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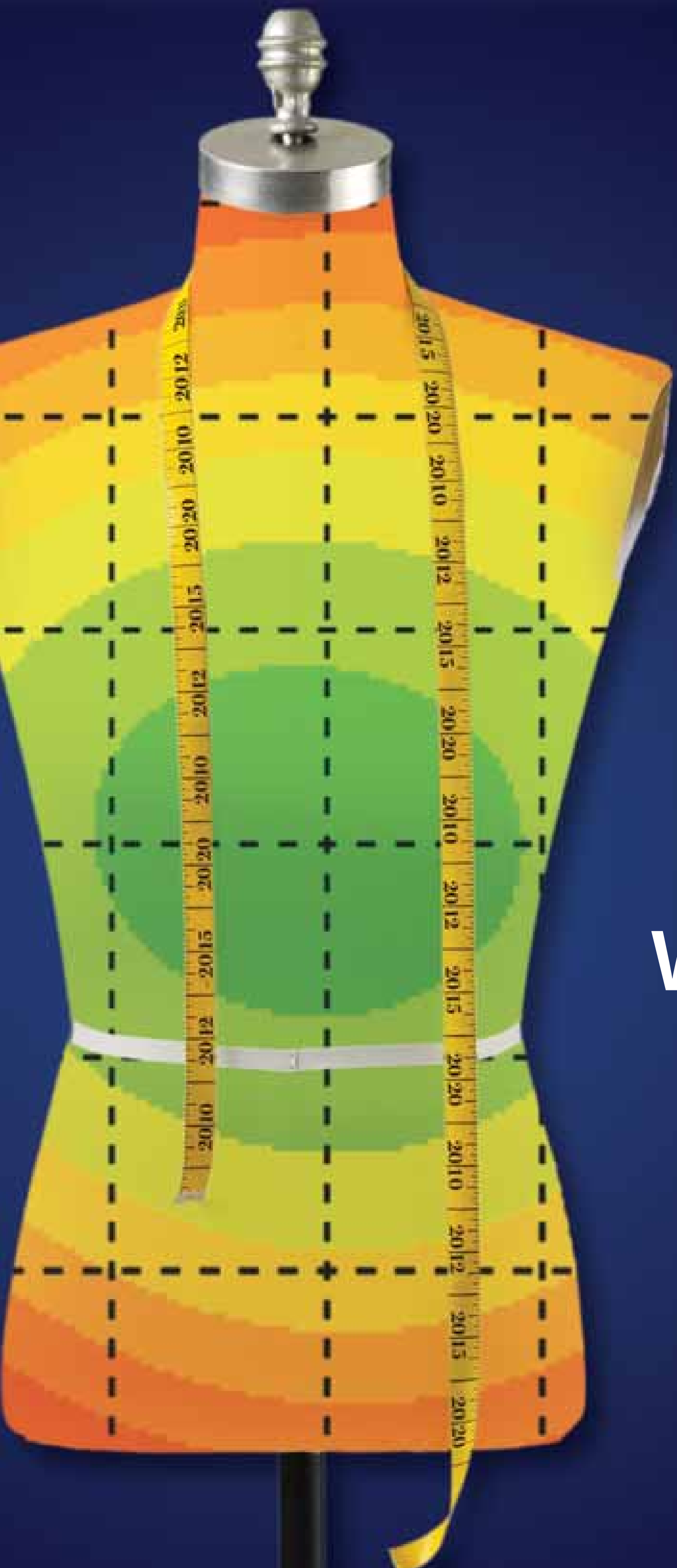

Tailoring Patient Outcomes Beyond 20/20 With Advanced Wavefront Technology

Featuring:

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Christopher L. Blanton, MD

Stephen Coleman, MD

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Customizing Laser Vision Correction

Technology's role in tailoring refractive correction and advancing patient outcomes.

BY ERIC D. DONNENFELD, MD

LASIK surgery in the past entailed cutting a flap and delivering a generic ablation treatment to every eye. Now, conventional or even wavefront-optimized excimer treatments no longer provide the best quality of care for our patients. Each eye has different visual needs, and the only way to meet consumer demand for best-quality outcomes is to truly customize the ablation to the individual's particular sphere, cylinder, and higher-order aberrations and also customize the LASIK flap so that it will minimize higher-order aberrations, heal effectively with minimal risk of movement, and reduce the risk of dry eye.

The iLASIK suite (Abbott Medical Optics Inc., Santa Ana, CA) is a comprehensive wavefront-guided laser vision correction system that allows the surgeon to fully customize every aspect of the refractive surgical procedure. Customization, in the form of targeted, wavefront-guided ablations and tailored flap shapes and corneal cuts, optimizes the eye's health, safety, and quality of vision. This advanced refractive procedure gives patients their best chance for achieving a premium outcome.

MANIFEST, WAVEFRONT, AND TOPOGRAPHY

Manifest-, wavefront-, and topography-guided treatments are all modalities that can or may soon be used to guide excimer laser ablations. Wavefront-guided treatments use an aberrometer to tailor the correction to the individual eye's unique optical pathway to address aberrations present throughout its visual system (Figure 1). To date, we have seen incredible results with wavefront-guided, customized corrections—improved quality of vision, results beyond 20/20, sharper contrast sensitivity, etc. Manifest-guided treatments, although capable of addressing lower-order terms, have come up short in terms of quality of vision and reducing higher-order aberrations, whether applied through a conventional or wavefront-optimized approach. Topography-guided ablations have long been discussed as an optimal way to guide laser vision correction. Although topography-guided treatments can effectively address topographical aberrations present in the cornea, they neglect to incorporate aberrations present behind the cornea.

"Customization, in the form of targeted, wavefront-guided ablations and tailored flap shapes and corneal cuts, optimizes the eye's health, safety, and quality of vision."

IRIS REGISTRATION

One of the most important aspects of a customized LASIK system is the ability to transfer the preoperative aberrometry to the eye during the surgery so that the treatment is applied to the intended area of the cornea. Technologies like AMO's Iris Registration (IR) play a key role in matching the ablation to the wavefront profile. The IR tracker identifies the preoperative marks the surgeon makes during aberrometry and then recognizes them again at the time of the ablation so that the laser may compensate for pupil centroid shift and cyclotorsion. Studies have shown that significant pupil centroid shift occurs when patients move from an area of low illumination to an area of high illumination, such as when they are positioned under an operating microscope.[1] Additional studies have confirmed that the best way to give refractive surgical patients better visual acuity after surgery without glasses than they had preoperatively with spectacle correction is by performing iris registration with a customized wavefront-guided laser system.[2] The majority of my patients see 20/15 after iLASIK surgery, which is a net gain of one line of vision. Exceeding patients' expectations in this way is what grows a LASIK practice.

FLAP CUSTOMIZATION

I greatly appreciate the ability to customize LASIK flaps with the iFS laser. This laser enables the surgeon to change a flap's diameter in 1-mm intervals, alter the length of the flap's hinge, create oval flaps to accommodate an oval ablation, and make thin planar flaps and reverse side cuts

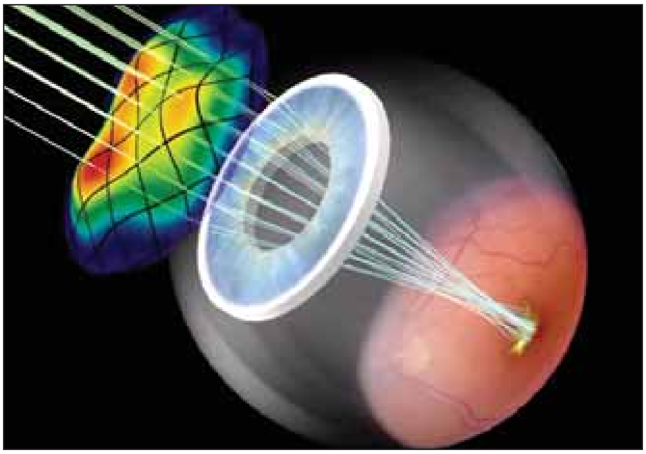

Figure 1. Wavefront-guided treatments address aberrations present throughout the entire optical pathway.

that are less likely to dislocate[3] and reduce patients' risk of dry eye after LASIK. Dry eye is the most common complaint patients have after LASIK,[4] and these flap cuts have been shown to better preserve the quality of the tear film and reduce the incidence of postoperative dry eye.[5] Furthermore, the iFS laser will not allow incomplete flaps if the applanator loses suction, which saves the surgeon from worrying about not being able to complete the flap in the event of a complication. I have been able to complete every flap I have made with the iFS laser, which is not the case with other femtosecond technologies.

In the following pages, experienced refractive surgeons share their similar experiences with customized laser vision correction. I believe the iLASIK suite represents the safest, most effective form of laser vision correction ophthalmology has to date and that it provides a quality outcome that exceeds patients' expectations on a regular basis. As you read the following articles, I invite you to decide for yourself. ●

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1. Donnenfeld E. The pupil is a moving target: centration, repeatability, and registration. *J Refract Surg.* 2004;20(5):S593-596.
2. Schallhorn SC, Tanzer DJ, Kaupp SE, et al. Comparison of night driving performance after wavefront-guided and conventional LASIK for moderate myopia. *Ophthalmology*. 2009;116(4):702-709.
3. Knorz MC, Vossmerbaeumer U. Comparison of flap adhesion strength using the Amadeus microkeratome and the IntraLase iFS femtosecond laser in rabbits. *J Refract Surg*. 2008;24(9):875-878.
4. De Paiva CS, Chen Z, Koch DD, et al. The incidence and risk factors for developing dry eye after myopic LASIK. *Am J Ophthalmol*. 2006;141(3):438-445.
5. Fiore J, Donnenfeld ED, Solomon KD, Knorz MC. Evaluation of corneal sensation and signs and symptoms of dry eye in eyes receiving 30-degree side cut or a 140-degree reverse side cut in bilateral femtosecond flap formation LASIK. Paper presented at: The ASCRS Annual Meeting; April 2010; Boston, MA.

Contents

The Benefits of Customizable Flap Creation

Platform control and flexibility directly affect patient outcomes and procedural safety.

BY PERRY S. BINDER, MS, MD

The primary benefit of the iFS femtosecond laser (Abbott Medical Optics Inc., Santa Ana, CA) is that it provides the surgeon with greater flexibility in his corneal refractive surgical planning. Through a combination of speed, customizable ablation shapes and angles, and the reliability of programmable depths, the iFS laser offers ophthalmologists unprecedented options when creating LASIK flaps as well as in performing numerous anterior segment procedures.

SPEED

The iFS laser's 150-kHz platform lets the surgeon decide how far apart to place each application spot as well as how far to place each line in the laser's raster pattern. This control helps facilitate flap lift and improves the quality of the bed. If the surgeon's goal is to create the flap as quickly as possible, then the laser can be set to a spot and line separation of 9 µm X 9 µm in order to create a 9-mm flap in 8 seconds.

For other corneal procedures, speed can also be an asset. For example, when making intracorneal channels for corneal rings or when performing IntraLase-enabled keratoplasty (IEK), the high-speed laser minimizes the risk of the recipient or donor eye's changing its orientation and interrupting the procedure.

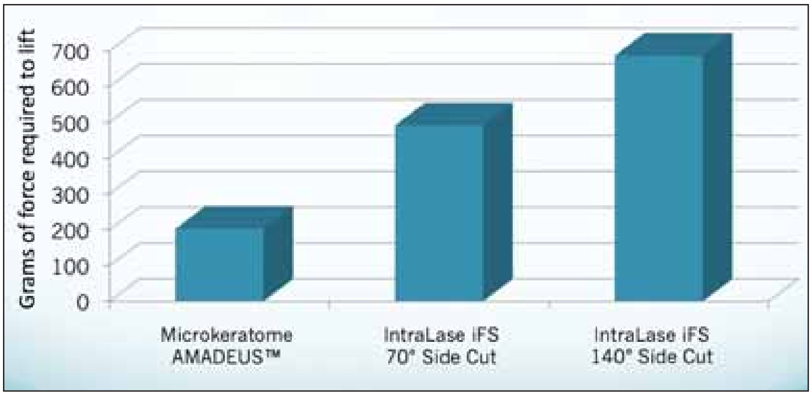

Figure 1. Flap tensile strengths comparison in New Zealand white rabbits. A peak force comparison between mechanical- and femtosecond-created flaps revealed improved flap tensile strength with femtosecond-made flaps that have more oblique side-cut angles.[1] (Data adapted from Knorz MC, Vosssmerbaueumer U. Comparison of flap adhesion strength using the Amadeus microkeratome and Intralase femtosecond laser in rabbits. *J Refract Surg*. 2009;24:875-878.)

> "By choosing an oval shape, the surgeon can maintain the same hinge angle or even increase it without crossing the ablation's path."

SIDE-CUT ANGLE CUSTOMIZATION

The iFS femtosecond laser enables the surgeon to change the side-cut angle from an acute 30° angle to a 150° bevel-in angle in order to enhance the flap's stability (Figure 1). This side cut is useful in patients whose occupations put them at risk for trauma, such as a correctional officer, military personnel, or perhaps a boxer.[1] An inverted bevel flap also has better wound adaptation.

When surgeons use acute-angle flaps of 30° to 70°, a small gape will remain between the flap's edge and the corneal bed in the immediate postoperative period (±1 hour). This effect is due to contraction of the collagen in the flap. Such gapes generally take a day to seal, time enough for debris or epithelial cells to enter the interface. With an inverted bevel angle of 120° to 150° (Figure 2), that gape disappears within an hour, which makes the patient more comfortable and restores the flap's stability more quickly. This inverted bevel angle creates a stronger wound that may also decrease the risk of ectasia, as supported by evidence that shows that suturing LASIK flaps can help restore the cornea to its normal curvature.[2]

FLAP CUSTOMIZATION

Oval Shape

The iFS laser enables the surgeon to change the shape of a flap from round to a 12% oval, in which the vertical meridian is 12% shorter than the horizontal meridian. This shape is beneficial in hyperopic ablations for preventing the excimer laser from ablating the hinge. With a circular flap, the surgeon would have to decrease the hinge's arc length from a width of 45° to 30° in order to move the hinge away from the path of the ablation. The tradeoff is that a hinge with a shorter width can decrease the strength and stability of the flap. By choosing an oval shape, the surgeon can maintain the same hinge angle or even increase it without crossing the ablation's path. The oval flap shape can be made with either a nasal or a temporal hinge. Long-time contact lens wearers who have significant blood vessels in the cornea's vertical meridian may also benefit from this option, because the surgeon can avoid cutting across those vessels and inducing bleeding in the interface.

There is some preliminary anecdotal evidence that creating an oval flap severs fewer nerves and corneal lamellae. Preserving these tissues would contribute to stronger corneal biomechanics and reduce the symptoms of dry eye as well as the risk of corneal ectasia.

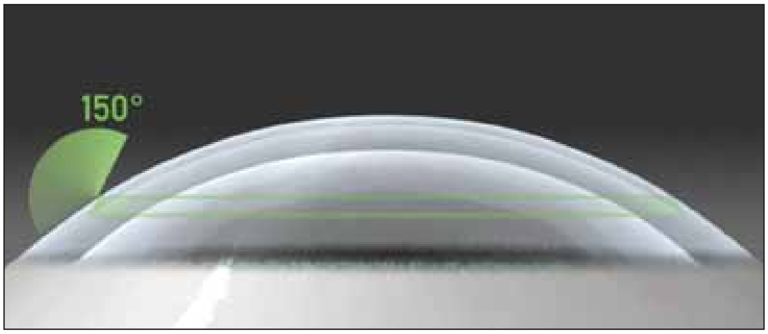

Figure 2. A bevel-in side cut created with the iFS laser.

Side-Cut–Only Option

A unique feature available on the iFS and IntraLase FS lasers is a side-cut–only option. This option is advantageous if suction loss causes an incomplete flap as the original side cut is underway. It is also useful if the surgeon must relift a flap to perform an enhancement. Rather than trying to relift or recut a flap, the surgeon can create a side cut through the previous interface by decreasing the attempted diameter by approximately 0.5 mm without worrying about crossing incisions.

Diameter and Depth

Mechanical microkeratomes as well as femtosecond lasers with handpieces similar to those of mechanical microkeratomes are sensitive to preoperative corneal curvature and thickness. A steep cornea results in a flap and hinge that are larger than planned, and a thick cornea produces a thicker-than-planned flap. The IntraLase lasers (60 kHz and iFS 150 kHz) are not sensitive to preoperative curvature and thickness, so the flap diameter and depth that the surgeon programs into the computer will be within the targeted range.

Considerations

There are no disadvantages to the oval flap shape or bevel-in side cut per se. However, with the inverted-bevel side cut, surgeons must remember that increasing the angle of the cut beyond 90° lengthens the time the laser needs to create the cut. It may take 5 to 8 seconds longer to make an inverted bevel-in side cut than a 70º angle. As the angle becomes more obtuse, the surface of the inverted side cut becomes smaller in diameter than the base of the flap. Therefore, the diameter of the excimer laser ablation will be affected by the degree of the angle. For instance, for a planned 9-mm flap and a planned side cut of 90° or less, the laser will create a 9-mm base. For a planned 150° bevel-in side cut, the diameter decreases to 8.4 mm. The surgeon must realize that his ablation will be smaller than that so he does not ablate the edge of the flap.

CONCLUSIONS

Evolving postoperative visual demands require responsive, customizable technology. Whatever emphasis the surgeon needs in a particular case—be it speed, depth control, or a particular angle—the iFS laser responds adeptly. This laser gives refractive surgeons unparalleled control and customization over LASIK flaps and corneal incisions. I find the laser a pleasure to use, and I am very pleased with the outcomes it gives my patients. ●

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1. Knorz MC, Vosssmerbaueumer U. Comparison of flap adhesion strength using the Amadeus microkeratome and Intralase femtosecond laser in rabbits. *J Refract Surg*. 2009;24:875-878.

2. Kaufman S. Abdelkaer A. Esquenazi S, et al. Healing process at the flap edge in its influence in the development of corneal ectasia after LASIK. *Curr Eye Res.* 2006;31:903-908.

Aberrometry's Role in LASIK

The quantifiable benefits of measuring and correcting higher-order aberrations.

BY STEPHEN COLEMAN, MD

Nearly 10 years ago, the first International Wavefront Congress took place in Santa Fe, New Mexico, marking the beginning of today's ongoing collaboration between optical scientists and ophthalmologists worldwide. Seven years ago this spring, the FDA granted VISX (now Abbott Medical Optics Inc., Santa Ana, CA) an approval for wavefront-guided, customized LASIK. This approval ushered in one of the most significant changes in the field of laser vision correction to date. Since then, the customized laser vision correction procedure has become widely accepted as a safer and more efficacious LASIK modality than conventional treatments.

Figure 1. The wavefront refraction can be used as a starting point to help identify the manifest refraction.

THE VALUE OF WAVEFRONT ABERROMETRY

Wavefront technology has improved our understanding of postsurgical optical complaints, such as nighttime glare and halos, by connecting these phenomena to corneal irregularities such as spherical aberration. A WaveScan analyzer (Abbott Medical Optics Inc.) can measure and quantify the fact that customized LASIK induces less positive spherical aberration than conventional excimer treatments.[1]

Capturing accurate wavefront data preoperatively is the cornerstone of achieving excellent, consistent postoperative refractive results. My staff and I begin evaluating prospective patients by performing a WaveScan. The wealth of information we obtain, such as the size of the pupil, a wavefront prescription measured in increments of 0.01 DS, and data about the eye's higher-order aberrations, allows us to tailor the refractive treatment to the individual eye. The WaveScan refraction can also be a good starting point for obtaining and refining the patient's manifest refraction (Figure 1).

WAVEFRONT CAPTURES FOR ROUTINE SURGERY

The three essential components to obtaining consistent, high-quality wavefront measurements are (1) taking the measurements in a dark room to maximize the pupil's size, (2) ensuring the patient's head is in the proper position (a comfortable, straightforward posture with no tilt), and (3) a homogeneous tear film, accomplished by having a patient blink right before the capture. In addition, my staff and I avoid excessive accommodation and interference from the eyelids.

WAVEFRONT CAPTURES FOR ENHANCEMENTS

For enhancement procedures, the protocol for capturing wavefront data remains the same, but the interpretation of these data can be more challenging. It is important to consider two points before performing a postoperative enhancement. First, it is unusual for a patient to complain about blurred vision or glare in the absence of residual refractive error. These symptoms are almost always associated with some degree of postoperative myopia, hyperopia, or astigmatism, with or without dry eye. Treating the refractive error or dry eye will almost always improve the patient's symptoms. Correcting postoperative higher-order aberrations with a wavefront-guided ablation increases the likelihood of fully satisfying the patient's visual goals.

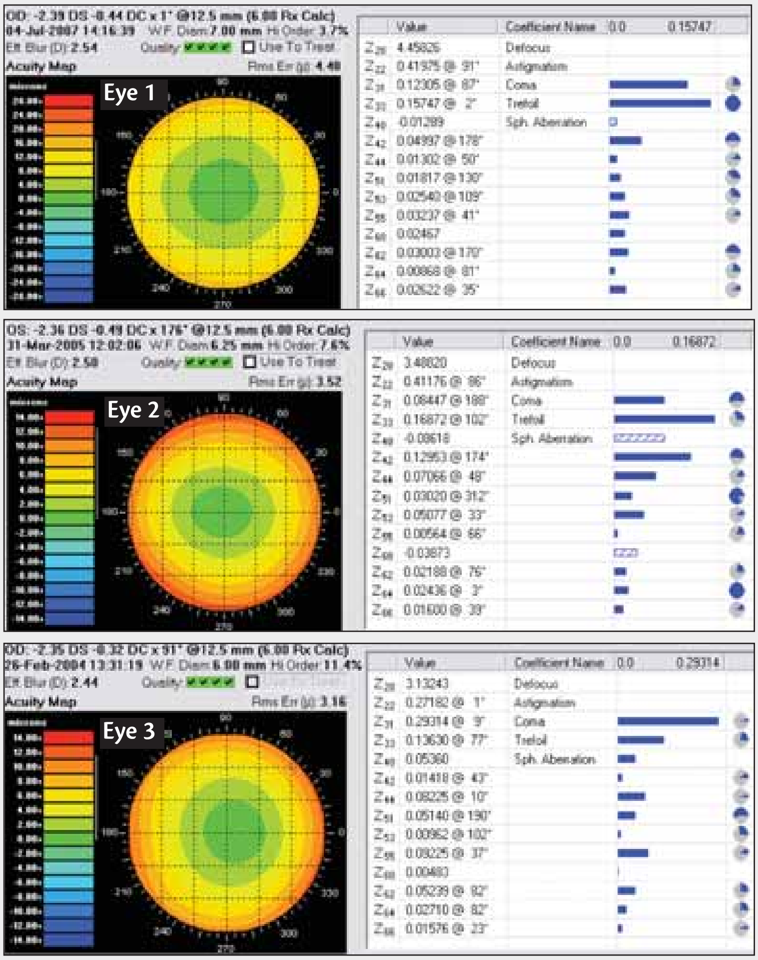
Second, we must take care when examining the correlation between the attempted dioptric correction and the total calculated ablation depth indicated on the treatment screen. This relationship should be close to 18 µm per diopter. In instances where the treatment is much deeper due to significant higher-order aberrations, adjusting the spherical component downward (in cases of myopia) can sufficiently reduce the depth of the ablation and avoid a potential overcorrection.

How a wavefront-guided platform identifies and treats aberrations most accurately.

By Christopher L. Blanton, MD

All three of the eyes in the WaveScans pictured show the same approximate refractive error (-2.50 D sphere with about -0.5 D of cylinder). Measuring these eyes at the phoropter would generate essentially the same treatment under a wavefront-optimized protocol. However, these eyes differ on many levels.

Each eye has a different contribution from its overall higher-order aberrations (3.7, 7.6, and 11.4%, respectively). Thus, each eye's optical problem has a different source. A wavefront-guided procedure would treat each of these eyes differently, expending pulses to correct the very specific aberrations. A wavefront-optimized excimer treatment would correct the refractive error with a population average for the spherical aberration. I liken this approach to buying a suit at a store that only stocks one size.



HIGHER-ORDER ABERRATIONS ARE FAIRLY COMMON

Some would have us believe that only 6% of the refractive patient population (those who have higher-order aberration values of more than 3 µm) needs wavefront-guided correction. However, several studies have shown that higher-order aberrations are much more common. Binder et al[1] demonstrated that 46.8% of eyes have more than 3 µm of higher-order aberrations, and Holladay[2] showed that 73% of the general population have higher-order aberrations of 2.1 µm or greater. Obviously, in order to detect and treat these aberrations, we need a sensitive aberrometer. If we do not start with a good ruler, we will not be able to detect these errors in patients' eyes.

The maps in Figures 1 and 2 show eyes with negative spherical aberration. Wavefront-optimized treatments assume a positive spherical aberration (the population norm), which will actually increase the higher-order aberrations in these eyes, potentially leaving these patients with persistent visual symptoms. The eye in Figure 3 has much more coma and much less trefoil than the other two eyes.

Treating these eyes without a wavefront-guided correction would fail to address their measured optical problems.

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1. Binder P. Distribution of higher order aberrations in patients undergoing LASIK. Poster presented at: The Annual ARVO meeting; May 3, 2009; Fort Lauderdale, FL.
2. Holladay JT. Wavefront-guided ablation and wavefront-optimized ablation. Paper presented at: The World Ophthalmology Congress; June 28, 2008; Hong Kong, China.

IRIS REGISTRATION AND THE PUPIL

An additional advantage to performing true wavefront-guided treatments (and perhaps equally as important as addressing higher-order aberrations) is the fact that Iris Registration (IR) technology compensates for intraoperative pupil centroid shift and cyclotorsion. IR registers the ablation profile on the cornea based on the WaveScan capture. This registration technology offers an additional level of accuracy and is a key element to achieving high-quality refractive outcomes.

FUTURE APPLICATIONS

Although topography-guided treatments on their own do not address aberrations throughout the entire optical pathway, the future holds great promise for combining customized wavefront-guided LASIK with features from earlier investigational excimer applications guided by topography. Imagine the implications of a single instrument that is capable of producing a corneal ablation profile generated from both wavefront and topographic data. Such a device will offer a significant step forward in both routine refractive surgery and therapeutic modalities. ●

Stephen Coleman, MD, is Director of Coleman Vision in Albuquerque. He acknowledged no financial interest in any product or company mentioned herein. Dr. Coleman may be reached at (505) 821-8880; stephen@colemanvision.com.

1. Schallhorn SC. Comparing optimized vs. wavefront-guided results. *EyeWorld*. 2005;9(suppl):S10.

Building a Practice Around Customization

How I use technology to maximize my outcomes and differentiate my practice.

BY JAMES C. LODEN, MD

My first excimer laser was an Autonomous, which became the LadarVision4000 with the CustomCornea upgrade (Alcon Laboratories, Inc., Fort Worth, TX). My practice became the first ophthalmic center in Tennessee to offer customized LASIK, and my staff and I marketed this fact heavily, both commercially and to our optometric network. Slowly, we gained name-brand recognition and became associated with providing customized LASIK.

INTEGRATING FEMTOSECOND TECHNOLOGY

The next step was to upgrade our laser platform to integrate femtosecond technology. In November 2005, we installed an IntraLase FS (30 kHz) laser, which we upgraded to an IntraLase FS (60 kHz) laser the following spring. When VISX launched its Iris Registration (IR) technology and rolled out the STAR S4 IR laser, we decided to switch platfoms. When we opened a second center across town in February 2009, we evaluated other systems, such as the WaveLight Allegretto wavefront-optimized excimer laser (Alcon Laboratories, Inc.). It had a lower click cost than the STAR S4 IR laser, because it was an advanced conventional treatment, not a customized ablation profile. However, we did not want to abandon the customized LASIK marketing message we had become known for over the years.

We also tried the Femto LDV femtosecond laser (Ziemer Group, Port, Switzerland) before purchasing the iFS laser for our second center. We found a lot of variability with the flaps made with the Femto LDV. Also, the flap parameters were determined by the suction ring and on keratometric measurements, much like with a mechanical microkeratome. Further, this laser did not allow me the same visibility of the flap throughout the entire procedure so I could make sure the ablation was of good quality. Once the ablation is completed and you start lifting the flap, you cannot go back and recut. With the iFS laser, if I see something abnormal in the ablation pattern, I can stop the laser, reapplanate, recut the flap, and still achieve an excellent outcome and not have to reschedule the patient or switch to a PRK procedure. Thus, we chose to offer the iLASIK suite in both centers.

> "We have exceptional outcomes and patient satisfaction; 97% of our iLASIK patients achieve binocular 20/20 or better UCVA after their initial surgery."

NUMEROUS ADVANTAGES WITH THE ILASIK SUITE

We have exceptional outcomes and patient satisfaction; 97% of our iLASIK patients achieve binocular 20/20 or better UCVA after their initial surgery. Beyond these results, we found a significant marketing advantage from being connected with the iLASIK consumer Web site. My staff and I tracked 136 eyes that we treated in 2009, and we were able to attribute an increase in gross revenue directly to referrals from the iLASIK Web site.

Another advantage of our having the iLASIK technology is that we are registered with the military as a certified iLASIK center. Because of the safety profile and vision performance resulting from these technologies, aviators can now have laser vision correction surgery. The military has strict requirements about the type of LASIK procedure personnel can undergo, and we would lose these referrals if we did not have iLASIK available.

Since we bought the iFS laser 8 months ago, the most significant improvement has been the absence of complications. I never see complications like buttonhole flaps, and I have never had to reposition a flap on day 1. This gives me peace of mind. Furthermore, a low complications rate contributes to your marketing efforts. You want patients to have a 20/20 or better "wow" factor on Monday morning, so they will tell everyone about their great outcome. ●

James C. Loden, MD, is President of Loden Vision Centers in Nashville, Tennessee. He acknowledged no financial interest in the products or companies mentioned herein. Dr. Loden may be reached at (615) 859-3937; lodenmd@lodenvision.com.

The link between higher-order aberrations and quality of vision.

By Jack T. Holladay, MD, MSEE

Today's laser vision correction procedures are adept at correcting sphere and cylinder so that patients may reduce their dependence on glasses and contact lenses. Simply correcting sphere and cylinder is no longer enough for our patients. Because quality of vision is the new measure of success in the modern refractive surgical practice, we must now be able to identify and correct higher-order aberrations.

HIGHER-ORDER ABERRATIONS AND VISUAL QUALITY

Higher-order aberrations play a significant role in patients' quality of vision. Both lower-order aberrations (such as cylinder) and higher-order aberrations bend light, so that what reaches the patient's retina is unfocused and unclear. This phenomenon explains why some patients are unhappy with 20/20 UCVA.

Wavefront-guided excimer ablations enable surgeons to at least maintain and usually reduce preoperative higher-order aberrations to improve quality of vision. I conducted a study in 2008 that demonstrated that wavefront-guided ablations provide the best optical results for more than 90% of refractive patients as opposed to wavefront-optimized corrections.[1] Wavefront-guided ablations are customized to individual eyes, whereas wavefront-optimized ablations deliver a generalized correction based on the average amount of sphere and cylinder found in the general population. The goal of wavefront-optimized corrections is *not to induce* higher-order aberrations, whereas the goal of wavefront-guided ablations is to *eliminate* all higher-order aberrations. Procedures that do not take into account an individual eye's higher-order aberrations risk inducing higher-order aberrations and thereby degrading quality of vision.

"Because quality of vision is the new measure of success in the modern refractive surgical practice, we must now be able to identify and correct higher-order aberrations."

NO CHANGE WITH WAVEFRONT-OPTIMIZED TREATMENTS

I conducted a retrospective chart review of IntraLASIK procedures from Q42005 to 2006. I studied the results of 102 eyes that had undergone laser vision correction with the IntraLase FS femtosecond laser (Abbott Medical Optics Inc., Santa Ana, CA) and the WaveLight Allegretto Wave excimer laser (Alcon Laboratories, Inc., Fort Worth, TX) and 109 eyes that had undergone the procedure with the IntraLase FS laser and the VISX CustomVue wavefront-guided ablation platform (Abbott Medical Optics Inc.). The treatments ranged from +3.00 to -11.00 D, with 0 to 3.00 D of astigmatism. I measured UCVA and BSCVA at high (98%) and low (5%) contrast, and then cross-analyzed these by the modulation transfer function, a measure of optical image quality.

I found a marked reduction in higher-order aberrations in the eyes that had received wavefront-guided correction versus those that underwent wavefront-optimized treatments (Figure 1). Fewer than 60% of the wavefront-optimized eyes showed an improvement in all higher-order aberrations compared with 90% of the eyes in the wavefront-guided treatment group (unpublished data).

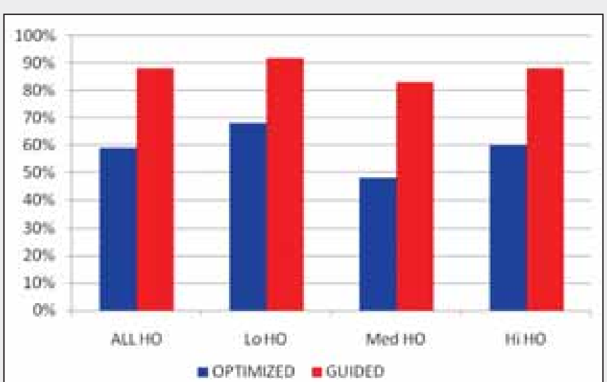

Figure 1. A greater number of patients in the wavefront-guided group showed an improvement in higher-order aberrations from pre- to postoperative levels than those in the wavefront-optimized group.

PATIENT SELECTION

There are some patients who are not currently candidates for a wavefront-guided treatment. The range of treatment for wavefront-guided ablations is +3.00 to -11.00 D with < 3.00 D of cylinder. Also, eyes with refractive IOLs cannot be measured accurately. Eyes with diffractive IOLs can sometimes be measured accurately for higher-order aberrations, but this requires a careful review of the patient's wavefront map. There is evidence that in some patients with low levels of preoperative higher-order aberrations, a wavefront-optimized procedure may provide similar results to wavefront-guided. However, wavefront-guided corrections are especially important in eyes with medium or high amounts of preoperative higher-order aberrations. The challenge is identifying these patients. Incorporating wavefront analysis into the patient work-up will identify which patients are candidates for wavefront-guided laser vision correction.

With today's technology and patients' expectations, 20/20 is no longer the acceptable measure of success. Improving the quality in addition to the quantity of vision is the new standard. To reliably enhance quality of vision, wavefront-guided laser vision correction is the best approach.

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1. Holladay JT. Wavefront-guided ablation vs wavefront-optimized ablation. Paper presented at: The World Ophthalmology Congress; June 28, 2008; Hong Kong.

Transitioning To Customized Laser Vision Correction

My experience switching to the iLASIK suite.

BY STEPHEN S. LANE, MD

In late 2009, my partners and I switched laser refractive surgery platforms to the iLASIK suite (Abbott Medical Optics Inc., Santa Ana, CA), which includes the STAR S4 IR excimer laser and the iFS femtosecond laser. The primary reason we chose this platform was our desire to incorporate femtosecond-customized LASIK flaps. Prior to purchasing this system, my partners and I were bringing a steadily increasing number of patients to a shared laser center to use the IntraLase FS laser. We especially preferred the femtosecond technology for making flaps in eyes with borderline thin corneas or borderline topography that necessitated a precise, thin flap. Also, a number of our referring physicians were aware of the advantages of femtosecond technology and began referring patients elsewhere because our practice lacked it. In addition, although we were very happy with the results from our previous laser, we wanted the capability to perform customized wavefront-guided procedures. The iLASIK suite offered us both technologies in a unique, well-proven package.

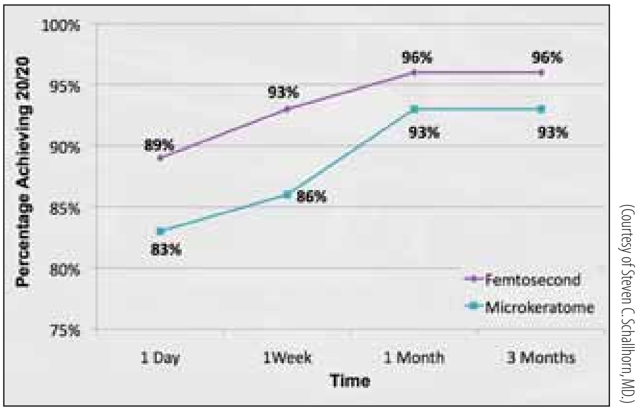

Figure 1. In a comparison study, Steve Schallhorn, MD, at Optical Express (Cumbernauld, Scotland) found that at all time points, patients in the femtosecond laser group achieved higher rates of 20/20 than those in the mechanical microkeratome group.[1]

ABERROMETRY

Conducting aberrometry with the WaveScan has made a significant difference in our surgical planning. The strategy we previously employed for wavefront-guided ablations required patients to come in an hour before their scheduled surgery so we could capture their wavefront measurements. With the iLASIK suite, we can perform patients' WaveScans on the day of their preoperative evaluation as part of their full examination. This strategy saves us from having to conduct extra testing on the surgical day that would require another technician and increase the patient's stress.

FEMTOSECOND TECHNOLOGY

I quickly realized the iFS laser's advantages, such as the ability to customize the flap's edge design and shape (I now employ a 110° bevel-out edge design that I believe improves keratectomic stability), the ability to perform keratoplasty and make channels for corneal rings or Intacts, and its rapid treatment time. The iFS laser also features ergonomic improvements—such as a compact design, a video microscope, a touch-screen magnification function, and a swiveling patient bed—that facilitate patient throughput.

EXCIMER

The STAR S4 IR excimer laser creates a precise, detailed wavefront-guided shape that has shown 20/20 or better UCVA in 91.8% of patients, and as many as 71.6% achieve 20/16 or better, in well-controlled studies.[1] The unique Iris Registration (IR) technology helps ensure proper alignment of the wavefront-guided ablation profile by compensating for both pupil centroid shift and cyclotorsional rotation. The IR and WaveScan technologies work synergistically to reduce existing higher-order aberrations without inducing new errors. Finally, the outstanding ergonomics of the S4 IR laser platform have made my transition very easy. Patients find the LASIK table comfortable; all its sides are open, so it is not confining or claustrophobic. All these features of the iLASIK platform have given my staff and me confidence that we will achieve excellent and predictable results for our patients as well as outstanding quality of vision, which I believe is the next great frontier in laser refractive surgery.

A wavefront-guided ablation treated the errors missed by a previous surgery.

By Steven J. Dell, MD

A 35-year-old graphic designer presented to my office stating that he was miserable with his vision. Two years prior, he had undergone wavefront-optimized LASIK. Although his UCVA was 20/20, he suffered debilitating glare, halos, and poor acuity. Upon examination, the patient's manifest refraction was +0.25 -0.25 X 160 OD. A WaveScan map showed significant higher-order aberrations (1).

I performed PRK on this patient with the iLASIK STAR S4 IR excimer laser (Abbott Medical Optics Inc.). He achieved 20/15 UCVA with a marked improvement in visual quality. His postoperative manifest refraction was +0.50 -0.25 X 40, and his symptoms were gone (2).

This is one example of several 20/20 unhappy patients that I have been able to correct with a wavefront-guided treatment over a conventional or wavefront-optimized treatment. Wavefront-optimized treatments are certainly an improvement over conventional treatments, but the former make blanket assumptions about spherical aberration, and they ignore asymmetrical astigmatism and coma, which are quite common. Further, I know of no reliable way to center a wavefront-optimized treatment on the true visual axis. It is great that we now have an option to help these patients. If this particular patient had received a customized wavefront-guided correction initially, he likely would not have required an enhancement. In my opinion, the true measure of any excimer laser is how well it performs when correcting the problems created by a different laser.

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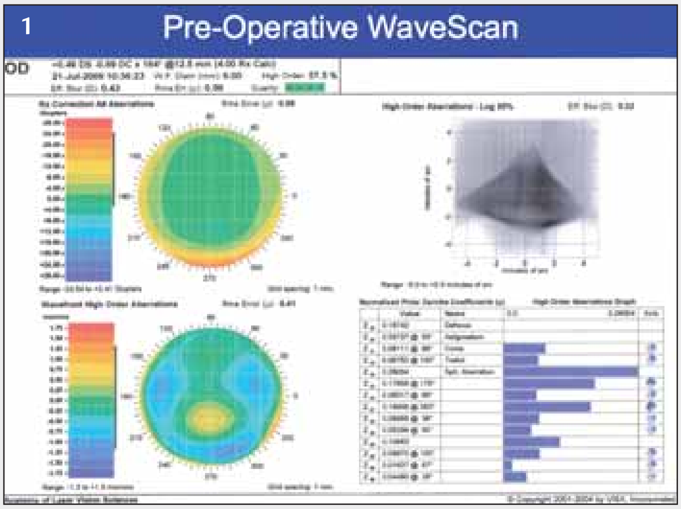

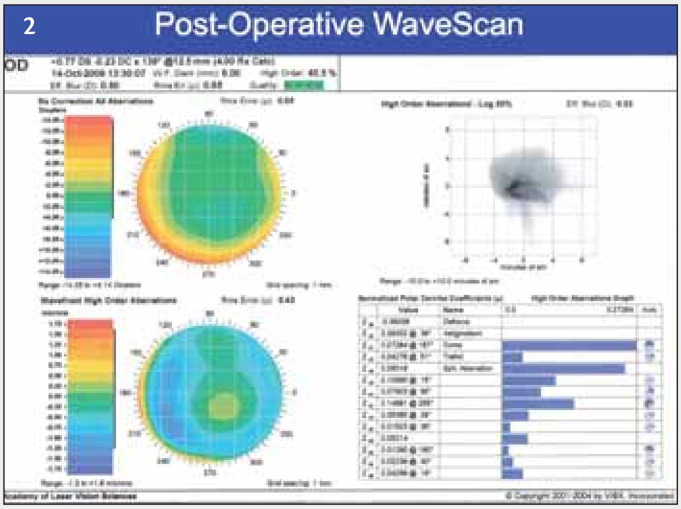

OUTCOMES

My staff and I now have 3-month outcomes data from the iLASIK suite. Although it is too early to directly compare these outcomes with those from our previous platform, anecdotally, our early iLASIK results have been excellent and on par with the high standards we have come to expect. Most importantly, the iLASIK suite has enabled my staff and me to expand the range of people we can treat. Between the femtosecond laser and the wavefront-guided treatments, we can now perform surgery on individuals with thin corneas, cylinder, high myopia, and other such challenging corrections. Prior to obtaining this technology, I was performing PRK on approximately 10% of my patients. With the iLASIK platform, my rate of PRK has dropped from 10% to 3%. We now perform customized wavefront-guided treatments on more than 95% of our refractive patients. It is an unusual eye in which we cannot capture a sound wavefront image or whose refractive error is significantly different than its WaveScan analysis.

IN CLOSING

While my experience with the iLASIK platform is too early for definitive or comparative data, I feel I am providing my patients with cutting-edge refractive technology that is user-friendly out of box, delivers excellent results, and improves quality of vision. The current generation of the WaveScan, iFS laser, and STAR S4 IR laser gives me the confidence necessary so I can reassure my patients that they will receive an optimal surgical result that will meet all our expectations. ●

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1. Schallhorn SC, Venter JA. One-month outcomes of wavefront-guided LASIK for low to moderate myopia with the VISX STAR S4 laser in 32,569 eyes. *J Refract Surg*. 2009;25 (Suppl):S634-41.

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