Two of the most significant recent advances in phaco technology are the improved delivery of nonlinear phaco power to remove the cataract and the enhancement of fluidics to give surgeons greater control of the intraocular environment.

NONLINEAR PHACO POWER
The move from linear to torsional and elliptical ultrasound has reduced thermal energy and therefore thermal damage to the phaco incision. At the same time, nonlinear ultrasound increases the efficiency of nuclear removal.

The majority of my experience is with the Whitestar Signature System (Abbott Medical Optics Inc., Santa Ana, CA), and I have found that the new version of Ellips Transversal Ultrasound with the Ellips FX handpiece (Figure 1A) maximizes the platform’s functionality. Specifically, the upgraded handpiece maximizes the delivery of phaco power and fluidic control.

Today, I use 100% Ellips ultrasound, and I consider the Whitestar Signature System to be the premier platform for nuclear removal, because it increases efficiency and decreases phaco time. I particularly like that I can deliver the elliptical energy through a straight phaco needle. This capability helps me in eyes with shallow anterior chambers. The Ellips technology also works with a bent needle, however, which increases the versatility of the platform—a benefit for practices in which multiple surgeons use the phaco unit. I have encountered no instances of thermal damage to the wound when using the latest version of the Whitestar Signature System.

FLUIDICS
The advantage of peristaltic pumps is more control over flow. The disadvantage is that full occlusion is needed at the tip to create vacuum, which can decrease efficiency during the removal of wispy strands of cortex. Of advantage with venturi pumps are that vacuum is always on and full occlusion is not needed, which augments efficiency. This could decrease control inside the chamber, however, especially with older phaco units and less experienced surgeons. Newer models such as the Whitestar Signature System allow surgeons to control the rise time of the vacuum such that they nearly equal the control of a peristaltic system.

To my mind, a major advantage of the Whitestar Signature System is that it allows surgeons to switch on the fly between a peristaltic and a venturi (B) pump for different steps of phacoemulsification.
the fly between a peristaltic and a venturi pump (Figure 1B). Particularly as the number and use of available premium lens technologies grow, efficient and complete cortical removal is becoming increasingly important to maximizing patients’ outcomes by minimizing posterior capsular opacification. I simply do not think a peristaltic pump can accomplish this task as well as a venturi pump.

During cataract surgery, I remove the nucleus using peristaltic mode. I remove the cortex and viscoelastic using venturi mode. The change involves the push of a button, and the transition is seamless.

All of the current phaco platforms represent improvements over the previous models in terms of chamber stability and fluidic dynamics. On the Whitestar Signature System, Advanced Chamber Stabilization Environment software prevents postocclusion surge and enables me to manage the anterior chamber environment quickly. That gives me peace of mind during surgery.

Y. Ralph Chu, MD, is the founder and medical director of the Chu Vision Institute in Bloomington, Minnesota. He is a consultant to Abbott Medical Optics Inc. Dr. Chu may be reached at (952) 835-0965; yrchu@chuvision.com.

# The Stellaris Vision Enhancement System

By Uday Devgan, MD

Cataract surgical techniques, instrumentation, and devices are in a constant state of evolution. The goal is always safer, more efficient, and less invasive phaco surgery. The purpose of today’s procedures is in essence the same as 20 years ago: remove the cataract and replace it with an IOL. The manner in which phaco surgery is performed, however, has changed considerably, and I expect progress will continue.

## SMALLER INCISIONS: THE MOVE TO MICROINCISIONAL CATARACT SURGERY

When phacoemulsification was introduced, one of its prime benefits was that the procedure allowed surgeons to remove the cataract through a smaller incision, although it required enlargement for the IOL’s implantation. The advent of IOL injector systems encouraged the reduction of the phaco incision’s size to the 2.8- to 3.0-mm range. This smaller incision induced significantly less astigmatism and sealed better, allowing surgeons to transition to sutureless incisions.

Cataract surgeons are at a point of change again. The ability to implant IOLs through incisions of less than 2.0 mm in size is leading to a shift toward microincisional cataract surgery (MICS). In the United States, Bausch + Lomb (Rochester, NY) was the first manufacturer to bring a complete sub-2-mm system to market: the Stellaris Vision Enhancement System with 1.8-mm tips and the Akreos MICS lens (MI-60), which has a 6-mm optic on a single-piece acrylic platform and can fit through that 1.8-mm incision. The Stellaris has been optimized to allow for incisions as small as either 1.8 or 2.2 mm in width or a traditional 2.8-mm incision. The system includes enhanced tubing, an improved vacuum pump, and upgraded software that balance the fluidic settings. With MICS, less fluid passes through the eye, the procedure is gentler on the delicate ocular tissues, and less astigmatism is induced.

### MAKING THE TRANSITION

Transitioning from a 2.8-mm phaco incision to a 1.8- or 2.2-mm microincision is simple, particularly with the Stellaris Vision Enhancement System. With all of the cur-

![Figure 1. Phacoemulsification has evolved from 2.8-mm coaxial surgery briefly to a period of biaxial surgery, which required two equal incisions, and finally to 1.8-mm coaxial surgery (A). The surgeon needs a new 1.8-mm steel keratome to make the new incision. A new phaco platform is helpful to provide the required fluidics. The surgeon performs the capsulorhexis with a thin-tipped forceps, which fits through the smaller incision (B).](image-url)
rent phaco platforms, the only required changes are an appropriately sized keratome, a finer capsulorhexis forceps, and an update to the fluidic parameters (Figure 1).

**Instrumentation**

To make the clear corneal incision for MICS, the surgeon uses a diamond or steel keratome to create a square entrance into the anterior chamber. Because the standard capsulorhexis forceps may not fit through this smaller incision, an upgrade to a newer instrument with thinner arms is advisable. Such forceps are available in both Utrata-style and 25-gauge retina-style formats. Because the incision is smaller, care must be taken to ensure that instrumentation floats within it in order to avoid corneal distortion, which can lead to a shallow anterior chamber and an errant capsular tear. This advice applies to the use of the phaco probe as well, because the diameter of the coaxial phaco tip makes its fit through the incision somewhat tight.

**Fluidic Parameters**

With smaller incisions, the primary fluidic consideration is the decrease in flow due to the narrowness of the phaco needle and sleeve. Poiseuille’s equation states that the flow of fluid through tubing is proportional to the radius of the tubing to the power of four. A small alteration in the tubing’s radius produces a much larger change in the amount of fluid flow. As an illustration, a person would need a large amount of vacuum in his or her mouth to draw a small amount of fluid through a narrow cocktail straw. In contrast, a small amount of vacuum in his or her mouth would produce a good deal of fluid flow through a large drinking straw.

When first trying sub-2-mm MICS, I recommend that surgeons raise the vacuum setting to at least 50% above or even double their standard level with sub-3-mm surgery. Keeping the bottle at the highest level will maintain the maximum level of fluidic inflow and inflow pressure, which aids in preventing surge. The surgeon can always lower the bottle height if the anterior chamber becomes overly pressurized. Restrictive outflow tubing can further balance the fluidics. These changes for MICS allow only a small amount of fluid to pass through the eye, and routine cases require just a fraction of the fluid needed for larger-bore surgery.

**CONCLUSION**

Thanks to improved phaco platforms and high-quality, single-piece acrylic IOLs, the transition to MICS is relatively easy, with a minimal learning curve for the surgeon and improved results for patients. In my hands, the advantages of MICS include excellent intraoperative stability, superb control, and a lack of surge throughout the cataract procedure. Postoperatively, eyes look clear with less inflammation due to the lower amount of fluid used during MICS. Moreover, patients have better visual outcomes due to the milder astigmatic effect of the smaller incision. Switching to MICS made it clear to me that there is no going back to larger, more invasive incisions.

Uday Devgan, MD, is in private practice at Devgan Eye Surgery in Los Angeles, Beverly Hills, and Newport Beach, California. He is a consultant to Bausch + Lomb Surgical but stated that he holds no direct financial interest in the products or company mentioned herein. Dr. Devgan may be reached at (800) 337-1969; devgan@gmail.com.

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**The Infiniti Vision System**

By Kerry D. Solomon, MD

Three advances in phacoemulsification have improved the cataract procedure and are preparing the way for surgery through sub-2-mm incisions.

**FLUIDICS**

All three of the latest phaco platforms available in the United States possess superior fluidics compared with the previous models. I favor the Infiniti Vision System (Alcon Laboratories, Inc., Fort Worth, TX), which features the Intrepid Fluid Management system. The tubing has a much higher compliance ratio than was available on the previous model. This system allows surgeons to use higher parameters without compromising the stability of the anterior chamber. The end result is a safer procedure for the patient.

**MICROCOAXIAL PHACOEMULSIFICATION**

During the past 1 to 2 years, the size of the cataract incision has shrunk from 2.6 to 2.4 mm and, in many cases, to 2.2 mm. Facilitating this change is not just our ability to operate through a small incision, but also our ability to maintain efficiencies and stable anterior chambers, thanks in part to the fluidic advances already described.

With the Intrepid Micro-Coaxial System (Alcon Laboratories, Inc.), we can perform cataract surgery
through a 2.4- or 2.2-mm incision that need not be
enlarged for the IOL’s implantation. In general, the
cataract incision is square and tends to self-seal with
great reliability.

TORSIONAL ULTRASOUND

The Ozil Torsional handpiece (Alcon Laboratories,
Inc.) has revolutionized cataract surgery. It is amazing
that something as small as the way in which the phaco
tip moves has had such a dramatic impact. Torsional
ultrasound has decreased the repulsion that occurs at
the phaco tip with traditional linear ultrasound. The
result is the more efficient removal of lenticular materi-
al.1,2 Torsional ultrasound creates an entirely different
fluidic pattern such that, in addition to decreased
repulsion, nuclear material is driven toward the phaco
tip.

Because torsional ultrasound produces less heat than
linear ultrasound, we can operate through smaller inci-
sions without the risk of thermal injury. Combined with
improved fluidics and more efficient nuclear removal,
torsional ultrasound allows us to lower our parameters
without compromising efficiency. This capability is key
with small incisions, which require the use of less fluid
in the eye.

Last year, Alcon Laboratories, Inc., introduced Ozil
Intelligent Phaco (IP) software upgrades (Figure 1).
Occasionally, the phaco tip on the Infiniti Vision System
becomes occluded. The Ozil IP software automatically
delivers microbursts of linear ultrasound when the sys-
tem senses blockage of the phaco tip and thus clears
the occlusion in a nanosecond, before we surgeons
could react. I use 100% torsional ultrasound, even on
the densest cataracts, so the Ozil IP software is invalu-
able to me.

CONCLUSION

Today’s phaco platforms are designed to maximize
efficiency and safety. Recent advances in phaco technol-
ogy are facilitating our transition to ever-smaller cata-
ract incisions. To continue our journey, however, I
believe we must be able to reliably place lenses through
square, sub-2-mm incisions without tearing or distort-
ing their architecture.

Kerry D. Solomon, MD, is the director of the Carolina
Eyecare Research Institute in Mt. Pleasant, South
Carolina, and an adjunct clinical professor of ophthalmo-
logy at the Medical University of South Carolina in
Charleston. He is a consultant to Alcon Laboratories, Inc.
Dr. Solomon may be reached at (843) 881-3937;
kerry.solomon@carolinaeyecare.com.

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