

Cataract & Refractive Surgery **TODAY**

The Grass Continues to Be Greener

**Why Surgeons Continue to Switch
to the INFINITI Vision System
With OZil Torsional Phaco**

INTRODUCTION

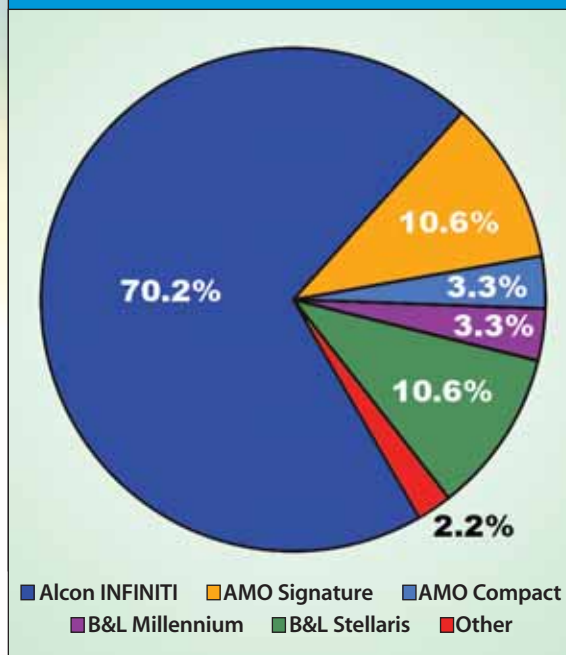
Cataract surgeons continue to show interest in the new phaco technologies offered by the "big three" companies. Each new system offers improvements over earlier models, and much hype has been made about the features of each machine in efforts to influence your surgical decision.

Surgeons' feedback on the INFINITI with the OZil Torsional handpiece and INTREPID Micro-Coaxial technologies has been so positive that we asked another group of surgeons who recently evaluated the different systems to describe why they decided to upgrade from their previous non-Alcon phaco technology and purchase the INFINITI Torsional ultrasound platform. Read their experiences and learn how the unique features of the INFINITI can benefit you and your patients.

Also, new laboratory studies indicate that INFINITI's fluidic design offers improved surge suppression and fluidic response versus competitive fluidic designs. These and other surgical benefits have made the INFINITI the preferred machine among phaco surgeons according to research conducted by Market Scope (St. Louis, MO).¹ When asked, "If you were to purchase a phaco machine today, which model would you purchase?" practitioners clearly preferred INFINITI (Figure 1). If you are considering purchasing a new phaco system, read what your peers are saying about the INFINITI's Torsional Ultrasound technology.

1. Q2-2008 Cataract Quarterly Update. St. Louis, MO: Market Scope; 2008:24.

Figure 1. If you were to purchase a phaco machine today, which model would you purchase?



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“The Most Advanced Phaco Capabilities Available.”

BY JERRY GALLOWAY, MD, AND STEPHEN TATE, MD

At our practice, the Galloway Regional Eye Center, PA, in Greenwood, South Carolina, we had become disenchanted with the surgical performance and outcomes with our current phaco platform, the Millennium Microsurgical System (Bausch & Lomb, Rochester, NY). We decided that it was time to invest in a newer phaco machine that had improved fluidic and ultrasound technologies. As high-volume premium IOL surgeons, we also wanted a phaco system that could better meet these patients' expectations and help us expand that part of our practice. We had been hearing about several new phaco technologies and decided to see what the buzz was about. We recently tested several different machines over several months, including the INFINITI Vision System with the OZil Torsional Handpiece (Alcon Laboratories, Inc., Fort Worth, TX), the Stellaris Vision Enhancement System (Bausch & Lomb), and the WhiteStar Signature system with Ellips Transversal Ultrasound (Advanced Medical Optics, Inc., Santa Ana, CA). I (Dr. Galloway) was particularly interested in this process, as I also hold a Bachelor of Science degree in chemical engineering. This discipline has a strong foundation in fluid dynamics, which is important in the understanding of the scientific principals of ultrasound, vacuum, and fluid control within the eye.

The following are our impressions based on our trial and early surgical experiences with all these new systems.

“The INFINITI and its OZil Torsional Ultrasound technology proved to be a huge advancement.”

THE EVALUATION PROCESS

We first evaluated the Stellaris system. Other than a slightly more efficient phaco handpiece, we did not find much of a difference surgically or in our outcomes compared with our existing Millennium.

When we evaluated the WhiteStar Signature system with the Ellips ultrasound, we were disappointed in our

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initial results. The majority of our surgeries require very low phaco power and total phaco energy. Even when using the Ellips technology, we experienced poor followability in removing nuclear fragments. We also noticed significant repulsion of fragments at the tip, and we actually asked our AMO representative to look through the teaching scope to observe this phenomenon. The representative was not able to offer changes in fluidic control or ultrasound modes to correct this issue. We had to “chase” the fragments and use a second instrument to guide them to the Ellips phaco tip. Furthermore, we both noted a surprising amount of corneal edema in our patients' eyes on the first postoperative day. The edema was not localized to the incision location, but it extended one-third of the diameter of the cornea. This finding concerned us enough that we ceased evaluating this system.

The INFINITI and its OZil Torsional Ultrasound technology proved to be a huge advancement. We were impressed by the INFINITI's increased surgical effectiveness in removing dense nuclei. We found this efficacy beneficial with a variety of surgical techniques. We tried several of the INFINITI's modes and options to experiment with both traditional and torsional ultrasound. Whether we used a chopping method or the divide-and-conquer technique, the system was extremely efficient and required lower total energy levels than our Millennium and the other machines we tested.

Its combination of fluidic and torsional ultrasound improvements offered us increased versatility, greater efficiency, and lower energy levels intraoperatively. We also tried a variety of styles and sizes of sleeves and tips, ranging from 2.20 to 2.85 mm. We found the 12° OZil tip to be very user-friendly and an easier transition than the

standard 20° Kelman tip. It was a good compromise between the straight phaco tip that we had used with the Millennium system and the 45° Kelman mini-flared ABS tip (Alcon Laboratories, Inc.).

Additionally, we were able to transition seamlessly from the Millennium's dual linear foot pedal fluidic control to the INFINITI's foot pedal control. The INFINITI delivered rock-solid anterior chamber stability and very precise and predictable low-vacuum control when we worked near the capsule or iris.

After testing various techniques on each machine, comparing costs, and analyzing other details, we just recently decided to purchase the INFINITI Vision System with the OZil Torsional handpiece. Considering its surgical efficiency, reduced amounts of ultrasonic energy, and superb fluidic control, we feel that the INFINITI is by far the best phaco machine we have used for removing all grades of cataracts.

INTRA- AND POSTOPERATIVE EXPERIENCE

Intraoperatively, we found that the INFINITI INTREPID Fluidic Management System (FMS), with its low-compliance (stiffer) aspiration tubing, maintained the chamber very nicely. We experienced no noticeable postocclusion surge or iris bounce, and the chamber was very solid, even at relatively high vacuum levels. This is important for difficult cases such as eyes with intraoperative floppy iris syndrome, high hyperopia with a narrow anterior chamber, pupils that do not dilate well, and very dense cataracts that may require high vacuum levels.

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Postoperatively, we were glad to see that our patients' eyes were quiet on day 1. We were also very pleasantly surprised at their 1-week visits, because it was difficult to tell they had undergone surgery. Again, these outcomes were excellent compared with the results we experienced using other new machines.

“After testing various techniques on each machine, comparing costs, and analyzing other details, we decided to purchase the INFINITI Vision System with the OZil Torsional handpiece.”

GRADE-A SUPPORT

We have been very pleased with the support we have received from Alcon's representatives at all levels. The company has always been ahead of the curve with new products and technology. Our Alcon representative has even helped us to develop marketing strategies for these products so we may better communicate with potential patients and build our premium IOL practice. Our Alcon reps have always been very proactive in practice building, even though we are located in a smaller community, and we have appreciated their suggestions.

CONCLUSIONS

We believe the INFINITI Vision System with torsional ultrasound has by far the most advanced phaco capabilities with the best efficiency currently available. We base our opinion on the real-world trials that we conducted over numerous surgical days with each of the three platforms mentioned. We anticipate that the INFINITI will be an extremely useful system in our practice going forward, and we look forward to working with our representative to learn even more about its advanced settings and techniques. With the INFINITI's increased efficiency and decreased operative times, we expect to be able to perform more surgeries per day while also continuing to improve our outcomes and thereby increasing our premium IOL patient conversions. ■

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“I Experienced a Total Surgical ‘Wow’ Factor.”

BY DAVID GOSSAGE, DO, FAOCO, FAAO

I had used the same Sovereign Phacoemulsification System with WhiteStar technology (Advanced Medical Optics, Inc., Santa Ana, CA) for approximately 7 years. Earlier this year, the WhiteStar Signature Phacoemulsification System with the Ellips Transversal Ultrasound technology (Advanced Medical Optics, Inc.) became available, so my colleagues and I considered purchasing this unit with the intent of using our existing Sovereign as a backup unit. When we finally got a chance to evaluate the Signature with the Ellips technology, we were surprised to find that its performance was only slightly better than that of our 7-year-old Sovereign system with WhiteStar. The newer system produced slightly clearer postoperative corneas, but I did not see a distinct advantage with the Ellips Transversal Ultrasound over the WhiteStar technology in terms of surgical efficacy and efficiency. Overall, I felt the Signature with Ellips was a better machine if we were looking simply to upgrade to something newer and possibly more reliable than our old Sovereign unit. Due to our ambivalence, however, my team and I decided to evaluate the INFINITI Vision System with OZil Torsional Ultrasound (Alcon Laboratories, Inc., Fort Worth, TX).

“As a surgeon, you want that wow factor for yourself as well as for your patients, and OZil Torsional Ultrasound gave both of those to me.”

TRIED AND SOLD!

I had tried the INFINITI platform when it featured the NeoSoniX and Aqualase technologies, but at that time, I was not impressed with the system enough to abandon our Sovereign unit. When I tried the OZil Torsional technology on the newest INFINITI system, however, I experienced a total surgical “wow” factor. The torsional technology compared to traditional longitudinal ultrasound was like PRK versus LASIK—an amazing difference. As a surgeon, you want that wow factor for yourself as well as

“The torsional technology compared to traditional longitudinal ultrasound was like PRK versus LASIK—an amazing difference.”

for your patients, and OZil Torsional Ultrasound gave both of those to me. I actually started giggling when I was removing a dense cataract, because the technology made this challenging procedure fun again. It enabled me to intraocularly chop and then remove extremely dense nuclei with great followability, minimal energy, excellent fluidics, and great chamber stability. The fragments almost dissolved in front of me. All of the patients I performed surgery on during my trial had great outcomes.

After that experience, my team and I tried the Signature system with Ellips again, and I did my best to replicate the INFINITI's performance. But, I could not get the Signature system to respond as well as the INFINITI. On the Signature system, cataract surgery felt like work. With the INFINITI and OZil technology, I do not feel like I am working at all. Everything flows easily and naturally. The INFINITI platform works seamlessly with me. Surgery with OZil Torsional ultrasound technology is like a whole new ballgame, an entirely new and exciting way of performing cataract surgery while also improving my outcomes.

SURGICAL TECHNIQUE

I have not had to alter my surgical technique in any way to use the OZil Torsional Ultrasound technology. I prefer to attempt to prechop lenses in the capsular bag, especially those of grades 2 and 3. I then transition directly into quadrant removal mode and emulsify the lens in the bag. I use 100% torsional ultrasound without the need for longitudinal ultrasound. I see absolutely no chatter at the torsional tip; its oscillatory movement easily shaves away the nuclear fragments. The lens material simply dissolves with incredible followability. On the Sovereign or Signature systems, I would consistently see the phaco needle pushing nuclear material away to

create effective cutting before it was able to emulsify the lenticular material. With the INFINITI and OZil technologies, there is no chatter or surge, and I do not see the nucleus bouncing around or being pushed away from the phaco tip. It is simply drawn into the tip. Also, the system's technologies let me use a minimal amount of fluid during the entire procedure; only 40 to 45 mL in most cases. Obviously, such low irrigation translates to very low edema and pristinely clear corneas postoperatively. I also feel that the risk of zonular ruptures or dehiscence is reduced. I believe that the INFINITI with OZil platform is safer than my previous phaco technology, and because of that, I feel more confident when I start my surgery.

I work in a rural community, and I see a lot of 20/200, count-fingers cataracts. If I cannot prechop these lenses (of grade 3 or 4), then I create a small groove in the cataract before proceeding with a divide-and-conquer technique. I break the nucleus into four quadrants, and then I use torsional ultrasound only for these dense lenses. Overall, the INFINITI system has reduced my average surgical time by 1 to 2 minutes per case.

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MICROINCISIONAL APPLICATIONS

The INFINITI Vision System with OZil and the INTREPID Micro-Coaxial System gave me the ability to perform micro-incisional cataract surgery without needing to purchase any new instruments. The 45° mini-flared OZil tip lets me work through a 2.2-mm incision with my same prechopping technique. I can use my existing instruments for the capsulorhexis, phacoemulsification, and lens implantation. Switching to a 2.2-mm incision from the 2.75-mm one I was previously using enabled me to reduce my induced astigmatism and theoretically lessen the risk of postoperative endophthalmitis. I also believe my patients' corneas have much less postoperative inflammation with the smaller incision.

"I believe that the INFINITI with OZil platform is safer than my previous phaco technology, and because of that, I feel more confident when I start my surgery."

LEARNING AND SUPPORT

My Alcon phaco rep was able to get the INFINITI's settings to work beautifully for me on my very first cases. He was very adept at learning my personal technique and then adjusting the machine's parameters to suit my needs. From a support standpoint, every time my staff and I had questions about the machine, my rep has been there for us. He brought me INTREPID blades so I could make the smaller 2.2-mm incisions. He also let me test each of the OZil tips to see which one I preferred. Alcon representatives make sure that their customers are taken care of, and I think the company has excellent after-sales service that will ensure its longevity.

I teach cataract surgery to ophthalmology residents, and my students have also noticed the advantage of the INFINITI with OZil over other phaco systems. They are able to adjust the machine's performance and settings if they need to proceed a little slower. The system lets them determine how fast or slow they want to work. It is equally responsive for both highly efficient and slower, more meticulous surgeons. It is surprisingly versatile for having such advanced fluidics.

IN CLOSING

My experience with torsional ultrasound is hard to fully explain. Everything about the system works in harmony. My surgeries are nearly effortless, as opposed to having to make constant surgical adjustments while extracting dense cataracts, as I had to do with other, longitudinal ultrasound units. ■

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“Surgical Efficiency and Technical Performance Were the Deciding Factors.”

BY JEFFREY DISKIN, MD, AND GARY KEOLEIAN, MD

Our team of surgeons at Michigan Eye Institute had been using the Millennium Microsurgical System (Bausch & Lomb, Rochester, NY) for more than 10 years with satisfaction. We thought it worked very well, and we were pleased with our surgical outcomes. In 2007, however, our machine was nearing the end of its life cycle, and we were opening a new surgery center. We therefore looked at the latest phaco technologies on the market.

BACKGROUND

We had heard of torsional ultrasound technology on the INFINITI Vision System with the OZil Torsional handpiece (Alcon Laboratories, Inc., Fort Worth, TX) and were interested in trying it. We have used Alcon IOLs for years, and our representative arranged for us to try this new torsional ultrasound technology. We also tested the Stellaris Vision Enhancement System (Bausch & Lomb). After an extensive trial period, we found both phaco systems to be very capable.

We ultimately chose the INFINITI Vision System, however, for a number of reasons. We were impressed with its cutting efficiency, the stable intraocular environment, and the complete absence of lens chatter using the OZil phaco tip. We have come to expect clear corneas on the first day following surgery, but when we used the INFINITI, even complex cases manifested clear, quiet eyes. The

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INFINITI simply made cataract surgery easier. Also, we seemed to be less fatigued at the end of the day when using this system, and our surgical staff preferred its ease of setup and specialized surgical packs.

We now have two INFINITIs with the OZil Torsional handpiece in each of our ambulatory surgery centers. The following describes our transition.

SURGICAL EXPERIENCE

Dr. Diskin

Our INFINITI representatives were extremely skilled at

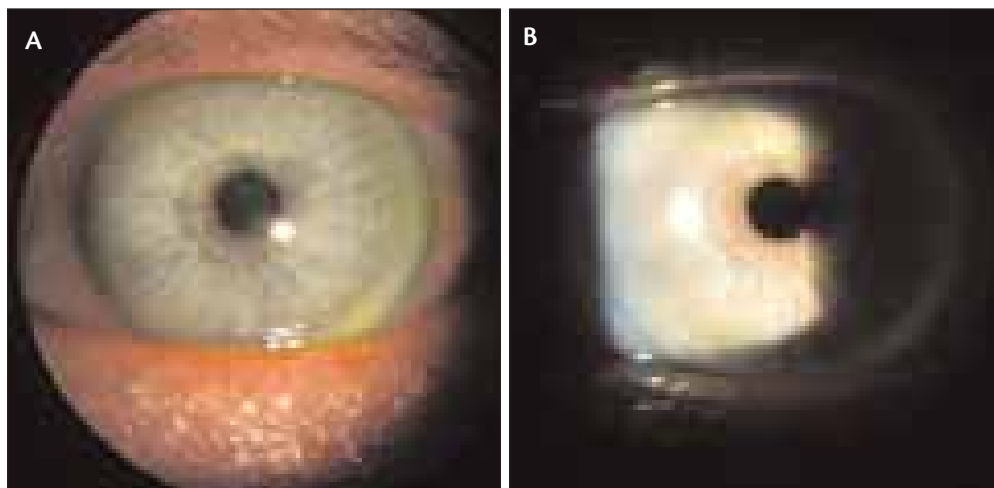


Figure 1. Slit-lamp images of an eye with intraoperative floppy iris syndrome on the first postoperative day after complex cataract extraction and implantation of the AcrySof SN60WF IOL (Alcon Laboratories, Inc.). The surgery was performed under topical anesthesia and intracameral epinephrine through a 2.2-mm micro-coaxial incision with the OZil Torsional handpiece. The eye is quiet with a crystal-clear cornea and no iris disruption (A and B).

helping us set up our new machines and make the transition from a venturi to a peristaltic fluidics system. I adapted to the INFINITI's foot pedal very easily and really did not have a learning curve. I found it simpler to use than the Millennium's dual linear foot pedal because of the INFINITI's excellent fluidics. The holding power for nuclear fragments is excellent. Whereas I would always have to increase vacuum power on the Millennium by moving to the right on the foot pedal, I now use a simple up-and-down movement on the INFINITI.

Our rep also helped me program settings for three different types of cataract. For routine cataracts, I prefer a stop-and-chop technique. I make a central groove in the nucleus with these settings, and then I switch to the quadrant removal setting that gives me more holding power. I use that setting on most cataract densities and find that it is extremely efficient and much easier than with the venturi system.

My second group of settings is for eyes with intraoperative floppy iris syndrome. These settings maintain low flow and keep the iris very stable, even with smaller pupils for which I would have previously used iris hooks. I use iris hooks much less frequently now that I have the INFINITI. I also manage these difficult eyes with intraocular epinephrine and DisCoVisc OVD (Alcon Laboratories, Inc.). All of these components have made operating on patients taking Flomax (Boehringer-Ingelheim Pharmaceuticals, Inc., Ridgefield, CT) much easier (Figure 1).

“When I use the INFINITI on a busy day, I feel less fatigued at the end of the day. I think this is because the technology does more of the work and puts less of the burden on me. I do not have to change my technique or the settings on the machine.”

My final group of settings on the INFINITI is for very dense cataracts, and it incorporates a small degree of longitudinal ultrasound with torsional (in the other two settings, I use only torsional ultrasound). I use the 45° Kelman mini-flared tip (Alcon Laboratories, Inc.) through a 2.2-mm incision. Even with very dense cataracts, I find that OZil's efficiency and control are phenomenal. I still perform a stop-and-chop technique with brunescient lenses, but I make the central groove deep to facilitate the initial crack.

Finally, I did not experience any surgical complications with the INFINITI Vision System during the transitional

“I use iris hooks much less frequently now that I have the INFINITI.”

period. I feel that the learning curve has not led to any adverse events for me, and I am very pleased with that.

Dr. Keoleian

There was a minimal, if any, learning curve with the INFINITI platform and the OZil Torsional handpiece specifically. It was an easy transition from a 2.75-mm incision to a 2.20-mm micro-coaxial incision. I had no need to change my instruments or technique. My program settings are similar to Dr. Diskin's. Most of the time, I use cataract mode two with 100% torsional ultrasound and the mini-flared 45° beveled OZil tip. The foot pedal allows me to select the various programs myself, making it easy to choose the correct program for a given lens. For instance, if I am faced with a very dense lens, I may start out with the chop setting, followed by quadrant removal. Conversely, if I am doing prechop, I can easily start with quadrant removal mode, all accessed from the foot pedal. This flexibility saves me time and allows for very efficient surgery. The INTREPID Micro-Coaxial System allows me to use a 2.2-mm incision throughout the entire case, with no need to enlarge the wound for IOL insertion.

Although the OZil system has the capability, I have not found the need to employ its power modulation settings, which was a critical component to other machines. The INFINITI with OZil provides the efficiency and flexibility to remove any grade of nucleus with virtually any technique, whether divide-and-conquer, phaco chop, or something in between. With the Millennium, my technique would vary based on a nucleus' density. Dense cataracts did not emulsify easily. Power modulation was essential to safely remove the dense lens and to achieve clear corneas on the first day with longitudinal-based systems. When I use the INFINITI on a busy day, I feel less fatigued at the end of the day. I think this is because the technology does more of the work and puts less of the burden on me. I do not have to change my technique or the settings on the machine.

PREMIUM IOLs

Dr. Keoleian

The INFINITI with OZil Torsional technology lends itself to premium IOLs for a number of reasons. Patients' expectations are elevated with premium IOLs, especially on the first postoperative day. We can consistently deliver excellent results with an extremely quiet eye on the first day after surgery. This is due to using a smaller incision size, having more efficient lens removal with the OZil handpiece, and

“We did not have to choose between price and quality, and that made the decision a no-brainer.”

awesome I/A. The curved I/A silicone tip allows me to gently yet thoroughly polish the posterior capsule and the anterior capsular leaf. As a result, the capsular bag is very clear. This tip greatly decreases my concern for inadvertent capsular rents when performing meticulous polishing. Having used a venturi pump for so long, I was surprised to find the INFINITI's fluidics to be as good as or better than venturi for I/A.

With premium IOL patients, we aim to maintain residual astigmatism at 0.50 D or less for the best functional results. The 2.2-mm incision is very helpful and predictable, because there is little or no induced astigmatism from the operative wound.

Dr. Diskin

Having the ability to operate through a 2.2-mm incision has reduced our induced astigmatism, and being able to maintain a coaxial system has eliminated any learning curve associated with adopting micro-incisional surgery. Also, because of the increased efficiency of the torsional technology, we use much less energy to remove cataracts and have much better flow dynamics within the eye. Therefore, our 1-day postoperative eyes tend to have very low inflammation and are very clear, and our results with the premium refractive IOLs have been very good.

We presently convert approximately 30% of our patient candidates to premium refractive IOLs, which is an increase over previous years. We continue to use a variety of premium refractive IOLs. We choose them based on the individual patient's needs. We use the AcrySof Toric IOL (Alcon Laboratories, Inc.) to manage astigmatism (we do very few limbal relaxing incisions).

SERVICE EXPERIENCE

We would classify Alcon's service as phenomenal, superb, and way above expectations. The surgical representatives know their products inside and out. Our rep was able to observe each individual surgeon and adapt

the system to the settings most suitable for that surgeon's technique and preferences. This individualized attention helped us transition naturally to the INFINITI, and it made the machine shine for each individual. Furthermore, as we mentioned, our rep had experience with both venturi and peristaltic phaco systems, and his proficiency during our brief transition period was paramount.

In addition to making sure that we were pleased with the equipment, our rep also went above and beyond to please our surgical staff. The company customized ready-made surgical packs to our specifications so that our technicians no longer have to prepare for each individual case. This unexpected level of service has made a big difference in our surgical efficiency and was a big selling point in our purchasing decision.

CLOSING THOUGHTS

What we like about the INFINITI platform and its INTREPID Micro-Coaxial technology is that it is a comprehensive, well-integrated surgical system. From the surgical packs to the phaco tip to the IOL—all of these products work harmoniously. The INFINITI's torsional technology has given our patients a more efficient, less invasive cataract surgery compared to our results on the Millennium. Their eyes are quieter and reveal more consistently clear corneas on postoperative day 1.

The final factor that helped us decide in favor of the INFINITI Vision System was that its cost was very competitive with other systems. We did not have to choose between price and quality, and that made the decision a no-brainer. ■

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Fluidics Comparison Study

BY KEVIN M. MILLER, MD

I have a background in electrical engineering, and I have an interest in how phaco machines compare to one another. In 2003, my group and I tested the AdvanTec Legacy (Alcon Laboratories, Inc., Fort Worth, TX), the Millennium Microsurgical System (Bausch & Lomb, Rochester, NY), and the Sovereign with WhiteStar phaco-emulsification system (Advanced Medical Optics, Inc., Santa Ana, CA).^{1,2} Now, we are continuing that testing with the INFINITI Vision System with the OZil Torsional handpiece and the INTREPID Micro-Coaxial FMS (Alcon Laboratories, Inc.), the Stellaris Vision Enhancement System (Bausch & Lomb), and the WhiteStar Signature phacoemulsification system (Advanced Medical Optics, Inc.).

We evaluated the three systems in multiple ways, and this article details our findings for two parameters tested: (1) postocclusion break surge, or the change in pressure inside a test chamber after an occlusion break; and (2) vacuum rise time, or the time it takes for a machine to reach a vacuum limit after the phaco tip's occlusion.

I would like to note that Young Keun Han, MD, PhD, an international fellow in cataract research at the Jules Stein Eye Institute in Los Angeles and an assistant professor of ophthalmology at the Seoul National University College of Medicine in South Korea, performed all of the experiments discussed herein.

ENSURING GOOD DATA

Dr. Han and I wanted to conduct these experiments in a way that could be easily duplicated by anyone with the same three phaco machines and similar testing equipment. One of the problems with many similar past phaco comparison studies is that they are performed inside of a pig eye or human cadaver eye, or even in the OR, where repeatability is impossible. One cannot even get the same results using the same phaco machine on the same eye two trials in a row because of variables such as changing compliance in the eye wall, incisional leakage, iris movement, etc. These published data are highly susceptible to whatever occurred during that recorded surgery.

We set up our experiments carefully to control for variables, and we were surprised at some of the things for which we had to control. For instance, we found that the bottle height measurements that the machines display are not identical. Every phaco system measures bottle height differently; the Signature's displayed height differed the most from the other machines' (its bottle height is understated by 26 cm H₂O versus the other consoles). Another

variable we found was the height from the ground of the sensor that each machine has for vacuum measurements.

POSTOCCLUSION BREAK SURGE

Background

When a nuclear fragment momentarily occludes a phaco needle, it allows vacuum in the cassette to build. Vacuum is beneficial in that it can better hold and extract fairly hard pieces of cataract, thereby allowing a surgeon to expend less ultrasound energy inside the eye. However, when a fragment is emulsified, it can create a surge at the unoccluded phaco tip that can suddenly pull fluid from the eye. This action is what we call *postocclusion break surge*, and it is what all cataract surgeons want to avoid.

Today's phaco machines use measures such as thick-walled aspiration tubing to reduce the amount of postocclusion break surge, and they have all succeeded to a large degree. The manufacturers have also modified their cassettes to further reduce compliance, but their designs vary considerably. Dr. Han and I compared the performance of the three machines under postocclusion break conditions.

Test Methodology and Parameters

In order to test the design of the systems' tubing and cassettes, we used the same phaco needle and handpiece on all three systems: a 0.9-mm 30° straight non-ABS phaco MicroTip with the OZil Torsional handpiece (Alcon Laboratories, Inc.). We then used the exact same test chamber, which had a pressure transducer inserted to measure pressure gradients very quickly. We set the bottle height at 90 cm from the middle of the drip chamber to the handpieces. We placed the handpieces 83 cm above the ground.

We tested each machine at the same vacuums levels: 200, 300, 400, and 500 mm Hg, which is the typical working range for most cataract surgeons. We clamped the aspiration line to simulate a cataract fragment occluding the phaco tip. When the vacuum had built to the preset limit, we suddenly released the clamp on the aspiration line and measured the pressure gradient that occurred in the test chamber on the needle side of the handpiece. The negative pressure goes down quickly, and then it returns to normal as the test chamber fills with fluid from the bottle. We were interested mainly in pressure versus time, so we measured the area under the curve.

Results

At 200 mm Hg, the INFINITI and the Stellaris had zero surge, and the WhiteStar Signature had a very slight

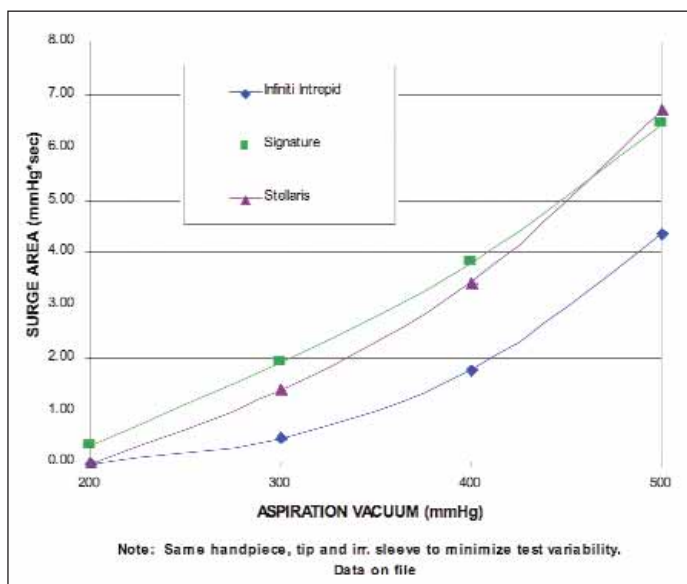


Figure 1. Occlusion surge area comparison.

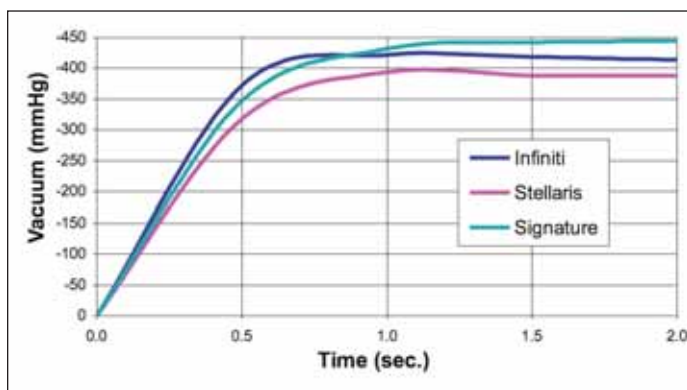


Figure 2. Vacuum rise comparison (400 mm Hg, 30 mL/min aspiration flow rate).

amount (Figure 1). As we increased vacuum levels, we found that the INFINITI outperformed the other two machines by a significant margin—almost one-third better at every data point above 200 mm Hg. The Stellaris performed slightly better than the WhiteStar Signature at all the vacuum levels except for 500 mm Hg.

VACUUM RISE TIME

The term *vacuum rise time* refers to the time it takes for a phaco machine to reach a vacuum limit once the phaco tip is occluded with nuclear material. We set all the machines at similar bottle heights and aspiration flow settings: a bottle height of 90 cm and an aspiration flow rate of 30 mL/min. For the first experiment, we selected a vacuum limit of 400 mm Hg. As Figure 2 shows, the INFINITI reached this vacuum limit first, in 0.6 seconds after the onset of simulated occlusion. The Signature recorded the second quickest rise

time at 0.7 seconds, and the Stellaris took 1.1 seconds to reach the 400-mm Hg vacuum limit.

The test also demonstrated that none of the machines actually reached and/or held the exact 400-mm Hg limit. At the 2-second time interval, the INFINITI slightly overshot the vacuum limit (approximately 414 mm Hg), the Signature overshot by the most (about 444 mm Hg), and the Stellaris slightly underachieved the vacuum limit (388 mm Hg).

We then conducted a second experiment to test the machines at a vacuum limit of 600 mm Hg. None of the machines actually achieved this target within the 2-second time limit, but the INFINITI came the closest (at approximately 590 mm Hg). The Stellaris was the second highest (at about 572 mm Hg), and the Signature was the lowest (at approximately 568 mm Hg).

Early Test Conclusions and Clinical Relevance

Based on our experiments, I believe the main difference between the machines is related to their compliance in the cassettes and aspiration tubing. The more compliant a system is, the larger the potential for postocclusion break surge and the slower its response time. As recorded in our laboratory testing, the INFINITI's INTREPID FMS has a lower compliance than the other systems, which allows this system to be inherently more responsive and to have lower postocclusion break surge levels.

It is essential for surgeons to maintain reliable and repeatable fluidic control during cataract surgery. Regardless of what practitioners take away from our data, they can be assured that all the newer phaco machines are much safer than previous iterations. ■

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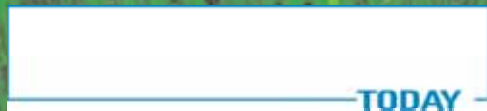
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