

What I Have Learned From Using the Laser

Surgeons weigh in on their experience performing laser cataract surgery using the available platforms.

Lensar: an Impressive Cataract Laser System With Benefits That Make an Impact



By Mitchell A. Jackson, MD

I recently decided to add a femtosecond laser to my refractive cataract practice, and the Lensar Laser (Lensar) was the clear choice for me. Compared with the other units, the Lensar system offered more features and benefits that I believed would make my transition to laser cataract surgery easier and pay great rewards in terms of precision. Now that I have more experience using the laser, I am impressed by the system's power and how it has profoundly changed the way I perform cataract surgery. Lensar boasts that its platform is "the intelligent choice for cataract surgery." Having used it in my practice now for 100 cases in 8 weeks, I am happy to say the device has provided benefits that can make a difference for my patients and for me.

SIZE AND ERGONOMICS

For starters, the Lensar Laser has the smallest footprint of the available lasers for cataract surgery. A great feature on paper, the advantage of the small size is even better in practice. Space was tight in our surgical center, so I needed a system that would fit inside the OR. This unit can be positioned just about anywhere that makes the most sense for the surgeon's workflow.

The device's ergonomics are worth mentioning as I am reminded of them during every procedure. The Lensar was designed from a blank slate, so every feature caters to the needs of the cataract surgeon. One example is the "no fixed-bed" design. Because the platform does not come with a bed, I am not slowed down by having to move the patient from bed to bed. I simply perform the procedure, move the laser head out of the way, and then bring in my microscope and phaco machine to complete the surgery. As a result, I have been able to perform all of my Lensar cases in less than 3 minutes.

It is Lensar's technology and imaging capabilities that have impressed me the most. Before deciding to purchase the system, I researched the advantages and disadvantages of other lasers' use of optical coherence tomography (OCT) versus the Augmented Reality Scheimpflug system employed by the Lensar. Augmented Reality utilizes superluminescent diode technology that scans at a variable rate depending on the target structure. This methodology ensures optimum contrast for both highly reflective surfaces such as the cornea and less reflective surfaces such as the posterior lens capsule. The Augmented Reality (structured illumination) software minimizes image background noise, permitting high-definition imaging and accurate biometric measurements regardless of nuclear density. The rotating Augmented Reality camera scans and displays the structures of the anterior segment from up to 16 different locations, unlike OCT-based systems that display only one sagittal and one transverse scan. Identifying lens tilt is important, because it allows the surgeon to center the anterior capsulotomy symmetrically over the optical

axis or pupillary center, avoid incomplete capsulotomies, and prevent damage to the posterior capsule. The pupil-centered capsulotomy is tilted to match the lens tilt, ensuring a complete capsulotomy. Fragmentation patterns are likewise adjusted for lens tilt to prevent damage to the posterior capsule.

The use of this proprietary Augmented Reality imaging instead of OCT became a strong selling point for me. Imaging is crucial to the success of laser cataract surgery and patients' safety, because the image guides the treatment. Not until I used the laser for the first time, however, did I really grasp the excellence of this imaging system and how it would change the way I perform cataract surgery.

MORE ON IMAGING

The Lensar's imaging system uses multiple technologies to provide an enhanced depth of field and outstanding contrast so as to clearly define all of the relevant structures in the anterior segment, specifically locating the posterior capsule with great precision. To achieve this level of detail, the system combines Scheimpflug, variable rate scanning, and superluminescent diode illumination. The laser also takes up to 16 images (two angles at up to eight positions) of the eye using its proprietary Augmented Reality rotating camera, and then with optical ray tracing, it creates a three-dimensional rendering of the entire anterior segment.

Because the imaging is clear and deep through to the back of the capsule, the Lensar's safety zone is smaller than the other devices'. As a result, I can optimize fragmentation for maximum phaco energy reduction. The real "aha" moment for me was when I realized that I no longer had to remove any epinucleus when using the laser. After chopping and removing the cataract fragments, I could move straight into irrigation and aspiration. In my standard phaco procedures, I need to remove the epinucleus in almost every single case.

This difference is a significant advantage, because most torn capsular bags occur during epinuclear removal, when the phaco tip is up against the back of the capsule. By eliminating this step, I am greatly reducing my chances of tearing the capsule. I am also reducing the amount of irrigation needed, which further lessens the potential for corneal edema and other ocular injuries.

DIFFICULT CASES

With the Lensar, I have been able to successfully remove cataracts in the most difficult cases. The contrast created by the device's variable-rate scanning and superluminescent diode have allowed me to see even extremely tough black cataracts (Figure), and the Augmented Reality three-

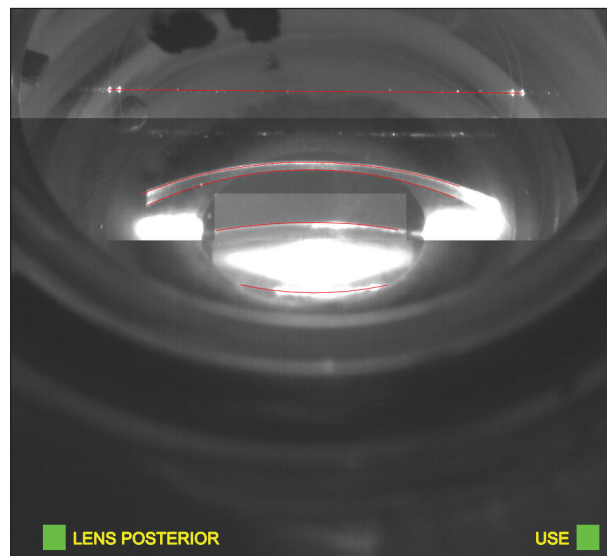


Figure. The black cataract, as seen with the Lensar Laser's Scheimpflug imaging. The first pair of red, curved lines marks out the front and back surfaces of the cornea. The second set of red, curved lines marks out the anterior capsule of the cataract and recommended posterior capsular demarcation line in this significant black cataract to avoid compromise of the posterior capsule with the laser.

dimensional image lets me visualize the selected treatment pattern in the patient's eye.

I also perform many postrefractive surgery cases for which I cannot remove any corneal tissue to correct the patient's vision. I am able to rely on Lensar's arcuate incision capabilities for astigmatic management. The system's initial imaging capabilities are comprehensive, and the device also reimages the cornea just seconds before making any incisions. This allows me to dial in the placement and make any last-second adjustments. Compared to manual arcuate incisions, I find laser incisions more accurate.

CONCLUSION

Lensar delivers on ergonomics, design, efficiency, imaging, fragmentation, and incisions. With every case I complete, I am more impressed with the device, and I am excited about the new features in development. It will soon be the only femtosecond cataract laser with iris registration and automatic cataract grading.

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Catalys: the Power of Imaging



By Sandy T. Feldman, MD, MS

When considering the transition from manual to femtosecond laser cataract surgery, it is easy to assume that the lasers all function much the same. In choosing a platform, many surgeons are most likely to consider the experience of other colleagues they trust who have invested in the technology and cost. Understanding technical differences in the laser beams and imaging technologies, however, is just as important.

KEY IMAGING CAPABILITIES

For me, the imaging capabilities of the lasers were a critical feature when I was choosing a platform. I reasoned that the better the accuracy of a device's imaging and software algorithms that guide the procedure, the more precisely the laser energy can be delivered to a planned location and pattern during the treatment.

Some systems only show the surgeon a single axial view, and others show both an axial and sagittal view. The type of imaging (optical coherence tomography [OCT] vs Scheimpflug) and interface (liquid, curved, or flat) differs among platforms, as does the degree to which the systems' interfaces automate the treatment based on imaging.

Ultimately, I chose the Catalys femtosecond laser system (Abbott Medical Optics). I felt that it offered the best combination of full-volume, three-dimensional (3-D) OCT; a nonapplanating liquid interface; and more image information on a higher-quality screen than other systems I evaluated.

After using the laser for a year and half, I have learned a great deal. I now believe that femtosecond laser imaging is already making me a better surgeon and that it holds even greater potential for the future of these devices than I first imagined.

PERFECTING INCISIONS AND CAPSULOTOMY

One of the first things I noticed after incorporating laser cataract surgery is that the quality of the incisions and capsulotomy is created exactly as I define it. I have found that the OCT imaging of the eye makes it possible to create precise corneal incisions and place them automatically or manually where I want them according to the pupillary center or limbus. I can place the laser capsulotomy according to the pupillary center, limbus, customized, scanned capsule, or maximized pupil, thus giving me a lot of flexibility based on the three-dimensional, full-volume OCT scan. The precision of the laser, along with the surgeon's

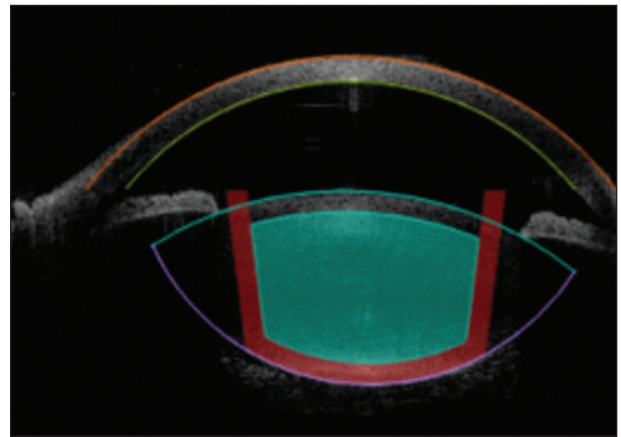


Figure 1. The blue area on the OCT overlay view indicates the fragmentation zone for lens softening, with the red area demarcating a posterior capsule protection zone of 500 μ m.

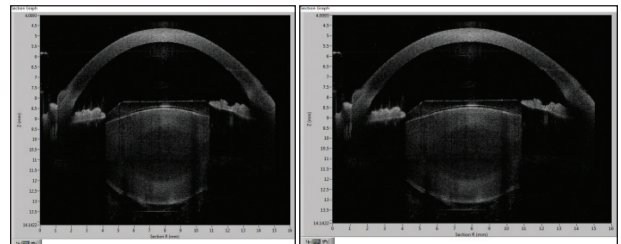


Figure 2. Catalys OCT imaging of an eye with a Visian ICL (STAAR Surgical) showing a slight tilt of the eye on the axial versus sagittal views.

preferences, allows for less variability from one case to the next and more precise incisions compared with manual surgery.

It is important that the laser interface is able to dock to the cornea without inducing folds, which is one of the reasons that I prefer a liquid interface. Folds caused by compression of the cornea produce anisotropic or nonuniform imaging and artifact. Clinically, this can result in skip lesions in the capsulotomy. The liquid interface smooths out irregularities of the cornea and gives the surgeon a wide view.

I considered myself a skilled surgeon before, but now, when I manually make a capsulorhexis, I am acutely aware of how imperfect it is. We surgeons do not yet have hard data on the clinical impact of more consistent capsulotomies, but I would expect laser-created capsulotomies to contract more uniformly as they heal.

BETTER APPRECIATION OF THE LENS

We know that lenticular density varies, and we approach a 4+ nucleus differently than a 2+ nucleus. The Catalys laser's OCT imaging provides much more information

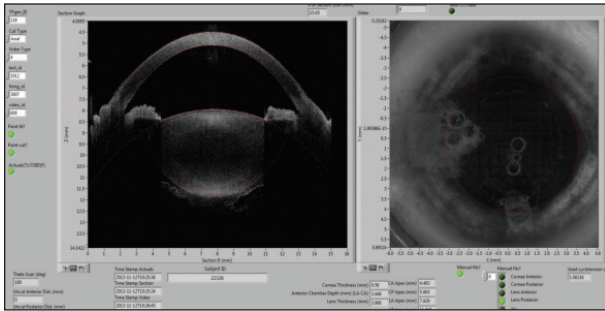


Figure 3. Axial fragmentation. Note there is no tilt in the axial view (left) at the completion of the case after capsulotomy, lens fragmentation, and temporal and paracentesis incisions (right). The user interface overlay view (not shown) consists of a single view with the overlay showing the fragmentation zone.

about the thickness and the volume of the lens, providing data that I would otherwise not have before entering the eye. This allows me to further customize the surgery, perhaps choosing a different segmentation pattern or tighter grid spacing to soften the lens as much as possible before phacoemulsification.

Even after many cases with the laser, I continue to be surprised at the variability in the size, shape, and density of lenses in my cataract patients.

I have also been surprised at the variability in lens size among patients and the degree to which the capsule can expand with age. We surgeons are removing a cataractous lens of significantly greater volume and replacing it with a thin IOL in a stretched capsule. On top of that, many eyes have a larger-than-average vertical or horizontal capsular diameter. In these eyes, the lens implant is likely to sit in a different position than it would in a more average-sized capsule. If the lens implant has hinged haptics, its final position would be even more variable.

It is clear to me now that much of the variability in our IOL calculation formulas and in refractive results from cataract surgery may be due to these anatomical differences in normal lenses and capsules. If we could image and measure lenses and capsules before surgery, we could potentially develop more complex power formulas that take individual anatomy into account or choose IOLs that are best suited to a particular eye. I can envision a day when we might design lens implants with a 3-D printer to precisely fit the anatomy of a given eye.

TRANSFERRING THE VISUAL TO THE TACTILE

With manual techniques, I can only see the eye in two dimensions. The Catalys laser provides a 3-D image that helps me fully understand all of the eye's surfaces, from the front and back of the cornea, to the lens volume, capsular size, and anterior chamber depth.

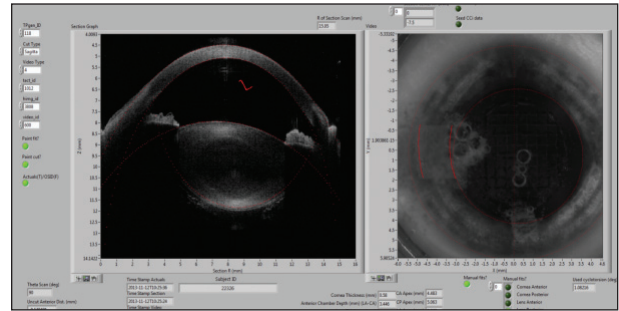


Figure 4. Sagittal fragmentation. Note that the tilt is visible in the OCT planning image (left) after capsulotomy, lens fragmentation, and the temporal and paracentesis incisions (right). This is the same eye as shown in Figure 3.

The resolution and quality of the display screen become critical as well to ensure that the surgeon is seeing the images in high definition. When I move from the laser to the phaco machine in the OR, I can mentally re-create the OCT image as I proceed with phacoemulsification. For example, I can easily see when an eye has a particularly shallow chamber and keep that in mind as I perform phacoemulsification more carefully or use a little more viscoelastic in surgery.

I also find that having a color-coded overlay of the safety zones on the OCT image is tremendously helpful. It serves as a visual reminder of exactly where 500 μ m from the edge of the posterior capsule is, relative to other structures. The safety zones for the capsulotomy and the lens softening are predefined by the laser system (Figure 1) but can be moved by the surgeon if necessary. This increases precision and saves time compared to a purely manual system, and it gives the surgeon more insight than a purely automated system. Driving the femtosecond laser by 3-D guided algorithms enhances safety in my opinion (Figures 2-4). Without a sagittal view (Figure 4), the eye tilt would be missed.

CONCLUSION

The femtosecond laser has already made me a better and more consistent surgeon, and we ophthalmologists are only just beginning to explore the potential contributions of OCT imaging to laser cataract surgery. In theory, everything that can be imaged can also be measured and quantified, including things we have never really measured before, such as lens capsule width and height. Perhaps that will prove to be the missing information that allows us to perfect lens power calculations and the refractive outcomes of cataract surgery.

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Making the Most of the Victus Laser System



By Michael J. Endl, MD

I first stepped on the pedal of my practice's Victus Femtosecond Laser (Bausch + Lomb) on Labor Day in 2012, becoming one of the earliest users of the commercial system in

the United States. Since then, integrating laser-assisted cataract and refractive surgery into our practice has expanded the range of options my colleagues and I can offer our patients in order to deliver the specific visual outcomes they want.

I have performed more than 2,000 LASIK flaps (averaging 20/week) and 1,000 cataract procedures (about 10/week), including capsulotomies and arcuate incisions, on the Victus. Although rates vary between our two offices, approximately 25% of our cataract patients currently elect to have premium cataract surgery with the laser. This increasing level of acceptance is generated by our focus on matching patients' expectations with the right surgical choices and the impact that patients who are happy with their visual outcomes have on our reputation in the community.

In terms of clinical performance, there are several unique features of the platform that I find particularly useful.

VERSATILITY

The ability to create both LASIK flaps and capsulotomies on the same platform was an advantage for our practice at the outset. The subsequent addition of arcuate and other corneal incisions has allowed me to refine my approach to correcting astigmatism in our cataract patients. For the vast majority of patients who have less than 2.00 D of astigmatism, I perform astigmatic keratotomy (AK) with the Victus, which gives me the ability to extend the incisions later with a diamond blade if I need a little more correction. In these patients, the combination of laser AKs with a Crystalens implant (Bausch + Lomb) gives me the ability to treat astigmatism in my cataract patients in a highly precise and repeatable manner. The recent clearance of lens fragmentation completes the cataract surgery capabilities of the laser system and provides a variety of fragmentation patterns to match cataract grade and surgical preferences.

CURVED PATIENT INTERFACE

The anatomically designed interface features intelligent pressure sensors with a light-emitting diode readout to facilitate real-time, procedure-dependent pressure control that reduces applanation of the cornea and minimizes corneal folds. In addition to enhancing surgical precision, this interface is more comfortable for the patient (particularly young, myopic men) than some other laser systems, which apply as much as 20 to 25 mm Hg higher pressure.¹ With LASIK flaps, my experience has been lower rates of postoperative hyperemia and subconjunctival hemorrhage, something my patients also appreciate.

REAL-TIME OPTICAL COHERENCE TOMOGRAPHY

Continuous, high-contrast optical coherence tomography provides excellent control in docking and centering, facilitating both surgical planning and treatment monitoring. I find this feature indispensable for the safety and precision of my AK procedures.

From the standpoint of practice success, there are key lessons we have learned from our experience with the Victus.

Know Your Patient

This is always important, but if you are asking a patient to consider a premium procedure, it is critical. You must be able to deliver the quality of vision that each patient wants and needs; otherwise, he or she will be unhappy. Ask your patients how they use their eyes most often, and then determine what special demands they might place on their vision such as time on a computer, driving (especially at night), hunting or other sports, reading novels in bed, etc. Be sensitive to nonvision-related cues as well. I have had patients who prefer to wear glasses to hide wrinkles, for example. I also use verbal images to better understand patients' preferences. If a new patient admits to being the type of person who sees a spot on the windshield and is compelled to hit the wipers, I suspect he or she may be among the 5% of patients who will not be happy with a multifocal lens. Ultimately, identifying what is going to get each patient to "20/Happy" is a blend of careful listening and your own expertise.

Get Help Educating the Patient

Your patients have a lot of choices to consider, and hitting them all at once with astigmatism, laser incisions, accommodating versus multifocal IOLs, and other considerations can be overwhelming. Each patient will have the best outcome if, together, you are able to identify

the right solution. To make this happen, my practice has changed the way we see patients. We developed a strategy in which our staff walks a cataract evaluation patient through the evolving technology with one-on-one discussions and tablet presentations before he or she sees me. I am then able to have a more productive discussion with educated patients, answer their remaining questions, and make the best recommendation for their visual lifestyle.

Develop a Nomogram

With the Victus, we now have access to more precise and repeatable incisions than ever before. Adopting and refining nomograms for correcting refractive errors will ensure that these advantages translate to better visual outcomes for your patients. Start with nomograms that are available online for traditional limbal relaxing incisions. Pay particular attention to the radius from the center used and the degree of arc, and then track your results so that you can tweak the approach.

Rely on Word of Mouth

The most common response to the question about how patients chose an ophthalmic surgeon in marketing surveys is that they have heard good things from a family member or friend. Word of mouth is how surgical outcomes translate into practice success. Managing patients' expectations—finding the best solution for their needs—means happier patients. This inevitably leads to more patients coming through your door. Of course, patients are not only talking about their outcomes and their surgeon but also about the kind of surgery they underwent. Thanks to positive word of mouth, we now have patients, Millennials and baby boomers alike, coming to us and asking for a laser flap in their LASIK surgery.

Especially if you are depending on your team to educate the patient, as we do, they become a critical component of your practice is marketing effort. Teach affiliated or referring optometrists and your staff, through internal programs and community seminars, what you know and why you are excited about femtosecond laser cataract surgery. Place displays, tablets, and video loops in your office to “break the ice” and get patients excited about this option.

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1. Endl M, Rousseau P. Intraocular pressure increase during LASIK flap creation over multiple devices. Paper presented at: ASCRS/ASOA Symposium and Congress, April 20-24, 2012; Chicago, IL.

Learning Curve for Surgical Technique: LenSx

By Scott E. LaBorwit, MD

It has been more than 2 years since the beginning of my journey using the LenSx femtosecond laser (Alcon) for cataract surgery. Looking back, I recall the uncertainty I felt about how quickly I could adapt to a new procedure, but I had the reassurance of knowing that, if the laser did not perform as expected, I could revert to methods used in traditional surgery. I soon learned, however, that laser technology is not so much about changing my surgical technique as it is about its enhancing each step with its precision and accuracy. The femtosecond laser itself and the manner in which it docks were familiar to me, as I use it to create flaps in LASIK. What is more, the suction raises the IOP less than 20 mm Hg, so patients were as comfortable as I was (data on file with Alcon).

A CAUTIOUS APPROACH GIVES WAY TO NEW CONFIDENCE

My initial learning curve with LenSx technology was minimal. A major concern was being able to dock the patient interface onto the eye, but after just a few cases, it became clear that, for me, it was easier than a dock for LASIK flaps. Because there is a soft contact lens with the cataract patient interface, and the suction is minimal, the IOP is not raised nearly as high. Using a strong lid speculum and good head position, along with coaching patients to remain still during the procedure, makes for an easy and well-positioned dock during my procedures.

In the OR, the corneal incisions open easily with a spatula; the laser cuts through the cornea are very precise, and it may take time to learn the path to follow to open the wound. Fortunately, every case will follow the same laser-cut path, which, most surgeons will quickly master. The laser-created capsulotomy is typically free without tags, although pushing down on the capsulotomy allows me to see a tag if present. During my first few cases, I used trypan blue to stain the capsule to be certain there were no tags.

For me, hydrodissection was the same, although I used much less volume. Initially, I only placed a chopping pattern with a small cylinder and used my usual lens removal technique, sculpting the lens and cracking it into four quadrants. After the first few cases, I found that I was able to comfortably perform the procedure using a very similar approach to traditional cataract surgery, with the added benefit of the laser's precision and accuracy.

I soon transitioned from being cautious and rigid during surgery to trying several new laser settings, ablation

sizes, and techniques—and this is when the fun began. At this point, the learning curve was now about finding the optimal ways to use the laser for more efficient surgery and better outcomes. Two years and 1,500 laser cataract cases later, I no longer use the laser to assist my surgical technique. Instead, I perform an entirely different cataract surgery involving new settings for the laser, along with adjustments to the phaco machine settings. These include reduced power, increased vacuum, and even additional modes. The surgery I use today is in many ways the opposite of how I performed traditional cases and incorporates many practices I avoided before I began using the laser for cataract surgery.

AN EVOLVING JOURNEY TO BETTER OUTCOMES

The journey from traditional cataract surgery to my current technique with the LenSx underwent several evolutionary stages. I stopped using hydrodissection when I realized the air bubble created by the laser treating the nuclear lens was pneumodissecting the posterior lens adhesions. It was no longer necessary to rotate the lens, because the chopping pattern easily created quadrants that could handily be removed. Over time, I added viscodissection from the capsular edge to the lens equator 270° to free up anterior lens adhesions and allow my quadrants to move more quickly into the phaco tip.

Early on, I had no cylinders cut in the lens; then I would create a small cylinder and, over time, a very large cylinder pattern; I eventually landed at a moderately sized cylindrical pattern of 4.7 mm and a chop diameter of 5.3 mm. Even my primary incision changed in many ways. I realized a laser-cut 2.2-mm opening was tighter than a 2.2-mm incision created with a steel knife keratome, so I increased my wound diameter from 2.2 to 2.3 externally and 2.4 mm internally. Although slightly bigger, the precise laser cut allows the wounds to seal better and heal faster in my experience.

When I began performing laser surgery with the LenSx, I was excited to have a laser create a triplanar primary incision; however, I transitioned back to biplanar because I found that, if hydration were necessary, the biplanar incision would seal very easily. My phaco energy and time (cumulative dissipated energy [CDE]) have been reduced from an average of 14 CDE to an average of 4 CDE, with a significant amount of ultrasound performed within the capsular bag.

To accomplish this, I created a new prephaco mode on my machine with no longitudinal phaco, high vacuum, and linear-controlled torsional phaco set very low. With the laser cutting 4.7-mm cylinders into

16 pieces at 90% depth, I can use high vacuum to remove the majority of the densest part of the cataract. The remaining pieces still crack and are removed within the bag. They tend to be less dense, which allows for less overall ultrasound during the procedure. This technique involves bowling out the nucleus, which surprises me because it is not even close to how I would perform a traditional surgery.

When I increased the cylinder's diameter, the remaining pieces were typically too soft. With my current technique, most of my phaco energy is delivered far from the cornea in the capsular bag, and I have reduced my CDE by an average of 70% compared to traditional cases. This speeds up recovery, reduces the need for drops, and increases the "wow" factor for vision on day 1.

CONTINUING CHANGE FOR CONTINUAL IMPROVEMENT

Laser technology is fluid, and it is not just the laser that is changing. The phaco machines, tips, and surgeons' ability to collect and incorporate patients' preoperative data into the treatment are changing, too. My LenSx has had more than five upgrades to both software and hardware since I began using it in 2012. This constant refinement enhances the procedure and also allows for new surgical applications and methods. Although the technology's ongoing improvement translates to an ongoing learning curve, it ultimately has a positive impact on surgical success and patients' visual outcomes.

CONCLUSION

The transition from traditional to laser surgery is typically quick and relatively seamless. The real challenge begins once you become comfortable with the technology, as this is when you begin to modify your surgical technique, and the learning curve can steepen. The laser can have an impact how you approach each step of cataract surgery, including reduced phaco power, greater ease of lens removal, better corneal incision closure, minimized capsular bag tractional forces, and minimized inflammation of the anterior chamber for improved postoperative vision. Although changing your surgical technique may take you outside your comfort zone, it can lead to a new place in your surgical regimen with rewards for both you and your patients. ■

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