

LASIK: Practical Pearls

These tips can be applied to flap creation with femtosecond lasers as well as mechanical microkeratomes.

BY A. JOHN KANELLOPOULOS, MD

I was 12 years into my career in ophthalmology before I used a femtosecond laser in the United States. At that time, in 2002, IntraLase (now Abbott Medical Optics Inc.) was the only ophthalmic femtosecond platform on the market, and its sole purpose was to create a LASIK flap. As a cornea surgeon, I felt—and still feel—very comfortable with manual keratomileusis maneuvers, but it took me minimal time to appreciate the superiority of reproducible flap parameters potentially perfected with femtosecond laser technology. Over the next 4 years, I converted from microkeratome to full-time use of the femtosecond laser for flap creation, and ours became the first center in Greece—and one of the first centers in Europe—to perform femtosecond LASIK exclusively.

As more femtosecond laser platforms hit the market, I found that several intrinsic surgical pearls could be applied to the procedure regardless of what system I used. We currently use the WaveLight FS200 (Alcon Laboratories, Inc.), which I feel is a real evolution of all the features a surgeon would like to have in a femtosecond laser, but I have experience with other platforms as well. In fact, some of these pearls are applicable even when using a mechanical microkeratome. I believe in the concept of peers teaching peers, and therefore I would like to share some of these tips. We have been offering a didactic course on basic LASIK for the European Society of Cataract Refractive Surgery (ESCRS) for the past 14 years, and I think I have learned as much by giving this course as I hope the hundreds who have taken it over these years have learned.

PRE- AND INTRAOPERATIVE TIPS

Evaluate corneal thickness. Corneal thickness is an essential measurement for any LASIK case, whether the flap is created with a femtosecond laser or with a mechanical microkeratome and, likewise, whether the patient is undergoing a customized or standard procedure. At our center, we evaluate corneal thickness in two ways: (1) using the Oculyzer (the Pentacam paired to the WaveLight Allegretto Wave; Alcon Laboratories, Inc.) to measure the anterior corneal surface and the posterior elevation and (2) using laser interferometry pachymetry to evaluate axial length. In our center, we

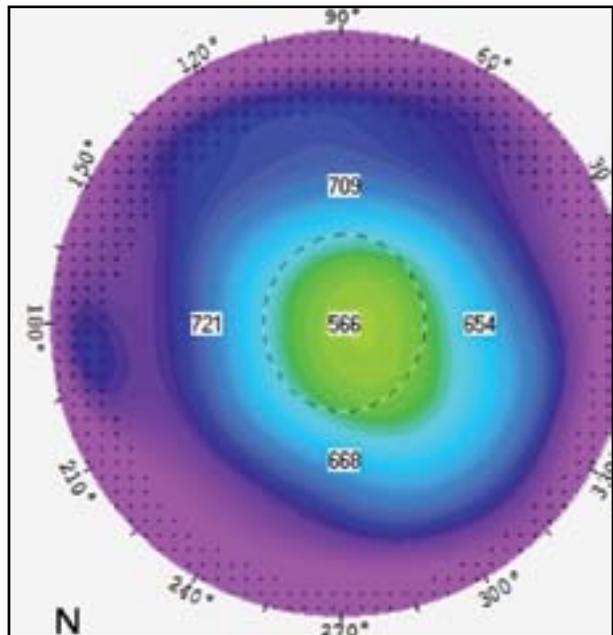


Figure 1. This patient's eye appeared normal, and the corneal thickness was 566 µm; however, the author classified the eye as abnormal for two reasons: (1) the thinnest point is inferonasal rather than central, and (2) the progression of corneal thickness is a distorted ellipse instead of symmetrical.

use the Lenstar/Allegro BioGraph (Haag Streit AG/Alcon Laboratories, Inc.), which produces both axial length and central corneal pachymetry measurements.

Many surgeons evaluate pachymetry numbers, but I feel they underutilize pachymetry as a topographic map. I have learned not only to value its properties as a diagnostic tool but also, in some cases, to trust it more than traditional anterior elevation-posterior elevation generated by Scheimpflug imaging. For instance, I would give more weight to a pachymetry map that is round and has a symmetrical progression of corneal thickness from the center to periphery than I would to irregularity on the anterior curvature map, which could be the product of dry eye or a transparent irregularity of the cornea. For example, the anterior and posterior elevations shown in Figure 1 are normal and corneal thickness in this case is

566 μm ; however, I would classify this eye as abnormal for two reasons: (1) the thinnest point is inferonasal rather than central, and (2) the progression of corneal thickness is a distorted ellipse instead of symmetrical.

If corneal thickness is questionable or the cornea appears in any way abnormal, I also consult an optical coherence tomography (OCT) system such as the Optovue OCT (Optovue, Inc.) for pachymetric measurements. We have also worked with the Artemis II (UltraLink LLC) high-frequency ultrasound biomicroscope with similar findings that are currently submitted for publication. Knowing the pachymetric distribution of the cornea can help distinguish between a normal cornea and one that is suspicious for ectasia.

Look for corneal scars. In addition to determining corneal thickness, it is also important to locate any superficial corneal scars using slit-lamp biomicroscopy (Figure 2). Corneal scars in the Bowman membrane can occur after sterile infiltrate or bacterial keratitis and are common in contact lens wearers, who make up the majority of patients who elect refractive surgery to correct myopia, hyperopia, and/or astigmatism.

During femtosecond LASIK, scars may also become noticeable after the patient interface cone applanates the cornea, especially in eyes with brown or dark brown irises. If a corneal irregularity is noticed and thin-flap LASIK is planned, it is safest to alter the flap to a slightly greater thickness to ensure an optimal outcome and avoid vertical gap breakthrough.

Double-check flap thickness. Pachymetry is an excellent tool to verify correct flap thickness and ensure that there is enough residual corneal depth for the planned ablation. Some excimer lasers, such as the one we use (WaveLight EX500; Alcon Laboratories, Inc.), have the capability to perform in-line pachymetry immediately after the flap is lifted. I particularly enjoy this feature, as it avoids placing an ultrasound probe on the bare stroma and risking contamination.

A reproducible protocol. I make sure that the number of drops and any other material that reaches the corneal surface before appplanation is consistent from one procedure to the next. I believe this increases flap accuracy. When anesthetic gel or a viscous artificial tear is applied before the procedure, that gel must be washed away to avoid interference with the intended corneal thickness. For instance, if a layer of lidocaine or hyaluronic acid solution, approximately 10 to 20 μm thick is left on the cornea, the resulting flap cut could be 10 to 20 μm thinner than planned.

I always use one drop each of Alcaine (proparacaine hydrochloride; Alcon Laboratories, Inc.) and Vigamox (moxifloxacin; Alcon Laboratories, Inc.) preoperatively,

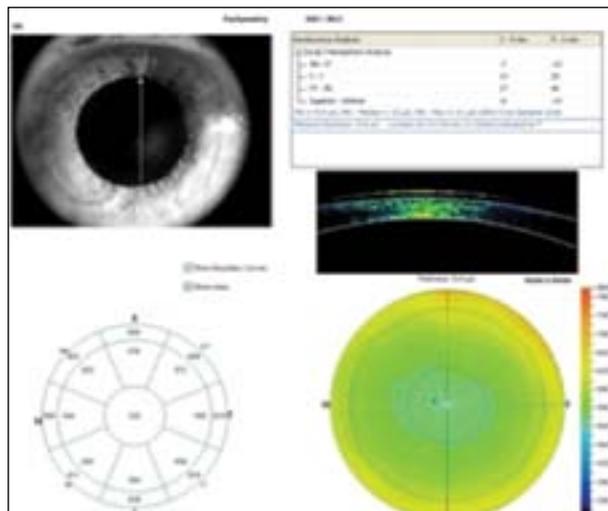


Figure 2. Corneal scar as seen on slit-lamp biomicroscopy (upper left).

which produces a layer approximately 5 μm thick. This has been accounted for in our nomogram for femtosecond LASIK, and after thousands of procedures we feel comfortable that our technique is reproducible and does not interfere with the resulting flap thickness.

Consider the patient's physical characteristics.

Determining the best side from which to approach the eye is important. In patients from Southern European who have deep-set eyes, a longer nose, and prominent brow bones, for instance, the above-average distance between the tip of the nose and the surface of the cornea makes the eye difficult to approach with the femtosecond laser. Of the thousands of patients I have evaluated over the past 6 years, I have had to exclude a few from surgery because of difficult access to the eye.

A woman's hairstyle may sound insignificant; however, it is important to recognize that long hair fixed on the back of the head can raise and tilt the patient's head on the surgical bed, requiring adjustment. The surgeon familiar with mechanical microkeratomers can work around this issue by tilting his or her working z axis. This is not possible with most femtosecond

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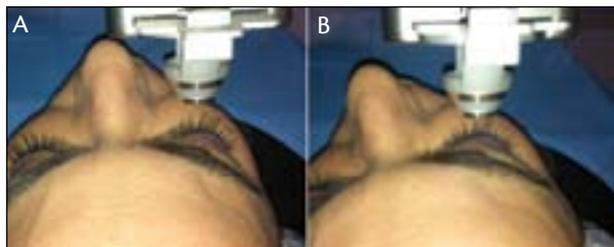


Figure 3. When contact with the patient interface cone occurs, the applanation should be paused to increase the tilt of the patient's head. (A) Normal position; (B) increased tilt to accommodate for prominent facial features.

lasers, as they require a perfectly horizontal plane of the approaching cornea and usually adjust for the x- and y-axis and up-down.

A similar principle should be applied to patients with large thoracic cavities. This may result in the head appearing tilted upward, toward the surgeon. An extra pillow or better adjustment of the headrest is beneficial.

Watch for any unnecessary contact between the patient and the machine. With my eyes focused on the screen to track corneal applanation, one of my assistants watches the eye to ensure that there is no contact between the descending patient interface cone and the patient's nose. If contact does occur, there is a chance for poor suction or loss of suction. If this occurs, we stop applanation, increase the tilt of the patient's head, and then redock the interface (Figure 3). This is especially helpful in patients with deep-set eyes, a longer nose, and prominent brow bones. If the patient's head has been tilted, it may be necessary to adjust the LASIK flap nasally.

Count down to flap creation. Patients tolerate the LASIK procedure more readily when they are briefed on the surgical steps prior to surgery. I tell each patient that the portion of the procedure that is most uncomfortable is flap creation; the patient must understand that pressure will be applied to the eye and there will be a short phase of visual blackout. The length of this phase varies depending on the method of flap creation and the diameter of the flap cut. With a femtosecond laser, blackout could last from 10 to 30 seconds depending on the spacing between laser spots, whereas with a mechanical microkeratome it is closer to 10 seconds.

One useful tip to reduce patient anticipation and ease the patient's fears during the blackout time is to count down the time to flap creation. This voice is the only sound the patient should hear. Cell phone rings or a head popping through the surgical suite door announcing, for example, that lunch has arrived may be enough to distract the patient and provoke unnecessary movement.

TAKE-HOME MESSAGE

- In some cases, pachymetry is more telling than traditional anterior-posterior elevation generated by Scheimpflug imaging.
- Thin flaps are not advised in eyes with corneal irregularity.
- Consider the patient's facial features, including the length of the nose and prominence of the brow bone, when planning the procedure.
- Do not forget to establish ground rules in the operating room.

A loose conjunctiva can cause questionable suction and an irregular flap. In cases where multiple topical medications have been administered, the conjunctiva may be erythematous, swollen, and loose. This can result in questionable suction with the patient interface cone, but, more important, it may allow loose conjunctiva to herniate through the edge of the cone and under the applanating glass surface, resulting in a tilted applanation and risk for an irregular flap. Several chilled balanced saline solution drops and a cold compress may do the trick to reduce swelling of the conjunctiva.

Irrigate the eye before performing the ablation. I use an aspirating speculum, which allows me to irrigate the eye immediately before lifting the flap. This clears the surface of meibomian gland secretions that can result from the pressure applied during the flap cut. Secretions that are left behind can penetrate under the flap and reach the surface to be ablated. Patients who squeeze their eyes produce more secretions during irrigation, so this may require several attempts. Flap lift should be completed only after the data are loaded into the excimer laser and the staff has ensured that the correct eye is represented on the laser panel.

Use copious irrigation after the ablation. Once the corneal ablation is completed, copious irrigation—using at least half a bottle of balanced saline solution—is performed under the flap and on the corneal surface. This is another point at which an irrigating/aspirating speculum is useful, to evacuate the irrigating solution. This helps to eliminate the risk of debris from the laser room air or meibomian secretions reentering under the flap.

Flap repositioning varies depending on the mode of flap creation. The flap is repositioned using a wet cellulose sponge if a mechanical microkeratome was used for flap creation. In eyes in which a femtosecond laser was used, it is better to instill a drop of Pred Forte (prednisolone acetate; Allergan, Inc.), as I have found that a sponge can create striae. The steroid drop's milky consistency helps to delineate the flap edges and position the flap. I also use the Johnston LASIK Flap Applanator (Rhein

Medical) to push the flap into the center of the cornea, check that the center of the flap is applanated onto the corneal bed, and remove any potential microstriae, which are particularly common after high myopic corrections (eyetube.net/?v=XXXXX).

Apply a contact lens to prevent flap striae. After a few drops of Vigamox (which, as a fourth-generation antibiotic, has the additional advantage of being nonpreserved) are instilled, a daily contact lens of 0.00 D power is placed on the cornea to protect the eye postoperatively; it should remain in place until the morning after the procedure to minimize friction between the eyelids and the LASIK flap and thus prevent formation of flap striae. Additional antibiotic drops can be placed on the contact lens to promote healing. These should be applied before releasing the LASIK speculum from the eye.

Establish ground rules. I spend significant time with my surgical team in training, and we follow several rules:

1. Nobody says, "I am sorry," during a procedure.

These words can be a great source of distraction for the patient, who may not understand that the apology could be directed from the nurse to the surgeon for bumping or stepping into one another or even for dropping a medication bottle or an instrument. Believe it or not, this may be the only thing an anxious patient will remember from his or her procedure for years to come.

2. Everybody pays attention to the patient's hands and leg movements. If the patient is over-anxious, one member of the surgical staff will break his or her position and hold the patient's hand.

3. All measurements and equipment parameters are ready before the patient enters the room; it is extremely distracting and anxiety-inducing for the patient to experience last-minute data fumbles.

4. Always cross-identify the patient with the data on the screen. As elementary as this may sound, it is a necessary safety step that also helps the patient feel secure.

CONCLUSION

I exclusively perform femtosecond LASIK, but the above tips are also practical when a mechanical microkeratome is used in place of a femtosecond laser for flap creation. ■

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