# The LASIK Flap: Ideal Size and Construction

Over this surgeon's career, his idea of the perfect LASIK flap matured along with the technologies available for its creation.

**BY A. JOHN KANELLOPOULOS, MD**

In my 22 years of practicing ophthalmology, I have been involved with LASIK for the past 18. It has been a fascinating journey to learn all the new techniques and technologies and experience performing this rewarding procedure firsthand.

Throughout the time I used a mechanical microkerotome, the idea of the perfect flap matured. It was in 2002, when I first started working with a femtosecond laser, that I realized that all the parameters I had fantasized about for an ideal LASIK flap could now be done with the ease of punching numerical buttons on a computer screen. Even so, it is hard to forget the years of calculating corneal diameter, thickness, and curvature and choosing keratome rings, microkeratome pass speeds, and blade sharpness, of calibrating blades and timing the suction on the eye—all with a complicated surgeon-specific algorithm to obtain the perfect flap.

After 10 years' experience creating flaps with the femtosecond laser, and about five femtosecond laser models later, I believe my preferences and my ability to create the ideal flap have solidified. I use the FS-200 laser (Alcon Laboratories, Inc.), and my ideal flap for a myopic treatment is 8 mm in diameter and 100 µm deep. It has been only with this femtosecond laser that I can consistently create a thin flap without going too thin (under 90 um). Opaque bubble layer (OBL) with femtosecond flaps, however, is an ongoing issue (Figure 1A). Although I cannot claim that I have solved OBL as a problem in general, I seldom see it with the FS-200 (Figure 1B).

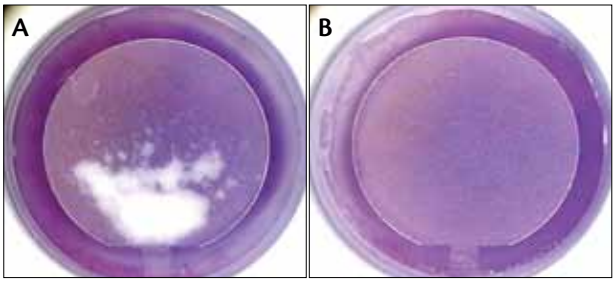


**Figure 1. (A) Opaque bubble layer is visible; (B) no noticeable opaque bubble layer is visible with the FS-200 flap.**

> Creating a smaller flap reduces biomechanical instability of the cornea as well as the area of the corneal surface that is affected during the LASIK procedure.

The advantage of thin-flap LASIK is a reduction in the biomechanical instability of the cornea induced by the procedure. The preference for a smaller flap diameter is obvious for the same reason, but a smaller flap also reduces the area of the corneal surface that is affected during the procedure. Thus, the risk for dry eye is reduced. With that said, an 8-mm flap is unforgiving, requiring precise centration; significant decentration errors result in postoperative refractive errors.

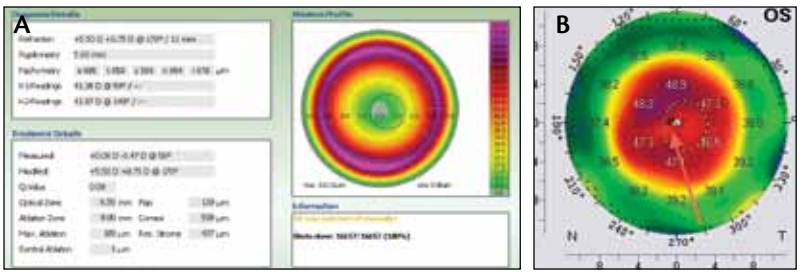


**Figure 2. (A) Using Placido-disc–based topography, the flap should be centered on the visual axis of a myopic eye with significant angle kappa. (B) Postoperative result of the treatment. The arrow points toward the visual axis.**

## MYOPIC TREATMENTS

A large angle kappa is relatively rare in myopic eyes in comparison with hyperopic eyes. However, not all myopic eyes have minimal angle kappa. Occasionally a myopic eye will have significant angle kappa, and in these cases the flap must be centered on the visual axis and not the pupillary center. The easiest way to double-check angle kappa in myopic patients is to use Placido–disc-based topography. If the pupil image is decentered from the central Placido reference disc, then significant angle kappa is present. This can be used as a quick reference guide for the busy LASIK surgeon; when the red light goes off on angle kappa, there is the potential for centration issues with a LASIK procedure, even in a myope. Our personal preference for years, which is currently submitted for publication, is to use the topography-guided platform of the WaveLight Allegretto (Alcon Laboratories, Inc.), as it automatically corrects on the visual axis (Figure 2).

There are a few caveats for a thin, small-diameter LASIK flap. Always check for corneal scars, especially in contact lens wearers, as past sterile ulcerations can disrupt Bowman membrane, creating a faint scar that may provoke vertical gas breakthrough during the flap-making process. This can trigger a buttonhole. Therefore, careful slit-lamp evaluation must be performed prior to the procedure. If a corneal scar is identified, a thicker flap should be created to avoid vertical gas breakthrough.

In addition to selecting the right flap parameters, handling of the flap must also be considered. I prefer to use disposable instruments, including a disposable irrigating cannula (Figure 3) to lift and reposition the flap (no hook or special autoclavable spatula is required). At the end of the procedure, I use a Johnston applanator (Rhein Medical, Inc.; Figure 4) to iron out the potential kinks in the flap over the myopic ablation. Adding this step has greatly improved flap adhesion and patients' postoperative quality of vision.

I use a drop of steroid suspension at the end of the procedure to delineate the flap gutter and to ensure that the flap is centered (Figure 5). If the gutter of the flap is thinner on any one side, this indicates that the flap is skewed either to the left or to the right, and if the inferior gutter is thicker than the side gutters, this is a sign that fluid is trapped under the flap, usually near the hinge.

A particular advantage of flap creation with the FS-200 is the chimney: This is an initial passage, from the limbus into the lamellar portion of the flap, which allows venting of the intrastromal gas created by the laser (Figure 6). The chimney reduces the occurrence of OBL and avoids the need to create a pocket to vent this gas.

## HYPEROPIC TREATMENTS

A large angle kappa is almost the rule rather than the exception in hyperopic eyes. For more than 8 years now, I have performed topography-guided treatment in hyperopic eyes. In hyperopic cases, the flap diameter is 9.5 mm. The larger flap diameter means more cutting time is required; it takes approximately 12 seconds for the FS-200 to create a 9.5-mm flap. Therefore, I increase the flap depth to 130 µm. If there is patient movement, loss of suction, or any other abnormality during the

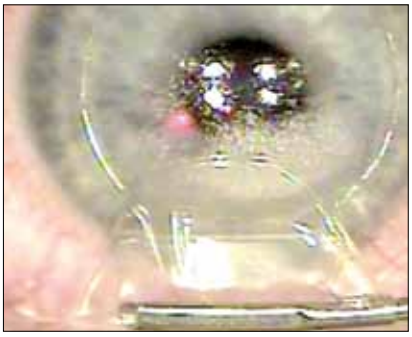

**Figure 3. A disposable irrigating cannula is used to lift and reposition the flap.**

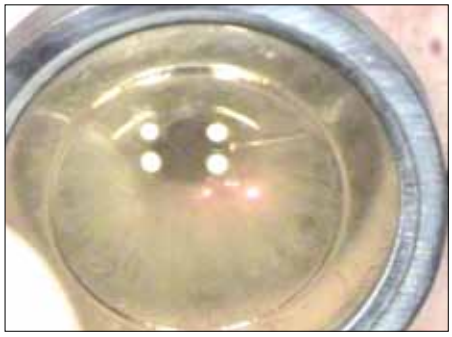

**Figure 4. A Johnston applanator is used to iron out the potential kinks in the flap over the myopic ablation.**

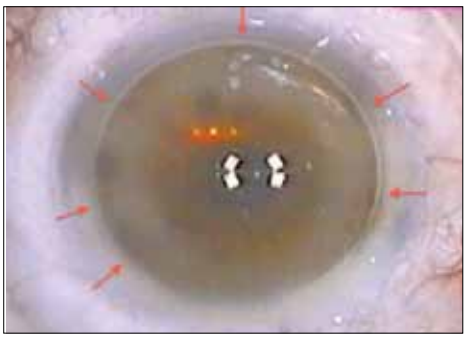

**Figure 5. A drop of steroid suspension is applied at the end of the procedure to delineate the flap gutter (arrows) and to ensure that the flap is centered.**

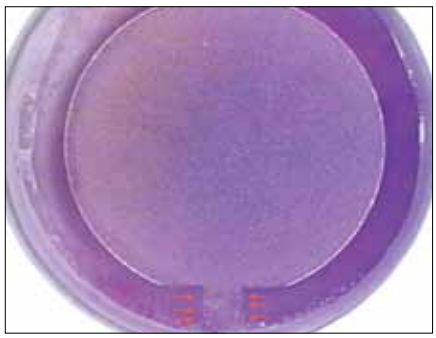

**Figure 6. An initial passage (arrows), from the limbus into the lamellar portion of the flap, allows venting of intrastromal gas.**

longer procedure, the laser activity will be deeper in the cornea, and I will have the room and ability to redo the flap. This would be more difficult if a 100-µm flap was planned.

A deeper flap requires a steeper and wider sidecut (my preference is 70°), posing a barrier to epithelial ingrowth, which is more likely in hyperopic eyes than in myopic eyes. The FS-200 allows the (intentional) decentration of the flap toward the visual axis, thus corresponding with the decentration of the ablation toward the visual axis, which is usually decentered nasally in hyperopic patients.

## OTHER CONSIDERATIONS

I evaluate all flaps with the online pachymeter of the EX-500 excimer laser (Alcon Laboratories, Inc.). Many other modern laser platforms have similar functions. All flaps are created with a femtosecond laser, avoiding the need for complicated calculations and the risk of producing a flap that is too thick or thin. Our experience now includes more than 4,000 cases performed with femtosecond laser flap creation, all with pristine results.

One of the promises of the femtosecond laser, performing ultra-thin flaps, has not come to fruition. Any time I have created a flap under 90 µm, I have seen late haze resembling the haze observed after PRK. Perhaps 90 µm is too close to Bowman membrane, exciting keratocyte activity in that location and leading to subepithelial haze. Therefore, in my opinion, the gold standard for myopic LASIK is the 100-µm flap, given that the femtosecond laser to be used can reproducibly create flaps with this thickness; alternatively, I would move toward 110- to 120-µm flaps, especially during the learning curve with a new femtosecond laser. On a sidenote, I have increased the minimum thickness of the residual stromal bed to about 340 µm, and a thinner flap allows me to do that.

It may sound like an extreme prerequisite to have a residual bed thickness of 340 µm for LASIK cases, but practicing in an area where keratoconus is rampant, and treating a lot of patients under the age of 30 who may appear topographically normal but may not in fact be normal, a residual stromal bed of 340 µm is safe. If I cannot confirm this thickness, I prefer to implant a phakic IOL such as the AcrySof Cachet (Alcon Laboratories, Inc.) or the Artiflex (Ophtec).

### TAKE-HOME MESSAGE

- The advantage of thin-flap LASIK is a reduction in the biomechanical instability of the cornea induced by the procedure.
- In a myopic eye with significant angle kappa, the flap must be centered on the visual axis and not the pupillary center.
- The author's myopic treatments have an ideal flap diameter of 8 mm and a depth of 90 to 100 µm; hyperopic treatments require a larger flap diameter (9.5 mm) and depth (130 µm).

## CONCLUSION

In my practice, LASIK is still the premiere refractive procedure for the correction of myopia up to 10.00 D and for hyperopia up to 6.00 D. My preferred parameters for myopia are an 8-mm flap diameter and 100-µm flap thickness; for hyperopia, it is for a 9.5-mm diameter, 130-µm thick flap centered on the patient's visual axis (usually infranasally). ■

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