Taking Advantage of New Phaco Technology

The Whitestar Signature System offers improved fluidics, an interesting capability of combining longitudinal and transverse ultrasound, and peristaltic and venturi vacuum systems that can shift on the fly.

By Randall J. Olson, MD

Which basic principles of a phaco machine are new and different, and how might they affect cataract surgeons' overall provision of care? The Whitestar Signature System is based on proven technology incorporated in the Sovereign system (both platforms from Abbott Medical Optics Inc., Santa Ana, CA) with some novel, interesting features. This article addresses them one at a time.

FLUIDICS

The ability to control postocclusion surge has been a critical variable in regard to phaco machines ever since the procedure was first developed. Postocclusion surge causes the anterior chamber to become shallow and increases the risk of a rupture in the posterior capsule. It is amazing the parameters surgeons can safely use today precisely because of the fluidics control systems available. The Signature is based upon the proven stability of the Sovereign platform.[1] The former, however, more actively monitors pressure in the aspiration line, and its motor responds more rapidly to react to any changes in that pressure. For example, with the system's CASE software, users can program the machine to respond to any variations in line pressure by automatically adjusting for the best balance of efficiency and safety.

The net result of this fluidics system is that postocclusion surge need not be managed by restricting flow or decreasing the tubing's diameter, and the control of surge "on the ragged edge" was the best of the machines tested comparatively.[2] There is another plus with this fluidics control system. Surgeons have assumed that, in peristaltic pumping systems, the vacuum is zero until the tip is occluded. In fact, at the parameters often used today, the vacuum without occlusion at the tip can be quite high, and restrictors combined with narrower lines to control surge only aggravate the problem.[3] Of the new machines tested, "unoccluded" flow vacuum (active vacuum with no occlusion and full flow passing through the tip) in the Signature was about half that of the other two machines tested.[2] This difference is likely to be greater with the smaller-bore cartridges being introduced. Theoretically, higher active "unoccluded" vacuum would appear more likely to break a capsule or tear the iris, were either inadvertently contacted by the phaco tip.

VACUUM

Ophthalmologists have been able to choose between a venturi and peristaltic pump since the introduction of the Millennium microsurgical system (Bausch & Lomb, Rochester, NY). Unlike with that platform, the Signature's venturi capability does not require a separate gas line, and users can shift on the fly between the venturi and peristaltic pumps.

Venturi pumps offer the advantage of full suction that is always active at the end of the phaco tip, whether occluded or not; this feature has also been a negative in terms of safety. For a vitrectomy, vitreoretinal surgeons generally choose venturi pumps due to the efficiency of constant active and full vacuum. Now, using the Signature, cataract surgeons can work near the capsule with a peristaltic pump and then, when safely away, switch to a venturi pump for its efficiency and hold without occlusion. It is too soon to know how this capability will affect the efficiency and safety of phacoemulsification. The possibilities seem important, however, and they provide a new avenue for improving an already excellent procedure.

ULTRASOUND

Advanced Medical Optics, Inc. (now Abbott Medical Optics Inc.), was the first manufacturer to develop very

(Courtesy of Mark Schafer,

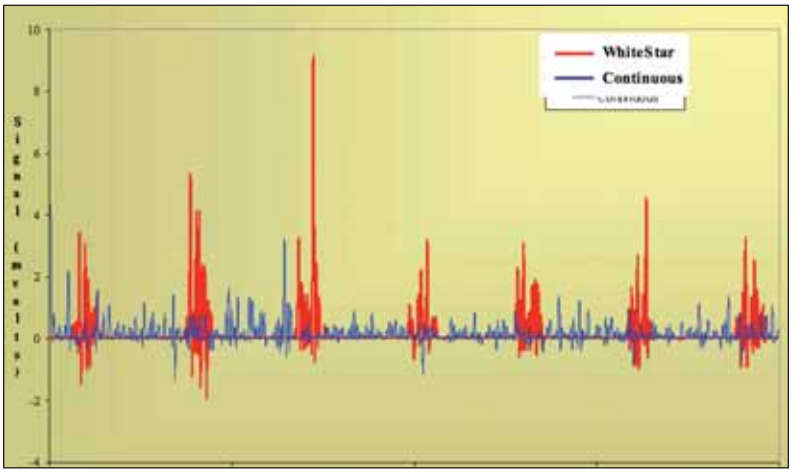

Figure 1. Actual cavitational energy generated at the same power level with continuous ultrasound and with 6 milliseconds on and 12 milliseconds off. Interestingly, the actual cavitational energy generated is equal with both approaches.

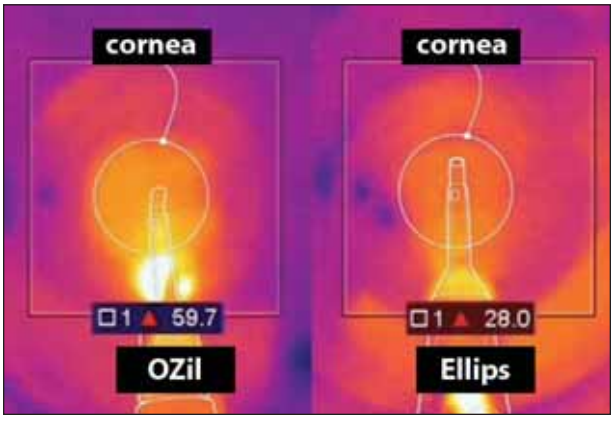

Figure 2. In a thermographic comparison of Ozil and Ellips at 100% power in water, the metallic stress at the needle's hub shows a difference in temperature between the two systems.

short ultrasound "on" and "off" pulses (Whitestar Technology) to improve efficiency (Figure 1) and decrease chatter.[4] The company has also provided variable Whitestar, which allows surgeons to progressively decrease "off" time with the foot pedal while the "on" time remains fixed. Variable Whitestar generally cut my effective ultrasound time by 30% over fixed Whitestar. This technological development was soon followed by the company's ICE program, which permits variation in the pulsed ultrasound form. For example, an initial ultrasound kicker for a variable and often brief period of time to enhance the cavitational energy is followed by a drop in energy to decrease the repulsion (or chatter) of lens fragments. A certain amount of time must pass before the actual repulsion occurs; with a fast kick early on followed by less longitudinal energy, the surgeon can get more cavitational energy and effect with less repulsion.

The variations in programming these features are limited only by the user's imagination. It will be interesting to see how these possibilities play out clinically.

ELLIPS

Ellips Transversal Ultrasound (Abbott Medical Optics Inc.) allows a horizontal movement of the needle that, over time, subtends an ellipse—hence the technology's name. Many surgeons have been pleased with horizontal ultrasound, because it essentially eliminates chatter and efficiently removes a nuclear fragment. An advantage of Ellips is that it can be used with a straight needle. Furthermore, because the wave through the needle subtends an ellipse, there is metallic stress at the hub of the needle for 360º, rather than just on two sides of the needle, as with the Ozil torsional handpiece (Alcon Laboratories, Inc., Fort Worth, TX). My group's preliminary work suggests that Ellips produces more diffuse heating of the needle's base near the hub and eliminates the two hot spots seen with the Ozil torsional handpiece, which could get hot enough possibly to cause a wound burn (Figure 2). Whether there is a clinical difference between these two approaches to horizontal ultrasound is currently unknown.

A potential advantage of Ellips is that, during the same cycle in which the needle is moving from side to side, the machine can incorporate any type of longitudinal stroke the surgeon desires. I like to use Ellips with variable Whitestar. With Ellips active, I can increase the frequency of my longitudinal cycles so that material flows freely without clogging the needle. The result is great efficiency and essentially no chatter.

CONCLUSION

The major issue for all surgeons to address is how many of the new features on today's phaco machines truly make a clinical difference. In several studies, my group has looked specifically at fluidics, especially post-occlusion surge. With a new experimental model, we will try to categorize the actual efficiency of ultrasound power to see what makes the most sense in regard to efficacy and decreased chatter. Although many of the changes in phaco technology do not have clinical studies showing their importance, surgeons' ability to use these

new tools will result in interesting research in the future. I believe it likely that studies will show some important clinical capabilities of this technology.

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The Infiniti Vision System offers increased efficiency, enhanced fluidics, and greater surgical control.

By Jason Jones, MD

I have performed cataract surgery with the Infiniti Vision System (Alcon Laboratories, Fort Worth, TX) for more than a year now. This article shares elements of my experience.

ULTRASOUND

The development of torsional ultrasound revolutionized cataract extraction. The side-to-side motion of the phaco tip is enhanced with a Kelman or angled tip; the ultrasound energy can emulsify nuclear material with every motion of the tip. The result is reduced nuclear repulsion and superior emulsification.[1,2] For surgeons who prefer a straight tip, Alcon Laboratories, Inc., produced the Ozil 12 with a milder bend than the traditional Kelman version. The former offers the feel of a straight tip while providing the enhanced efficiency of torsional ultrasound. The Ozil handpiece is light and maneuverable, with both longitudinal and torsional ultrasound capabilities.

The increased efficiency of phacoemulsification achieves a lower thermal profile with less energy and lower fluidic parameters. The result is better vision for patients in the immediate postoperative period and greater confidence for the surgeon. The advantages of the Infiniti Vision System apply not only to dense cataracts but also to soft nuclei, because lower fluidic parameters are gentler on the intraocular environment. My ability to set a linear threshold reduces the ramping up of torsional amplitude while maintaining the linear flexibility of the parameter. This threshold setting also enhances my use of the pedal travel, because the ultrasound activated during a foot pedal position 3 starts at the lower threshold value programmed in the setting. I therefore use the treadle excursion for the phaco amplitude I want without the lower percentage being expended.

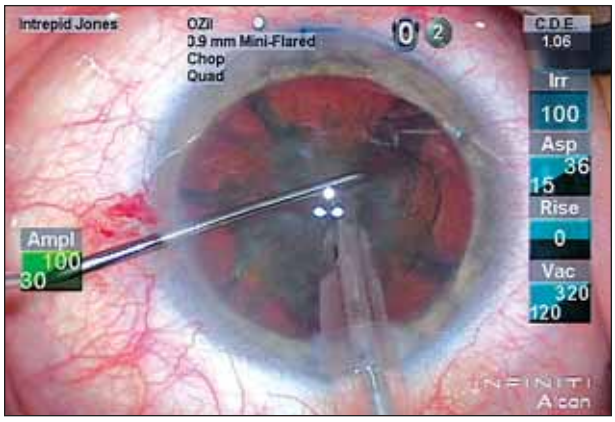

Figure 1. The linear amplitude, aspiration, and vacuum are at thresholds that optimize the energetic and fluidic parameters for this step of the procedure.

FLUIDICS

With this phaco machine, I can choose between two Fluidic Management System cassettes: regular or Intrepid. Both offer efficient priming, consistent performance, and excellent room turnover. With the Intrepid FMS, however, I have better control of the fluidic environment because of the tubing's reduced compliance. The peristaltic pump responds rapidly and allows titration of the aspiration separate from the vacuum. The system's most recent software package allows me to set minimum threshold values with linear parameters. I therefore have finer control of the fluidic parameters throughout each step of the procedure. As with the ultrasound settings, the less efficient lower parameters are removed while the flexibility of a linear setting is preserved.

CONTROL

As mentioned earlier, threshold settings allow finer titration of the phaco amplitude and fluidic environment. Complementing this enhanced control is the ability to add individualized steps to the procedure with a rapid transition from one to the next (Figure 1). The preset grading of cataracts allows logical raising or lowering of parameters to meet the needs of a particular case or

Figure 2. The Intrepid irrigation sleeve maximizes the fluidic performance of torsional ultrasound by directing flow through the ports rather than the distal opening. The sleeve is designed to complement microcoaxial phacoemulsification through a 2.2- to 2.4-mm incision.

even a change on the fly when warranted. In my experience, the Infiniti has proven extremely reliable during a very busy cataract surgical schedule.

MICROCOAXIAL PERFORMANCE

With the Infiniti, I reliably perform microcoaxial cataract surgery through a 2.2- to 2.4-mm incision for all grades of cataract. My patients and I enjoy a low degree of surgically induced astigmatism. A key element to my success with the system is the irrigation sleeve (Figure 2). The company's enhanced Intrepid sleeve features larger irrigation ports and a smaller distal opening at its tip, which helps to shunt fluid out the irrigation ports with reduced distal flow. The separation of inflow and outflow further refines the fluidics for phacoemulsification and I/A. With the Intrepid irrigation sleeve, I find I can literally fill the microincision: there simply is no leakage during the surgery, and the promise of enhanced fluidics is fulfilled time and again.[3]

THE BOTTOM LINE

Since transitioning to the Infiniti Vision System, I have greater confidence and less stress during my surgical day. As a result, I can reliably deliver to my patients a higher quality of cataract surgery.

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The Stellaris Vision Enhancement System's vacuum pump affords cataract surgeons exquisite control during nuclear removal.

By R. Bruce Wallace III, MD

The Stellaris Vision Enhancement System (Bausch & Lomb, Rochester, NY) offers many advantages over the other phaco platforms available today.

VACUUM AND FLUIDICS

The Stellaris (Figure 1) allows surgeons to choose a peristaltic or a vacuum system. Flow-based phacoemulsification uses a peristaltic pump, which maintains the same preset flow rate while the vacuum varies depending on the occlusion of the phaco tip. Ophthalmologists are very familiar with flow-based systems, because most manufacturers have built their phaco technology around this platform. The surgeon typically experiences a short delay in the removal of nuclear material as the vacuum builds at the tip during occlusion. Immediately thereafter, surge commonly occurs, especially with higher vacuum settings. In contrast, vacuum-based phaco systems use a vacuum pump with variable flow. Because this process does not depend on the tip's occlusion for vacuum during nuclear removal, the chamber may be more stable, and less surge may occur.

Surgeons can customize the Stellaris based on their fluidics preference by choosing the flow-based or the vacuum-based StableChamber Fluidics System. Although both are effective due

Figure 1. The Stellaris Vision Enhancement System.

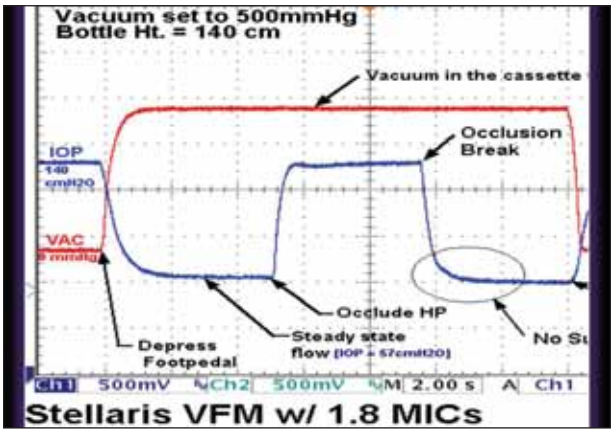

Figure 2. IOP fluctuations during microincisional cataract surgery through a 1.8-mm incision.

to the Stellaris' improved phacofluidics, I have found the vacuum module to be a real winner. The theoretical advantages of vacuum systems have always made more sense for eye surgery; that is why retinal surgeons use a vacuum-based system. In the anterior segment, however, the "instant on" phaco energy with vacuum pumps required rock-steady anterior segments for surgical control and confidence in order to avoid engaging the iris and/or capsule instead of nuclear material. The Stellaris with StableChamber Fluidics significantly reduces surge and provides surgeons with exquisite control of nuclear removal at much higher vacuum levels. Tight fluidics means less phaco energy is needed for the rapid removal of even dense nuclei. In addition, less energy expended translates into greater protection for the corneal endothelium and phaco incisions.

In a recent study comparing the fluidics of the phaco machines from Alcon Laboratories, Inc. (Fort Worth, TX), Abbott Medical Optics Inc. (Santa Ana, CA), and Bausch & Lomb, the Stellaris demonstrated minimal postocclusion surge with the vacuum-based system.[1] One of the factors that have helped reduce surge is the Stellaris' specially designed StableChamber tubing. The tubing's small diameter increases resistance during conditions of high vacuum to maintain a steady low flow. An internal mesh captures material and prevents clogging of the aspiration line.

MICROINCISIONAL CATARACT SURGERY

The Stellaris is the first phaco platform to offer true coaxial microincisional cataract surgery through a 1.8-mm incision. In a study comparing 1.8-mm coaxial microincisional cataract surgery with 2.65-mm standard coaxial cataract surgery, with no enlargement of the wound, the investigators concluded that the former produced significantly less surgically induced astigmatism and an equally if not more secure wound.[2] Many surgeons who use the Stellaris now routinely perform cataract surgery through a 1.8-mm incision, even though it must be enlarged for the IOL's insertion (of note, the recently approved Akreos MICS lens from Bausch & Lomb with its new insertion device can be implanted through a 1.8-mm incision). The smaller incision results in less surge at higher vacuum levels. Figure 2 illustrates IOP fluctuations during microincisional cataract surgery through a 1.8-mm incision. With vacuum at 500 mg Hg, no surge occurs after occlusion at the phaco tip breaks.

Many surgeons are concerned about a learning curve with microincisional cataract surgery. Fortunately, I found that the procedure felt natural, even safer, than standard cataract surgery after only one or two cases. A multinational field observation study involving almost 1,500 cases from 45 investigators demonstrated no loss of nuclear followability and improved chamber stability with microincisional cataract surgery using the Stellaris compared with standard coaxial phacoemulsification.[3]

ADDITIONAL FEATURES

The wireless, dual linear Stellaris foot pedal represents a real breakthrough in design. It provides excellent tactile foot control. In addition, the surgeon can toggle between various phaco presets during a procedure in order to handle cataracts of different density or to transition from phacoemulsification to I/A.

The stroke length of the phaco needle on the Stellaris is 50% longer than on the Infiniti Vision System (Alcon Laboratories, Inc.) and 40% longer than that of its predecessor, Bausch & Lomb's Millennium microsurgical system. The six-crystal handpiece provides consistent power with the latest in duty cycle energy delivery for excellent nuclear followability.

CONCLUSION

The real highlight of the Stellaris Vision Enhancement System is its beyond-venturi nuclear removal in a very stable anterior segment environment. With this phaco platform, I feel more confident about performing even difficult cases. ■

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