements of ultrasonic speeds to improve the efficiency with which the lens is removed. There is less need for energy in the eye, which increases safety. It should also speed patients' visual recovery, because less energy often corresponds to clear corneas.

All three of today's phaco machines represent major improvements on earlier models. My comments will focus on the Infiniti Vision System's Ozil IP (Alcon Laboratories, Inc., Fort Worth, TX). This state-of-the-art technology optimizes the safety and efficiency of the cataract procedure.

### INCISIONS

The key to successful phacoemulsification with Ozil IP is not only to remove the cataract through as small

an incision as possible. It is also to maintain that small incision when inserting the IOL and through the completion of the case.

I can reliably and predictably perform cataract surgery with self-sealing incisions using the Infiniti Vision System. I favor coaxial phacoemulsification, which has been shown to provide remarkably stable chambers.

Complementing the 2.2-mm incision is the combination of the Ozil IP handpiece and its software. Ozil IP has been shown to reduce thermal injury when compared with traditional and longitudinal phacoemulsification. I have been impressed by the ability of the Ozil IP software to minimize occlusion and prevent thermal injury to corneal tissue. As cataract surgeons transition to smaller and smaller incisions, they want to optimize fluidic efficiency while maintaining safety. I find that Ozil IP allows me to do just that.

### FLUIDICS

The Intrepid Fluid Management System is a mainstay of the Infiniti Vision System. Coaxial phacoemulsification is the most efficient means by which to remove lenticular material quickly, safely, and effectively while maximizing fluidics. High-compliance tubing and, more recently, Alcon's Intrepid Microcoaxial System minimize surge.

The era of laser cataract surgery has begun. With this new technology or current phaco platforms, surgeons will continue to rely heavily on efficient fluidics to remove cataracts.

### CHAMBER STABILITY

Alcon's Intrepid Micro-Coaxial System optimizes the stability of the anterior chamber. The cassette and tub-

ing were designed to anticipate and prevent surge. Depending on my preferences, the Infiniti Vision System can precisely alter the level of vacuum, and I have found it to be incredibly responsive in its variation of the flow rate and speed. Because the Ozil IP handpiece forms a nice seal for almost leak-proof 2.2- to 2.4-mm clear corneal incisions, it produces a deep, stable chamber.

### ENERGY EFFICIENCY

The tip of the Ozil IP rotates back and forth along the arc of the handpiece. In both clinical and laboratory settings, the phaco procedure has been more efficient, with less dispersion and more rapid removal of lenticular material from the eye. I find that nuclear fragments seem to come to the tip quicker and stay there for more efficient removal.

Ozil IP's effects are twofold. First, the handpiece has improved cutting efficiency compared with a longitudinal phaco tip. Each stroke of the former is a 100% mechanical action of cutting lenticular material. Second, unlike with longitudinal ultrasound, the handpiece produces no forward repulsion of nuclear material.

### CONCLUSION

The next area of cataract surgery requiring improvement is the predictability of surgical outcomes, which should rival that of LASIK. To achieve that goal, cataract surgeons need more defined measurements of the cornea and more predictable long-term placement of the lenses. Femtosecond lasers for cataract surgery may not only increase the safety of phacoemulsification, but they may improve refractive outcomes as well.

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### STEVEN DEWEY, MD



Although the new nonlongitudinal phaco modalities get all of the attention, each is dependent on the precision of the fluidics system it accompanies. The Whitestar Signature System with Ellips FX handpiece (Abbott Medical Optics Inc., Santa Ana, CA) is a perfect example. By utilizing an innovative dual-pump system, a surgeon can choose between venturi and peristaltic

vacuum and even switch back and forth between these modes during the same case.

At first glance, a dual-pump system simply offers versatility at an ambulatory surgery center, where a number of physicians may have different preferences. I, however, was completely happy with my peristaltic vacuum using the Whitestar Signature System with Fusion Fluidics until I tried the venturi pump. Within the 3 months, I had switched entirely.

### MAKING THE TRANSITION

When adopting any new machine, or even new settings, it is possible to ease the transition. While these steps seem intuitive in hindsight, they may diverge from a surgeon's habits and at first seem to hamper his or her efforts to evaluate a new system.

First, I suggest using a smaller phaco needle. The advantages of the newer platforms include higher vacuum settings that can be used safely. Even so, using a 19-gauge needle may be like drinking through a fire hose. Smaller phaco needles, even down to 22 gauge (700  $\mu\text{m}$ ), perform effectively and will increase the stability of the anterior chamber.

Second, I activate the sound panel on the phaco unit to determine the position of the foot pedal. An unfamiliar foot pedal or the new settings on an old foot pedal can be difficult to manage. Poor control will undo even the most precise fluidic settings. The audio feedback has facilitated my gradual transition to a new system. More importantly, it has helped me to avoid feathering the foot pedal in and out of position, which tremendously improves the chamber's stability.

### THE BASICS BEHIND THE SYSTEM

Differences in the two vacuum systems on the Ellips affect their utility. Broadly speaking, venturi accelerates to its preset maximum quicker than peristaltic mode. Control of the venturi vacuum is straightforward and limited to the depression of the foot pedal through position two. Once the pedal is depressed, the vacuum is "live." While the acceleration can be reduced through control of the settings, no software adjustments can be employed to alter the effect of venturi. It is all in the speed of the surgeon's foot, hence my recommendation to use a smaller-gauge needle.

Peristaltic vacuum has traditionally been considered safer than venturi, because the former builds more slowly. More importantly, peristaltic vacuum does not build at all until an occlusion (or partial occlusion) is achieved, at which point it may be modified. This aspect drives the "occlusion mode." Not only can the vacuum itself be modified, but so may virtually any

aspect of the technology controlled by software as the vacuum level changes.

Regardless of the style of vacuum, its magnitude is the key to achieving surgical efficiency. Engaging the vacuum brings the nuclear fragment in apposition to the needle's tip. If the material is soft enough, the force of the irrigating solution alone can shear the layers. As the rigidity of the material increases, the application of ultrasonic energy plays two roles: it deforms the material and then shears and emulsifies it. Vacuum here becomes critical. Regardless of the modality, if the level is too low, much of the transmitted energy is wasted in the form of chatter. If the level is just right, then energy is seamlessly delivered to the fragment with a balance referred to as *followability*.

With traditional longitudinal ultrasound, the risk was too much vacuum relative to the density of the cataract. Two to 3+ nuclear sclerotic cataracts could be perfectly fragmented by the cookie-cutting action of the needle and create a clog. This occlusion allowed vacuum to build, and as the occlusion broke, the resultant surge in outflow could easily collapse the anterior chamber or draw the iris or capsule against a sharp phaco needle.

### VANISHED POSTOCCLUSION SURGE

The transversal motion of the Ellips FX handpiece changed the phaco procedure. As the needle moves forward, it oscillates side to side. This elliptical movement (as viewed from above) does not allow the needle to penetrate material head on. The side motion prevents the fragment from creating a complete plug, and the risk of postocclusion surge is virtually gone. Without the risk of surge, the surgeon can explore higher vacuum settings to improve efficiency without compromising safety.

One of the key features of the Signature 2.0 software is the nonzero start for phaco power in foot pedal position three. The engineers at Abbott Medical Optics Inc. have always had the "zero" value for power set at the point at which cavitation begins. Now, a surgeon can start with 10% power, for example, and immediately begin removing a quadrant or sculpting. This setting decreases the inefficiencies of ineffective power delivery for quadrant removal and can be gentler to the zonules, especially during sculpting.

A more advanced technique exploiting the improved chamber stability of Ellips FX with venturi vacuum involves eyes with intraoperative floppy iris syndrome. When I am using a rounded phaco needle (Dewey Radius Tip; MicroSurgical Technology, Redmond, WA), intracameral dilation, a dispersive viscoelastic, and a tightly constructed incision, the followability of the venturi vacuum allows me to keep the tip of the needle in

the center of the pupil. If I perform an in situ chop, the fragments are drawn to the needle and rarely, if ever, stray into the anterior chamber.

Admittedly, using high flow and high vacuum in a case of intraoperative floppy iris syndrome flies against conventional wisdom. I have tried the lower flow and vacuum settings, but in eyes with small pupils, I left behind too many fragments. The peristaltic vacuum is effective, but it only becomes active when occlusion is achieved. It thus provides a great hold once a fragment is in apposition, but a loose fragment has the opportunity to stray from the tip. If a stray fragment ends up behind the iris in the case of a small pupil, it may get left behind.

### CORTICAL AND VISCOELASTIC REMOVAL

Two other areas where venturi vacuum shines are for the removal of the epinuclear bowl/residual cortex and the viscoelastic. The system simply draws cortex either into the lumen of a rounded phaco needle or the tip of a standard I/A handpiece. For viscoelastic removal, venturi vacuum has been nothing short of amazing. I have not changed my technique. I irrigate between the IOL and capsule and then direct irrigation into the chamber angle prior to I/A. The difference is that I see far fewer pressure spikes than when I was using peristaltic vacuum for the same task.

### CONCLUSION

When considering the advantages of a new nonlongitudinal phaco system, surgeons should not overlook fluids. I also recommend taking the time to explore each system's potential. For the densest or the softest cataracts, a more stable anterior chamber makes phacoemulsification easier.

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### R. BRUCE WALLACE III, MD



Fortunately, phaco machines continue to evolve. Most improvements allow for greater safety and efficiency. Although I use a variety of phaco equipment, I am partial to the Stellaris Vision Enhancement System (Bausch + Lomb, Rochester, NY), which is now available for anterior and posterior segment procedures as the Stellaris Procedural Choice.

### ANTERIOR CHAMBER STABILITY

When I first evaluated the Stellaris, I was surprised by the stability of the anterior chamber, even with high vitreous pressure and dense nuclei. Nuclear followability was also impressive. At first, I did not consider a dual linear foot pedal to be an important option. However, after adjusting to the proper foot position, I am able to make better use of the machine's superb fluidics and minimize phaco energy. The wireless pedal has wonderful tactile feedback and allows foot-controlled toggling to change presettings depending on nuclear hardness.

### VACUUM PUMP

While the Stellaris can incorporate a peristaltic system, most surgeons prefer the vacuum pump. The concept of a vacuum pump may be unfamiliar to phaco surgeons trained on peristaltic systems. With the latter, as the surgeon presses on the foot pedal, the level of aspiration or flow remains constant, but the vacuum increases, although only when the tip is occluded. There can be problems with postocclusion surge. Conversely, vacuum pumps are designed to maintain a set vacuum level but increase aspiration with a downstroke on the pedal.

Initial experiences with vacuum systems for anterior segment procedures 25 years ago were not all positive. The rapid on-off vacuum destabilized the anterior chamber. Thanks to important upgrades to hardware and software, modern vacuum phaco machines like the Stellaris are much more surgeon friendly. In a short time, many anterior segment surgeons learn the benefits of the quicker responsiveness of vacuum pumps, just as retinal surgeons have recognized for decades.

### UNIQUE FEATURES

Some unique features of the Stellaris are its digital air pump infusion, termed the Stellaris Digiflow, and its ability to allow phacoemulsification through a 1.8-mm incision. This incision does not require enlargement if the surgeon implants the Akreos MICS (Bausch + Lomb). During nuclear removal, Digiflow minimizes IOP fluctuation and can allow for higher rates of infusion for high-vacuum, low-energy cataract surgery. One study showed that 76% of surgeons found more stable chambers with the Digiflow System compared with gravity feed.<sup>1</sup>

### REDUCTION IN POSTOCCLUSION SURGE

Bench studies of the Stellaris performed by Terrence M. Devine, MD, showed a reduction in postocclusion surge. An important factor in the anterior chamber's stability is the denser-walled tubing (stable chamber tubing). The redesigned tubing increases resistance for high vacuum and provides steady, low aspiration. An

internal mesh captures lenticular material and prevents clogging. The unique tubing is coupled with stable chamber fluidics, which incorporates a new-generation, centrifugal, pump-and-valve technology. This combination results in a vacuum system that goes beyond venturi to allow for better responsiveness and aspiration efficiency.

### MONITORED FLOW RATES AND VACUUM LEVELS

The Stellaris simultaneously monitors flow rates and true vacuum levels, and it modulates the pump to enhance the stability of the chamber. I have found the system to be exceptionally responsive to postocclusion surge, with a rapid return to an equalized condition and solid anterior chamber stability. The fluidics were designed to take advantage of the increased responsiveness of this closed system. The feedback to the pump from the central microprocessor occurs 50 times per second.

### EFFICIENCY

Designed to offer remarkable efficiency through a 1.8-mm incision, the Stellaris Attune handpiece has a unique six-crystal design (rather than the usual four crystals). It operates at a lower frequency than the handpieces of most other phaco systems, a characteristic that optimizes cavitation cutting. A longer needle stroke length enhances mechanical activity. The Stellaris Attune handpiece was purposefully balanced to reduce the pull of the attached cable and to minimize fatigue of the surgeon's hand.

### CONCLUSION

Today's phaco surgeons are fortunate to have so many wonderful technologies available. For me, the Stellaris Procedural Choice with vacuum-directed fluidics provides a more stable chamber and safer cataract surgery than earlier platforms. ■

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