Transforming cataract surgery: Guidance for adopting LACS

by John Vukich, MD

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The transformation of cataract surgery: Clinical and practical guidance for adopting laser-assisted cataract surgery

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ASCRS Clinical Survey reveals educational needs

Each year, the ASCRS Clinical Survey is a key driver of the association’s educational content, determining the issues members are interested in and areas where there may be educational opportunities.

The 2014 ASCRS Clinical Survey, conducted in April 2014, focused on the most compelling and controversial topics confronting members. Information was gathered from more than 1,500 unique respondents. The survey included 268 data points from 137 questions on key clinical opinions and practice patterns.

When members were asked about the percentage of their patients receiving laser-assisted cataract surgery (LACS) overall, respondents reported that 4.8% of their patients received this procedure (U.S. surgeons, 5.8%; non-U.S. surgeons, 3.6%).

When questioned about the clinical benefits of LACS versus conventional cataract surgery, 42.2% of respondents believed it does not provide any improvement in creating the capsulorhexis, 47.9% believed it does not improve lens fragmentation, and 40.7% believed it does not offer advantages in creating arcuate incisions (Figure 1).

Among those who have not adopted LACS, financial issues are a major obstacle. When asked about barriers to adoption, respondents reported reimbursement and financial concerns (61.7%), a lack of access to technology within their practice or via an open access center they would consider (32.7%), and a lack of data showing clinical benefits (35%) (Figure 2).

When members were asked how confident they were that there is currently an adequate reimbursement solution (private pay or insurance), almost 60% were not confident at all, indicating a major barrier to adoption. However, looking to the future, almost 45% were not confident that there will be an adequate reimbursement solution in 5 years.

Based on gaps and needs determined from the 2014 Clinical Survey, we have gathered several experts who have adopted LACS and will share their strategies on how to implement this technology successfully.

Figure 1. The 2014 ASCRS Clinical Survey asked, “In which of the following clinical areas do you believe laser cataract surgery may provide a significant clinical benefit versus conventional cataract surgery (select all that apply)?”

Figure 2. The 2014 ASCRS Clinical Survey asked, “If you are not performing femtosecond laser-assisted cataract surgery, what are the barriers to your adoption of the technology (select all that apply)?”
Laser-assisted cataract surgery: Intraoperative OCT to predict lens position

by Joseph J. K. Ma, MD, FRCSC

Three-dimensional morphology may offer advantages in predicting effective lens position

Beyond improved safety, the main rationale that surgeons use for adopting laser-assisted cataract surgery (LACS) is the promise of improved accuracy. Effective lens position (ELP) is the most significant source of error in current intraocular lens power calculations. Although it has been theorized that refining the capsulorhexis will improve ELP estimates, research has not yet clearly demonstrated improved accuracy.

There are significant barriers to demonstrating an improvement: We refract subjectively in 0.25-D increments, resulting in an error of approximately 0.4 D; most lenses are only available in 0.5-D increments; there exist potentially significant differences between actual lens power and box labeling; and lens thickness varies between powers for any given model.

Searching for solutions

We explored whether there might be a better metric for outcomes analysis by taking advantage of intraoperative OCT to achieve improved predictions and demonstrate improved accuracy.

To estimate ELP, we currently rely on axial-based measurements. Olsen’s 5-variable multivariate formula for estimating ELP is a good example. To compare our OCT morphology-based technique, we looked at data from the IOLMaster (Zeiss Meditec, Jena, Germany) with a 3-variable multivariate formula, the Haigis formula, using anterior chamber depth and axial length, and data from the LENSTAR (Haag-Streit USA, Mason, Ohio), including lens thickness, using Olsen’s formula. Because intraoperative aberrometry relies on axial length segmentation for improved accuracy, in practice it is also highly dependent on the measurement of axial length.

For this study, we proposed that we might not need axial length measurements to predict the postoperative actual measured true lens position (TLP) as a physical manifestation of the estimate of ELP. Instead, we would use only the three-dimensional morphology of the eye in an algorithm.

OCT lens position study

In a retrospective study of 120 consecutive eyes, Scheimpflug images were examined an average of 4.5 months after LACS was performed, and the actual TLP was measured (Figure 1). We subsequently also used swept-source OCT postoperative imaging, which has confirmed and validated the Scheimpflug image results. The technicians performing these
measurements were blinded regarding algorithm predictions.

Figure 2 displays data from the study. Predictions based on the three-dimensional OCT morphology-based algorithm demonstrated the highest correlation coefficient with the TLP in comparison with the Olsen and Haigis predictions. Bland-Altman plots also demonstrated tighter 95% limits of agreement between the predicted lens position and the TLP. Interestingly, correlations for TLP predictions were also higher for the Haigis and Olsen formulas than previously published results.

**Conclusion**
Intraoperative three-dimensional OCT morphology may be superior to current axial-based formulas in predicting postoperative ELP. The correlation coefficients for these formulas in our study using LACS are also higher than published values. Further study of this may enable us to demonstrate the benefit of a more consistent capsulorhexis.

In addition, TLP may prove to be useful for outcomes analysis utilizing a different paradigm. New formulas based on predicted TLP may help improve refractive accuracy. For comparison, instead of a potential 280- to 400-µm lens position prediction error, comparable to approximately 0.4 D of refraction error, objective measurement will likely achieve an error in the order of approximately 50 µm.

We are currently studying a ray trace method, as well as a radial basis function model (similar to that recently proposed by Dr. Hill), using this data. However, even with our current, more-basic algorithm, we have demonstrated that we can obtain better predictive results than more commonly used methods (Figure 3). We hope this work will ultimately add to the accuracy and consistency of postoperative refractive outcomes and continue to improve the lives of our patients.
Advancing astigmatic keratotomy

by George O. Waring IV, MD, FACS

Emerging that show LACS may be superior in terms of safety and predictability in achieving target outcomes.

Femtosecond lasers offer a number of potential benefits, including image guidance, femtosecond-enabled corneal incisions, capsulotomy, and fragmentation. A major benefit is the ability to perform femtosecond-assisted astigmatic incisions.

**Femtosecond laser-assisted astigmatic keratotomy**

In our practice, femtosecond laser technology has allowed us to expand the range of candidates for astigmatic correction, as well as candidates for multifocal intraocular lenses (IOLs).

Villegas et al. used adaptive optics to study the minimum amount of perceptible astigmatism that impacts visual acuity. They found that 0.3 D was visually perceptible. We feel that precise and reproducible laser incision architecture gives us the confidence to treat not only higher but lower degrees of astigmatism (Figure 1).

We anticipate continued improvements and innovations. Clinicians such as Dr. Eric Donnenfeld and Dr. Julian Stevens have developed femtosecond limbal relaxing incision (LRI) nomograms, and more are in development.

When creating an astigmatic incision with the Catalys Precision Laser System (Abbott Medical Optics, Abbott Park, Ill.) it takes only seconds, and we have full control in terms of the optical zone, depth, and other characteristics.

**Case report**

A 76-year-old woman presented to our clinic complaining of blurry distance vision, requesting an enhancement. She previously had cataract surgery in both eyes with monovision and a history of previous hyperopic LASIK before cataract surgery emerging that show LACS may be superior in terms of safety and predictability in achieving target outcomes.

Dr. Waring is director of refractive surgery and assistant professor of ophthalmology, Medical University of South Carolina, Storm Eye Institute, Charleston; medical director of Magill Vision Center, Mt. Pleasant; and adjunct assistant professor of bioengineering, College of Engineering and Science, Clemson University, Clemson, S.C.

**Astigmatic correction is a key benefit of femtosecond technology**

Refractive laser-assisted cataract surgery (LACS) has been shown to be safe and effective. Its superiority in comparison with manual techniques has been debated, but more and more data are emerging that show LACS may be superior in terms of safety and predictability in achieving target outcomes.

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Next-generation lens extraction: Customizing phacoemulsification in LACS

by Tal Raviv, MD

Dr. Raviv is clinical associate professor of ophthalmology at Icahn School of Medicine at Mount Sinai, New York, and is founder and medical director of the Eye Center of New York.

Laser fragmentation options and dual pumps provide flexibility for each case

Research has demonstrated that lens fragmentation with the femtosecond laser provides measurable benefits in reduced phacoemulsification time, endothelial cell loss, and postoperative inflammation.1–3

With the Catalys Precision Laser System (Abbott Medical Optics, Abbott Park, Ill.) in addition to creating corneal incisions and capsulotomy, we can segment and soften the cataractous nucleus. The segmentation option enables surgeons to split the lens into large quadrants or sextants, and fragmentation patterns allow surgeons to soften the lens to almost a slurry by adjusting the grid spacing.

Relying on these features, we can customize phacoemulsification for each lens.

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surgery. On examination, she had moderate dry eye with approximately 1.0 D against-the-rule residual astigmatism in her dominant eye and a spherical equivalent of near plano.

To minimize further impact on her dry eye, we wanted to consider options other than an excimer enhancement. After ocular surface optimization, we elected to use the Catalys to perform astigmatic incisions.

In this case, we programmed a paired astigmatic keratotomy of 80% with an expanded optical zone of 10.5 mm to keep the astigmatic incisions outside of the flap and inside the limbus. Our normal optical zone is set for 9.0 mm. Afterward, we simply opened the astigmatic incisions at the slit lamp.

Her preoperative tomography demonstrated 1.0 D of against-the-rule astigmatism. After her femtosecond laser-assisted astigmatic keratotomy (FLAAK), her tomographic astigmatism was reduced to 0.2 D, with a refractive result of plano and resolution of her symptoms. Qualitative analysis here is important. Historically with manual astigmatic incisional surgery, I would observe decreased tomographic astigmatism, but not typically full tomographic resolution. I observe this much more frequently with femtosecond laser astigmatic incisions, and I believe this is why we are seeing improvement in our refractive outcomes (Figure 2).

Conclusion

Astigmatic keratotomy is a key benefit of femtosecond lasers. We expect technology advances, including new nomograms that ideally will be validated. In the near future, we will have integrated guidance devices to guide our laser-created incisions.

Femtosecond astigmatic LRIs allow surgeons to expand the range of candidates for upper and lower limits of astigmatic correction and, as a result, candidates for multifocal IOLs. We feel that femtosecond-enabled astigmatic incisions are a key factor in the improved refractive outcomes we are observing with femtosecond laser IOL surgery. The future is bright, and I am excited to see just how good our outcomes will be with further advances such as intraoperative guidance for femtosecond laser astigmatic incisions.

Reference


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Tailored treatment
When I examine a patient at the slit lamp, I determine whether the lens is dense or soft. If the lens is dense, I plan for 4-quadrant segmentation and softening, typically choosing a 350-µm grid. If the lens is very soft, I soften the lens using a larger 600-µm grid, skip the segmentation, and use a supracapsular technique.

We sometimes encounter special situations. If the patient has a dense lens and small pupil, I skip the femtosecond capsulotomy and proceed with the lens segmentation and softening. With small pupil cases, I prefer to perform a manual capsulotomy instead of limiting myself to a tiny femto capsulotomy. Having the lens already fragmented in these dense nuclei still affords me the lens-softening benefits.

If the patient has a posterior polar cataract, I perform capsulotomy without fragmentation. A small case series showed a higher complication rate with the laser, likely due to the femtosecond-induced plasma bubbles creating pressure against the existing posterior capsule defect.4

We have been moving from ultrasound-driven lens removal to fluidics-driven lens removal, and femtosecond lens softening accelerates that trend. I use the Catalys and Whitestar Signature Phacoemulsification System (Abbott Medical Optics), which includes a dual pump, allowing me to switch pumps within each case. The peristaltic system holds large fragments at the tip (during initial “chopping” of presegmented nuclei), and the venturi pump draws small fragments to the tip (Figures 1 and 2).

With a soft lens, I proceed directly to venturi fluidics and perform a femto-flip. It’s a very efficient way to remove the lens safely. I have found that by laser fragmenting the cataracts (lens softening), even medium density lenses can be femto-flipped easily and safely while maintaining corneal clarity. This is especially true with the followability of venturi fluidics.

Conclusion
Using the femtosecond laser and a dual pump phacoemulsification unit, we can tailor lens fragmentation to the specific cataract density and type. I plan whether to segment, soften, or perform both, and then I chose whether to use venturi fluidics alone or a combination of peristaltic and venturi with the Ellips FX Technology (Abbott Medical Optics). This provides a customized solution for all cataract types. With these two technologies, I believe we have achieved the highest level of safety.

References

Figure 2. Fluidics settings by intraoperative step

"Using the femtosecond laser and a dual pump phacoemulsification unit, we can tailor lens fragmentation to the specific cataract density and type."
Technology innovation: Examining the tipping point

by Gary J.L. Foster, MD

Dr. Foster is a cataract and laser eye surgeon in Fort Collins, Colo.

Timing of LACS adoption has sweeping implications

In the 2014 ASCRS Clinical Survey, 92% of respondents reported that they will become involved in laser-assisted cataract surgery (LACS) within the next 10 years. We all play a role in determining when this tipping point will occur. Each surgeon’s decision to adopt LACS affects his or her partners and colleagues—but also the entire community of ophthalmologists.

Learning from experience

When 15-Hz and 30-Hz femtosecond lasers were introduced for LASIK, we preferred to continue using the mechanical microkeratome. We told our patients that it provided superior or equal results. When the 60-Hz laser later made its debut, we held our ground. We adopted a defensive strategy in justifying our choice to patients, even though the femtosecond laser was being used for most cases within the profession.

We ultimately adopted the femtosecond laser about the time the IFS system (Abbott Medical Optics, Abbott Park, Ill.) was introduced. However, it was so late in the adoption pattern that we could not raise our prices to cover our extra time, risk, or technology investment. Although the financial outlay was lower because used machines were available, we lost significant reputation with our referral sources and patients.

In contrast, early adopters—and their patients—reaped the benefits. These clinicians gained significant marketing, reputational, and financial advantages.

When LACS emerged, we were faced with a new tipping point and what felt like almost the same decision. We were grateful we had been given a second chance in our practice lifetime to make a better decision with technology adoption. This time we chose to get involved early.

Consequently, I have been able to offer the benefits of LACS to many more of my patients than if I had waited. We also received significant marketing, financial, and reputational advantages in our community, where we have been rewarded for our time and investment in improving the lives of our patients.

Examining the impact

When choosing to implement new technology, it is important for surgeons to look at the tipping point for their clinics. Before we began offering LACS, I sat down with my staff and shared the documentation demonstrating its advantages. At the end of that discussion, we were a different organization because we were all on board.

In addition, we must consider the tipping point of patient adoption. Patients may be hesitant to pay the additional cost. At first, I only told my patients that I preferred to use laser technology, and approximately 10–25% chose this option. When the lasers improved to the point where I could tell patients that the laser was more precise and I preferred to use it, they were less intimidated by the fee. Approximately half chose the femtosecond procedure.

With ongoing laser improvements, I hope to someday be able to assure patients that it is both more precise and safer than mechanical methods. However, we have not reached that point yet in my opinion. The moment that happens, another 25% will elect LACS.

As an industry, we have not completely tipped yet but we are very close. Clinicians can still become involved and gain the benefits of being early adopters. The risk of entry has decreased. Clinicians now can rely on proven technologies and platforms and opt for mobile and used options. If more surgeons commit to LACS, it signals to the industry that it should invest more in the technology to improve patient benefits. Conversely, the tipping point could shift faster if industry would invest more in these technologies at an earlier stage to increase the benefits of LACS compared with standard cataract removal, changing the fulcrum.

Conclusion

The ideal model would be that cataract surgeons and industry would all lean in at the same time and commit further to adopt and advance this technology. This would provide the maximum benefit to our patients and our profession in the long run.
Before adopting new technology, surgeons need to lay groundwork with staff and patients

At the Centre for Sight Group of Eye Hospitals, we were early adopters of refractive laser-assisted cataract surgery (LACS). When we implemented this technology, we meticulously prepared our practice and patients—essential steps that are key to success.

Preparing the foundation

When incorporating a new technology, the price must be right. If a premium procedure is underpriced, it will devalue it and diminish returns. However, if it is overpriced, the fee will be restrictive.

Before we launched this procedure, we offered presentations to our staff that explained the technology. Femtosecond cataract surgery became our buzzword as we spread the word to all of our staff, from the front office to physicians in all of our departments.

We identified core team members, including physicians, optometrists, and counselors, developing a network of femto cataract experts.

Training continued after installation of the technology, including the surgical team, staff, and counselors. When implementing the procedure, the team examined patient flow.

Spreading the word

When LACS is promoted, it must be differentiated strongly from standard cataract surgery performed by others. Our staff informs patients that this new blade-free technology makes surgery simpler, reduces phaco time, and may increase accuracy. We also can correct preexisting astigmatism, and recovery will be faster.

We begin spreading the word at reception. All patients receive an informational brochure regarding LACS when they register, regardless of their age.

Patients should continue to receive these messages in the waiting area via an interactive computer, signboard, or other means.

Our optometrists discuss LACS with patients, and physicians offer it as the default cataract procedure.

Subsequently, our senior consultant confirms the patient’s interest, and the counselor discusses the pros and cons and cost-benefit ratio of LACS, schedules the patient for an appointment, and follows up with the patient.

To market the procedure externally, clinicians can advertise in newspapers and magazines, provide informational lectures, and network with general practitioners, creating brand awareness about this advanced technology available at their premium center. An online presence, employing social media, is also necessary.

Tricks of the trade

Our practice now performs 80 or 90 LACS cases per month, and all staff members play a role. We offer them team rewards as motivation when a record number of procedures is reached in a month. It is important to set targets and track the number of procedures performed each month.

Practices should remember that marketing generates leads, but not cases. We track our leads and determine what works. When potential candidates contact us about the procedure, staff members respond promptly and schedule appointments. A dedicated refractive counselor connects with patients and continues to follow up.

LACS must be treated as a premium procedure. Patients should be treated exclusively and have a quicker and more efficient preoperative, intraoperative, and postoperative experience. They desire premium services and are willing to make the investment if they believe the results are worthwhile.

Conclusion

To achieve success in offering LACS, surgeons must believe in it and share their enthusiasm with their team. Patients will believe in this technology only if the entire surgical team believes in it.

Surgeons must prepare to lead in this process, choosing technology that works. The power of the laser will help convince patients. With these results, the technology potentially will pay for itself.