

# Cataract & Refractive Surgery TODAY

October 2009

# Targeting Refractive Perfection

Strategies for Moving  
Beyond 20/20

David R. Hardten, MD, interviews colleagues about how they achieve their results with the iLASIK platform.

Featuring:  
Lieutenant Colonel Charles "Chaz" Reilly, MD  
Captain (Ret.) Steven C. Schallhorn, MD  
Stephen C. Coleman, MD  
Marc G. Odrich, MD  
Edward J. Holland, MD  
Robert K. Maloney, MD

20/16

# Getting the Most Out of the iLASIK Platform

BY DAVID R. HARDTEN, MD

**D**ecades ago, refractive surgery was first performed using the radial keratotomy (RK) technique. Over the years, we have seen innovation take us from RK, to laser ablations, to LASIK flaps using mechanical microkeratomers. The most recent wave of innovation included flap creation with a femtosecond laser and the shift from refraction-based to wavefront-guided ablations.

As our technologies have advanced, so have patient screening, surgical planning, nomogram development, and postoperative care techniques. These advances have contributed to unparalleled visual acuity and quality surgical outcomes. The original expectation when refractive surgery first debuted was to consistently achieve 20/40 UCVA postoperatively. Today, physicians are regularly achieving beyond 20/20.

## PERFECTING THE LASIK FLAP

Femtosecond technology has significantly contributed toward the improvement in the results and increased safety of refractive surgery by eliminating issues related to the movement of the keratome across the eye. Less variation in the flap's thickness across the stromal bed may lessen peripheral corneal weakening, in turn reducing the risk of ectasia. There is a lower incidence of buttonholes, short flaps, epithelial defects, and flaps that are too thick. The IntraLase FS and iFS lasers (Abbott Medical Optics, Inc., Santa Ana, CA) also allow us to better center the flap on the pupil so that it more perfectly aligns with the area of laser ablation. This advanced technology with increased speed and enhanced flap customization capabilities means patients experience a faster postoperative recovery.

## QUALITY PREOPERATIVE MEASUREMENTS = QUALITY RESULTS

Excimer laser ablations have also improved significantly over the last several years. Unlike other methods, wavefront-guided ablations allow the surgeon to correct a patient's unique visual imperfections and to center the refractive ablation better on the pupil using the technique of pupil centroid shift alignment. This alignment technique enables a more ideal match between the entrance pupil and the laser ablation and has been incorporated into the eye tracking and registration abilities of the STAR S4 IR laser (Abbott Medical Optics, Inc.). Verifying that the manifest, cycloplegic, and

wavefront refractions are within a tight range improves the results in patients who undergo laser vision correction.

## STRATEGIES FOR SUCCESS

A careful preoperative assessment, advanced intraoperative technique, and attentive pre- and postoperative patient management are all very important steps in consistently achieving 20/16 visual acuity with LASIK. In the following articles, our faculty members will address the variables that play a role in today's postoperative outcomes and share their strategies for achieving high-quality results. ■

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# Refining Parameters for Patient Selection Criteria for LASIK

BY CAPTAIN (RET.) STEVEN C. SCHALLHORN, MD

**Dr. Hardten:** You recently performed an analysis of several thousands of patients treated at Optical Express (Glasgow, United Kingdom) to assess if the patient inclusion/exclusion criteria for LASIK treatments were valid. What were your findings?

**Dr. Schallhorn:** Our goal was to refine patient selection for wavefront-guided LASIK with the iLASIK platform (Abbott Medical Optics Inc., Santa Ana, CA). We analyzed the outcomes of hundreds of thousands of procedures from a robust electronic medical records system. The Optical Express medical advisor board used this analysis, as well as peer-reviewed literature and organizational guidance, to institute several changes in our inclusion and exclusion criteria for laser vision correction patients.

For example, we changed the limits on estimated postoperative keratometry for hyperopic corrections. Previously, there was a limit of 48.00 D on the estimated postoperative corneal curvature for hyperopic treatments. After analyzing hyperopic outcomes and complications in thousands of eyes, we determined that concerns about postoperative keratometry was driven by the amount of hyperopia corrected and not the value of the keratometry.

The curvature of the cornea after hyperopic LASIK depends on two factors: how steep the cornea is before surgery, and the amount of hyperopic correction. For instance, a 47.00 D cornea that had a +2.00 D correction would be estimated to be 49.00 D after surgery. In a similar fashion, a

45.00 D cornea that undergoes a +4.00 D correction would also have an estimated postoperative keratometry of 49.00 D. Although both corneas would be estimated to have a 49.00 D cornea after surgery, the difference in preoperative hyperopic correction is the important outcome factor.

We found that the visual outcome and possible side effects/complications, such as dry eye symptoms, are not dependent on the postoperative curvature of the cornea, up to 50.00 D, but rather on the amount of hyperopia corrected. As a result, we increase the suitability for hyperopic treatment if the estimated postoperative corneal curvature is up to 50.00 D.<sup>1</sup>

**Dr. Hardten:** What does this adjustment in patient selection criteria mean for you, your practice, patients, and the ophthalmic community as a whole?

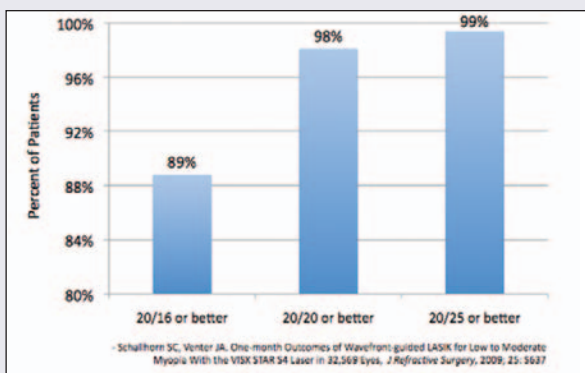
**Dr. Schallhorn:** It has allowed us to better select patients for surgery. Some of the parameters allowed us to expand our patient selection, and others have caused us to retract it. Fine-tuning patient selection criteria for LASIK is better for everyone.

**Dr. Hardten:** What are your clinical results with the iLASIK platform?

**Dr. Schallhorn:** In a word: outstanding. Most myopic patients routinely achieve 20/16 UCVA with the iLASIK platform (Figure 1).

The femtosecond laser and wavefront-guided ablations provided with iLASIK each represent a paradigm shift. Both of these core technologies have improved the safety and effectiveness of the surgery. It is important to keep in mind, however, that the real strength of this technology is a higher quality of vision. By this, I mean the clarity and sharpness of vision, contrast sensitivity, and especially vision at night.

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**Figure 1.** An analysis of the binocular UCVA of 15,035 LASIK patients shows that 89% achieved 20/16 or better outcomes postoperatively.

1. Young JJ, Schallhorn SC, Brown MC, Hettinger KA. Effect of keratometry on visual outcomes 1 month after hyperopic LASIK. *J Refract Surg*. 2009;25(Suppl):S672-S676.

# Achieving Beyond 20/20 With Advanced Technology

Dr. Reilly describes his preoperative and intraoperative procedures with the goal of superior laser vision correction outcomes.

BY LIEUTENANT COLONEL CHARLES "CHAZ" REILLY, MD

**Dr. Hardten:** What are your typical laser vision correction results?

**Dr. Reilly:** In the US Air Force, 20/20 is not only achievable, it is expected. In 97% of our cases, we can achieve 20/20 or better UCVA with laser vision correction; of these, approximately 60% of our patients gain 20/16 or better, and 30% gain 20/12 or better (Figure 1). Even more important is the quality of vision that we achieve for our patients. Wavefront-guided LASIK used with a femtosecond laser to cut the flap allows us to deliver superior low-contrast vision. We test this vision with our 5% precision vision low-contrast chart. Our best-corrected low-contrast visual acuities are double the patients' preoperative measurements, so we know that we are not only providing improved vision, but the quality of the vision our patients enjoy is also enhanced.

**Dr. Hardten:** What does your typical laser vision correction patient work-up include?

**Dr. Reilly:** Something we do differently from our civilian colleagues is that we normally keep our patients out of contact lenses for at least 1 month prior to surgery, as opposed to 2 weeks. This time out of contact lenses allows us to see the cornea without artifacts that may remain after 2 weeks. Most of my practice's procedures are wavefront-guided, so we make sure our capture technique is of high quality and that the manifest refraction and the astigmatism (cylinder) agree to within 0.50 D of the sphere of the wavefront refraction. We also ensure that there is no more than 15° of disagreement in the axis of the astigmatism between the wavefront refraction and the manifest refraction. These steps have gone a long way in helping us to achieve high-quality results.

**Dr. Hardten:** Over the years, have you found ways to make the work-up process more efficient?

**Dr. Reilly:** Yes. For example, if we do find mild disagreement in the wavefront versus manifest refraction,

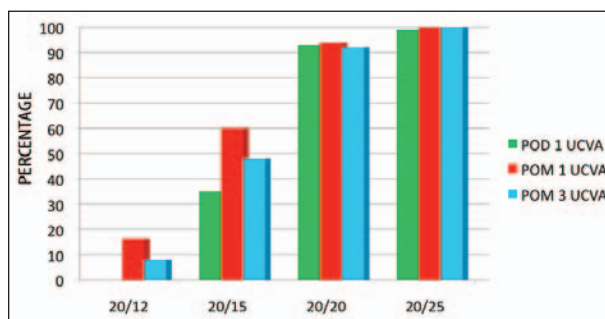


Figure 1. Nearly half of patients achieved 20/15 or better UCVA at 3 months postoperatively.

we will perform a wavefront-adjusted manifest refraction (WAMR) to determine the patient's true visual potential. Often, we find that the wavefront refraction is more accurate than the manifest refraction. Additionally, in the military, we have a fair number of younger patients compared to the average age of refractive patients in most surgical practices. Not surprisingly, many of them have been previously overcorrected. We give these patients a new prescription, allow it to stabilize for 3 to 6 months, and then we check their eyes again. This process adds time to our patient workup, but the dividend is a happier patient.

**Dr. Hardten:** What process do you follow on the day of surgery, and why?

**Dr. Reilly:** We have a separate laser suite for our femtosecond laser, so I make several flaps, have the patients wait, and then laser those patients to maximize efficiency. We perform an equal mix of LASIK and PRK. On a typical surgical day, I will treat approximately 20 patients (40 eyes). For our LASIK patients, we prefer to use the femtosecond laser to make their flaps, so my typical routine is to laser a couple of LASIK flaps, then perform a couple of PRK procedures, after which I will complete the LASIK procedures. The time lapse for the LASIK patients allows the opaque bubble layer (OBL) to dissipate. The only drawback of this approach is that some LASIK



patients experience discomfort between the time we create the flap and lift it for the laser correction procedure.

**Dr. Hardten:** What pearls can you share for creating consistent flaps?

**Dr. Reilly:** The best pearl I can offer for flap creation is to be consistent in the docking technique. Centration is everything when using a femtosecond laser. When applying the patient interface, it is important to be perfectly centered. I use a very light docking technique to minimize OBL; however, regardless of technique, the docking of the laser must be consistent. Surgeons should create their own personal technique. If they decide to alter that technique, I would advise that they change only one thing at a time so that the cause and effect can be evaluated for each change.

I use Douglas Koch, MD's, temporal hinge technique with the femtosecond laser. My flap size is consistently 8.3 mm in diameter. When I lift the flap, I achieve a 9-mm stromal surface area, because the temporal hinge opens up more space. Most of the trauma the eye suffers will come from the temporal side; the superior side is protected by the brow, the nasal side is protected by the nose, and the inferior side is protected by the cheek. The only spot on the eye that is vulnerable to trauma is the lateral side. By making a lateral hinge, I am able to preserve the temporal nerves that are entering the cornea, thereby minimizing trauma.

"I am a proponent of wavefront-guided treatments. In my experience, they have been shown to produce the best results."

**Dr. Hardten:** What are your pearls for performing the ablation?

**Dr. Reilly:** I am a proponent of wavefront-guided treatments. In my experience, they have been shown to produce the best results.

Aside from the general concept of customizing treatment, I try to minimize manipulations of the flap as much as possible, which, in my opinion, is also key to good results.

The operating environment is also important; the temperature and humidity in the LASIK suite should be kept consistent for all procedures. In a recent LASIK study in which I participated,<sup>1</sup> these parameters never varied by more than 2° in temperature and 1% humidity.

"Improved technology has played a significant role in the quality and reliability of our laser vision correction results."

Once the environment is stable and consistent, the surgeon can then adjust his or her nomogram in a step-wise fashion to maximize results.

**Dr. Hardten:** What does your postoperative management consist of?

**Dr. Reilly:** We have our LASIK patients instill a topical steroid every 2 hours during the first 24 waking hours. Then, we prescribe a fourth-generation fluoroquinolone for 5 days postoperatively. We keep our surface PRK patients on a fourth-generation fluoroquinolone for the first 5 days, along with a bandage contact lens. Once the bandage contact lens is removed, the patient can stop taking the antibiotics and taper the steroid (fluoromethylone) beginning at q.i.d. and tapering the dose on either a 2- or 4-month schedule.

**Dr. Hardten:** What role has improved technology played in the quality and reliability of your laser vision correction results?

**Dr. Reilly:** Improved technology has played a significant role in the quality and reliability of our laser vision correction results. We are a high-volume laser center with multiple surgeons, and anything that we can do to standardize our technique between surgeons and the application of the laser between patients pays off in our results. By performing a majority of wavefront-guided treatments (these make up about 90% of the surgeries at our surgery center), we know that there is going to be a consistent application of the laser to the eye, regardless of which surgeon is operating. This allows us to follow our results closely and maintain a level of consistency between surgeons and the treatments. Also, the femtosecond lasers enable us to make consistent flaps between surgeons, which again has an important impact on outcomes. ■

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1. Trattler W, Reilly C, Coleman S. Refractive outcomes with advanced CustomVue iLASIK. Poster presented at: The XXVII Congress of the ESCRS; September 12-16; Barcelona, Spain.

# Pearls for Obtaining Quality Wavefront Captures

Tips for preoperative evaluation and maintaining consistency in measurements.

BY STEPHEN C. COLEMAN, MD

**Dr. Hardten:** Please provide an overview of your experience with wavefront-guided LASIK on the iLASIK laser platform (Abbott Medical Optics Inc., Santa Ana, CA).

**Dr. Coleman:** My clinic was a beta site for the iLASIK technology, and my staff and I worked through some technical issues prior to starting the initial clinical study for low myopia (0 to 6.00 D) in May 2002. For instance, initially, we thought that blue eyes captured less frequently than darker-colored eyes, which we now know is not the case.

I was immediately impressed by the visual outcomes we achieved with the customized treatments. My cohort of patients for this study all achieved 20/20 UCVA post-operatively, and two-thirds of them reached 20/16, so clearly, we were on to something. Most interesting, however, were the subjective comments from patients. They described their postoperative vision as considerably sharper than their prior contact lens-corrected or spectacle-corrected vision. This feedback, in addition to that from a majority of patients who stated that their night vision was improved following wavefront-guided LASIK, pushed me toward becoming an all-customized practice.

“I have never considered the additional step of capturing a wavefront image an obstacle to patient flow.”

In 2004, when I began using the femtosecond laser to make LASIK flaps, I had the ability to customize both the flap and the excimer profile, which are two very complementary technologies. My patients’ visual recovery was greatly accelerated once I began using the two platforms together.

**Dr. Hardten:** How important is the patient’s wavefront to your refractive surgical outcomes?

**Dr. Coleman:** I have never considered the additional step of capturing a wavefront image an obstacle to patient flow. I find that the wavefront map is a much more helpful tool for talking to patients and describing their particular condition as well as planning a treatment. Also, from a clinical perspective, not being able to capture a WaveScan image can in many instances give insight into an eye’s abnormality that surface topography alone cannot provide. The WaveScan (Abbott Medical Optics Inc.) can be sensitive to tear film issues, which contact lenses can influence. So, in my practice, we always repeat the WaveScan on the day of surgery and compare it to the scan from the day of the evaluation. Most of the time, if a technician is unable to capture a wavefront image, it alerts us to the possibility that there is an anomaly with this particular eye. So, I feel it is a great screening tool.

**Dr. Hardten:** How do you evaluate and work up patients who wear contact lenses?

**Dr. Coleman:** Rather than having my counselors tell patients over the phone to not wear their contacts for a few weeks before coming in for a preoperative evalua-

<i>Pearls for Wavefront Capture</i>	
✓	Remove glasses in waiting room
✓	No reading or watching TV
✓	Sit-up straight
✓	Check for head tilting
✓	Neck relaxed
✓	Use hood to enlarge small pupils
✓	Capture in a dark room
✓	Blink immediately before capture

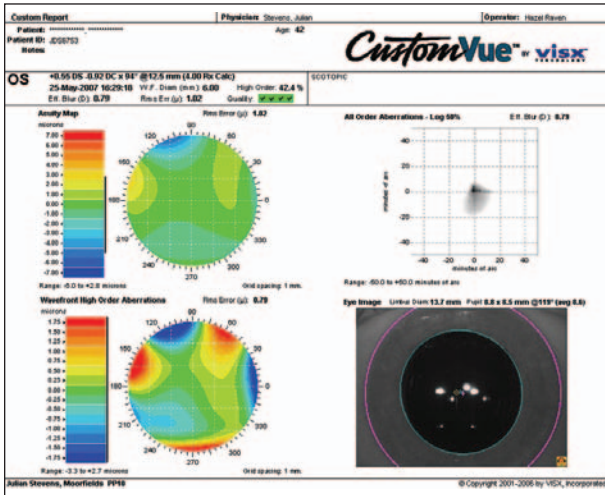


Figure 1. Four green boxes with check marks indicates a high-quality wavefront refraction capture.

tion, I have the patient come in and take his or her contacts out while in the office. This enables me to obtain a baseline set of measurements, which includes a WaveScan. Once I have baseline measurements, I can determine whether the patient should be out of his or her contacts for 2 weeks, 3 weeks, or more to achieve firm measurements before surgery. The baseline measurements allow me to see the rate of change on the patient's cornea.

“Wavefront and iris captures are critical, and I obtain these for 100% of my cases.”

**Dr. Hardten:** Do you capture wavefront and iris information data on all your LASIK patients?

**Dr. Coleman:** Wavefront and iris captures are critical, and I obtain these for 100% of my cases. In fact, the only time I perform a conventional LASIK treatment is by default. We do not group people by customized or conventional treatments. All patients who fit the criteria, which is 95% or more of patients, receive an iLASIK treatment.

**Dr. Hardten:** How important is consistency in wavefront captures?

**Dr. Coleman:** The capture process needs to be consistent; if we achieve this, we do not necessarily need to have the same person perform the capture. In our practice, multiple technicians take the measurements, but they all follow the same process under my supervision.

“[The WaveScan] is a great starting point for the discussion as to why a patient may or may not be a suitable candidate for LASIK.”

Essentially, we have built upon and reinforced the principles and techniques that were outlined for us at the time our iLASIK system was installed.

**Dr. Hardten:** What are your pearls for obtaining a quality wavefront and iris capture?

**Dr. Coleman:** The small, seemingly inconsequential things actually do matter. It starts with good head position and making sure that the patient is comfortable, because we are essentially striving to reproduce the position and alignment at the WaveScan later in the laser suite at the time of surgery. For example, the patient should not stretch his or her neck too high, be hunched over, or tilt the head to the left or the right. If necessary, we can use a hood to achieve maximum pupil size. Finally, the patient should blink immediately prior to the capture, so that his or her tear film is homogeneous and does not show signs of patchy dryness or tear drop-out. These straightforward steps routinely result in excellent, high-quality wavefront data to accurately drive the laser profile and take full advantage of the tremendous benefits of Iris Registration (Figure 1).

**Dr. Hardten:** Do you find that adding a wavefront capture to your patient work-up process interrupts your patient throughput?

**Dr. Coleman:** At this point in time, most patients are relatively familiar with the nuances surrounding LASIK, such as the sounds, the smells, and what to expect on the day of a procedure and immediately following it. Patients tend to be more data-driven now and are very interested in learning about the picture of their eye and all the numbers that influence the decision-making process for them, from a doctor's perspective. So, on evaluation days, the WaveScan tends to be the centerpiece. It is a great starting point for the discussion as to why a patient may or may not be a suitable candidate for LASIK. ■

*Stephen C. Coleman, MD, is the founder of Coleman Vision in Albuquerque, New Mexico. He reports no financial relationships in the products or companies mentioned herein. Dr. Coleman may be reached at (505) 821-8880; Stephen@Colemanvision.com.*



## Using a Wavefront-Adjusted Manifest Refraction for Superior LASIK Outcomes

BY MARC G. ODRICH, MD

**Dr. Hardten:** What is a Wavefront Adjusted Manifest Refraction (WAMR) on the iLASIK suite (Abbott Medical Optics Inc., Santa Ana, CA)?

**Dr. Odrich:** A WAMR allows for a comparison of the WaveScan wavefront, sphere, cylinder, and axis measurements to a patient's refraction to create a refined measurement on which to base a laser vision correction treatment plan. This WAMR has the advantage of being a speedy and precise way of targeting the patient's surgical refraction.

**Dr. Hardten:** How do you perform a WAMR, and why is it important to your refractive outcomes?

**Dr. Odrich:** The first step in performing a WAMR is to obtain a high-quality WaveScan. I typically have patients take off their glasses as soon as they come into the waiting room and close their eyes for at least 5 to 10 minutes. Then, my technician takes two to three quick but consistent WaveScan readings before any other test. It is essential that these initial WaveScans be performed prior to any other testing of the patient's optical system. After we have these initial WaveScan(s), we perform a refraction that is based on this data. Specifically, we use the cylinder and axis from the WaveScan to guide the refraction. With the cylinder and axis from the WaveScan placed into a phoropter, the essential last step is identify the least negative sphere that provides the best-corrected acuity.

The WAMR is important in achieving superior LASIK outcomes because, when patients are refracted for glasses or contact lenses, the astigmatism often is not properly identified. The WaveScan is particularly good at correctly identifying astigmatism and axis, making it an important factor for avoiding over- and undercorrections.

**Dr. Hardten:** What are the advantages to using the wavefront-based refraction as a starting point to identify a patient's manifest refraction?

**Dr. Odrich:** Speed and precision. WaveScans can be performed by a skilled operator in less than 3 minutes on both eyes. The biggest advantage is that inherent biases of manifest

"The WaveScan is particularly good at correctly identifying astigmatism and axis, making it an important factor for avoiding over- and undercorrections."

refractions—which include but are not limited to the meridional image distortion of spectacles—are eliminated. Additionally, the WaveScan refraction allows me to start with a consistent treatment to compare against the manifest refraction.

**Dr. Hardten:** Does performing a WAMR make the work-up process more efficient?

**Dr. Odrich:** Absolutely. This process reduces our refraction time by one third.

**Dr. Hardten:** In your experience, does performing a WAMR play a role in achieving consistent visual outcomes?

**Dr. Odrich:** For me, it has. It is critical to make sure that the WAMR is of high quality and is consistent with the other presurgical workup (topographic cylinder in the appropriate position) and spherical equivalent of manifest in close agreement with spherical equivalent of the Auto-Selected WaveScan treatment. My surgical outcomes have been much more consistent since we began using WAMRs. In the past, using only refraction measurement, I have found that a patient can have 10% to 30% more astigmatism than was found in the refraction, which is a significant reason for increased retreatment rates. Using the iLASIK platform and the WAMR, I have brought my retreatment rates to below 2%. Ninety-five percent of my patients achieve 20/20 UCVA, and approximately 60% of my patients achieve 20/16. ■

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## Incorporating Environmental Factors Into Your Nomogram

BY ROBERT K. MALONEY, MD

**Dr. Hardten:** Are there any intraoperative factors surgeons should consider when planning iLASIK treatments?

**Dr. Maloney:** The two main environmental factors to consider are temperature and humidity. My colleagues and I reviewed all enhancements in our center for under- or over-corrections following primary surgeries performed between 2003 and 2006. Our OR's humidity ranged from 11% to 58%. In 270 eyes undergoing an enhancement for undercorrection, the mean humidity at the time of the original surgery was 39%. In 238 eyes undergoing enhancement for overcorrection, the mean humidity was 40%. In other words, humidity had no effect on outcomes (Figure 1).

We also reviewed the temperature in our OR between 2005 and 2006 and found it was 70° to 72°. Out of 283 enhancements, 106 were overcorrected, and 107 were undercorrected. At that point, we increased the temperature in the OR, because we had several complaints from patients who thought it was too cold. Between 2006 and 2007, we found a significantly higher number of overcorrections. Out of 111 enhancements, 87 were overcorrected and eight were undercorrected, which translates to an increased relative risk of overcorrection by a factor of 11. We then cooled the room down to 69° to 70°, and our results reversed. We have since maintained the temperature in this range and adjusted the Maloney nomogram appropriately.

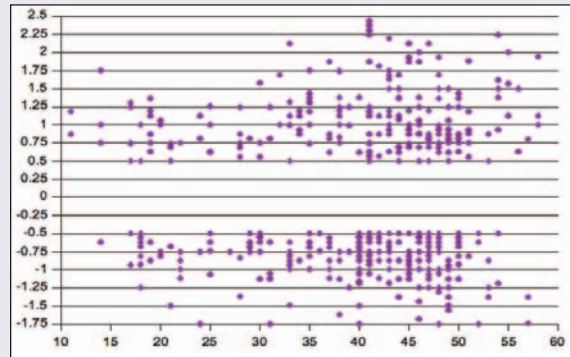
Based on our results, the OR room temperature appears to have a significant effect on refractive outcomes.

**Dr. Hardten:** If you are working in an environment that is not ideal, how would you adjust your nomogram?

**Dr. Maloney:** The problem with adjusting the nomogram is that there is a greater standard deviation of results when the room temperature is higher. So, even if your nomogram is correct, on average, you will have more undercorrections with a cooler room and more overcorrections with a warmer room, because there is more spread. So, I would adjust the environment, not the nomogram.

**Dr. Hardten:** Are there any additional steps you or your technicians take to improve your outcomes?

**Dr. Maloney:** I am very careful to do the same thing on



**Figure 1.** A retrospective analysis of pre-enhancement MRSE shows a limited effect of OR humidity on the over- or undercorrection of primary LASIK treatments.

both eyes. We keep the second eye taped shut while we treat the first eye. I also try to treat both eyes at the same pace. I make an IntraLase flap OS and then OD, and then I perform the CustomVue ablation OS then OD.

**Dr. Hardten:** How often do you reassess your environment throughout the day?

**Dr. Maloney:** We reassess the surgical environment continuously throughout the day. Our goal is to keep the room's temperature at 69° or 70° and the humidity at 40% or above.

**Dr. Hardten:** What kind of adjustments would you recommend for surgeons who are not regularly achieving 20/20 or better results?

**Dr. Maloney:** It is not expensive to control your OR's environment, so make the necessary investment to do so, because every patient who needs an enhancement represents someone who will not refer patients to you. The cost of a higher enhancement rate is far greater than the cost of controlling the OR's environment. ■

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# Maximizing LASIK Outcomes By Eliminating Preoperative Dry Eye

How to prevent this most common of complications.

BY EDWARD J. HOLLAND, MD

**Dr. Hardten:** Can you provide an overview of your experience with wavefront-guided LASIK and dry eye?

**Dr. Holland:** I feel that wavefront-guided LASIK is the latest innovation in refractive surgery and that this technology affords our patients even better results than non-customized LASIK. The quality of data obtained from a wavefront image depends on a healthy ocular surface. An abnormal tear film or corneal epithelial layer from conditions such as dry eye, blepharitis, and epithelial basement membrane degeneration can negatively impact the wavefront image.

**Dr. Hardten:** How important is it to treat dry eye before LASIK?

**Dr. Holland:** Dry eye is the most common postoperative problem in all laser vision correction procedures. To some degree, every patient undergoing laser vision correction has neurotropic dry eye, so it is an important part of the pre- and postoperative evaluation.

**Dr. Hardten:** What type of screening do you do?

**Dr. Holland:** It is important to take a detailed history and look for symptoms of dry eye. In fact, many of the patients I see who want laser vision correction are contact lens wearers who are now contact-lens intolerant because of dry eye. A careful slit-lamp examination of lid function to ensure there is a complete blink and to look for signs of posterior blepharitis or meibomian gland disease is also necessary. Patients who have posterior blepharitis or meibomian gland disease often have an unstable tear film and evaporative dry eye, which can be every bit as problematic as aqueous tear deficiency dry eye. Signs of meibomian gland disease include inflammation of the posterior lid margin with dilated telangiectic vessels, inspissation of

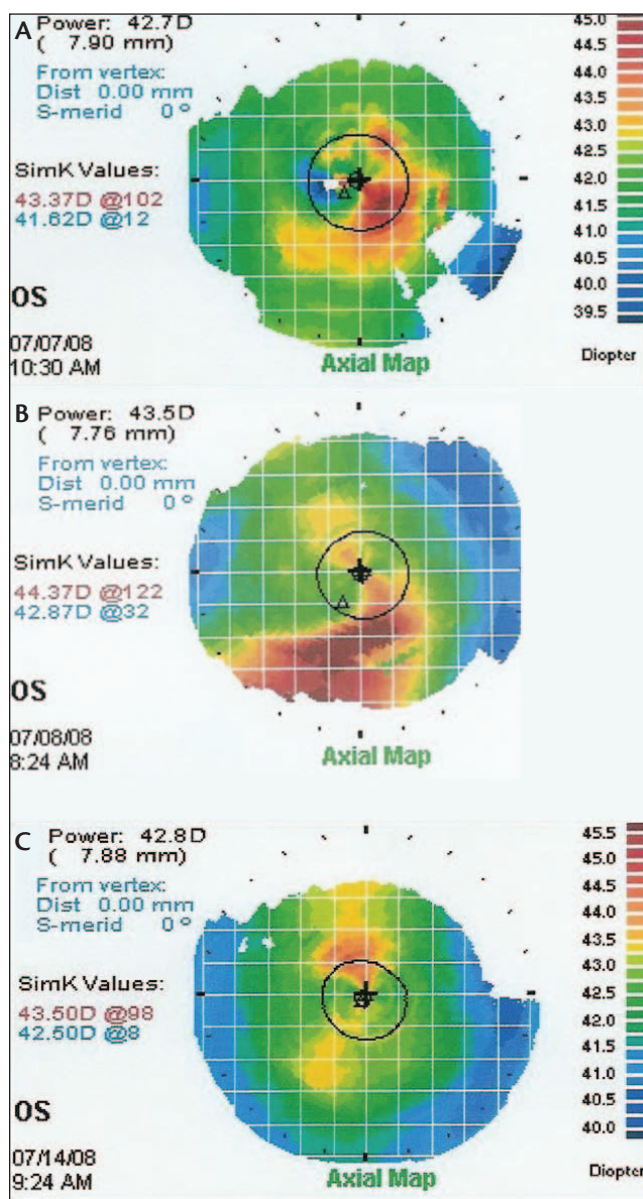


Figure 1. Topography reveals ocular surface disease in an eye preoperatively (A), at 1 day postoperatively after receiving Pred Forte (prednisolone, Allergan, Inc., Irvine, CA) q.i.d. along with lubricating drops (B), and at 1 week after treatment (C).

the glands, foamy tears, and a rapid tear-breakup time. When looking for aqueous tear deficiency, we look for a low-volume or scant tear film and conjunctival injection, particularly interpalpebral conjunctival injection. Fluorescein staining of abnormal corneal epithelium is a sign of advanced dry eye when there is punctate staining of the epithelium. More sensitive tests, however, are rose bengal and lissamine green staining, which stain abnormal epithelium in the conjunctiva to pick up signs of dry eye earlier than fluorescein staining.

Another diagnostic tool that is often forgotten is topography. Subtle abnormalities of topography, especially irregular astigmatism, are often signs of an abnormal tear film (Figure 1 A-C).

**Dr. Hardten:** How do you suggest patients treat mild symptoms of dry eye before surgery?

**Dr. Holland:** I recommend that patients with mild dry eye use artificial tears. I use Blink Tears, and have found it to be excellent in relieving dry eye and creating a more stable tear film. If they are using tears more than three or four times per day, we recommend a nonpreserved tears product, and I consider treating these patients more aggressively. We need to answer the question: is it aqueous tear deficiency or evaporative dry eye? If we are treating evaporative dry eye, we want to aggressively use lid hygiene and warm compresses to improve the oil flow in the meibomian glands. Newer treatments, such as topical azithromycin (Azasite; InSpire, Raleigh, NC), which is an antibiotic and anti-inflammatory drop that has good tissue penetration in the lids, may benefit this type of patient. I will also have these patients take an omega-3 fatty acid nutritional supplement to alter the consistency of the oil layer in their tears. Finally, oral doxycycline, dosed 20 mg twice a day or 50 mg once daily, is a good way of changing the lipid layer in the evaporative dry eye patient.

“If the corneal surface is not entirely healthy preoperatively, the patient will have a very difficult course postoperatively.”

Aqueous tear deficiency is typically an inflammatory disease, so I will prescribe topical cyclosporine 0.05% (Restasis; Allergan, Inc., Irvine, CA). First, however, I prefer the patient undergo an introductory period with a topical steroid, such as loteprednol 0.5% (Lotemax; Bausch & Lomb, Rochester, NY).

“With appropriate treatment, the patient with dry eye can have great results from laser vision correction.”

**Dr. Hardten:** What is the length of treatment before surgery for aqueous tear deficiency patients?

**Dr. Holland:** For patients with moderate aqueous tear deficiency who have healthy looking corneas but significant symptoms, I will initiate steroid therapy and then proceed with topical cyclosporine 3 to 4 weeks before surgery. If a patient has significant dry eye (eg, corneal staining), I recommend delaying surgery, because if the corneal surface is not entirely healthy preoperatively, the patient will have a very difficult course postoperatively. If the patient's corneal signs persist and I cannot improve the ocular surface, I may consider recommending PRK over LASIK.

**Dr. Hardten:** How has aggressively treating these patients changed your postoperative outcomes in terms of visual quality, comfort, and higher-order aberrations?

**Dr. Holland:** With appropriate treatment, the patient with dry eye can have great results from laser vision correction. As previously stated, we may have to delay the surgery in the most significant cases of dry eye, but I would rather postpone the surgery and have the patient return multiple times than compromise his or her ocular surface. The patient then understands, especially with multiple visits, that he or she has a significant ocular surface problem. The alternative scenario is that the surgeon proceeds with surgery and then treats the dry eye problems postoperatively. Naturally, the patient is prone to blame the LASIK procedure itself for his or her corneal dryness. With careful preoperative evaluation and treatment, I believe that patient satisfaction is much better. ■

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