Benefits of Femtosecond Laser Versus Manual Flaps in LASIK

Patients are willing to pay more for a safer procedure.

BY MARJAN FARID, MD

Successful corneal surgeries require consummate precision. Femtosecond lasers, unlike mechanical microkeratomes, in my opinion, provide the LASIK surgeon with the precision and speed needed to produce excellent outcomes. Femtosecond laser technology has become a fixture in ophthalmology offices across the globe for good reason: they safely deliver consistent, reproducible results with unprecedented speed.

Well-informed with respect to the benefits of technology and its contribution to the safety and efficacy of the LASIK procedure, today's patients are willing to pay more to reduce unnecessary risks when it comes to their eyesight. The laser is unparalleled in its safety,[1,2] and it provides refractive surgeons with options and advantages that I believe are worth the cost of the device.

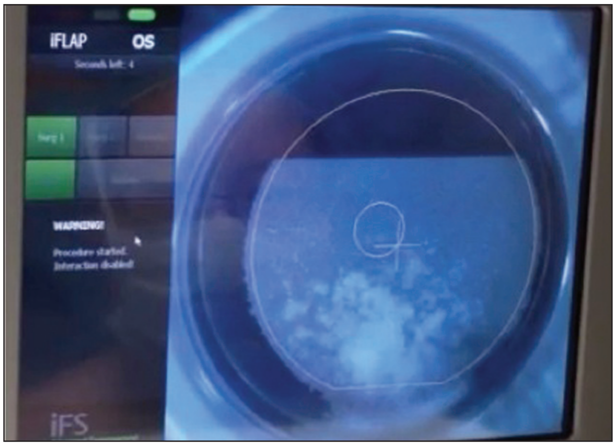

Figure 1. Creating the flap.

SAFETY AND SPEED

Flaps created with a mechanical microkeratome are associated with complications such as free caps, buttonholes, striae, central islands, and infection. Use of the femtosecond laser has led to a significant decrease in these types of complications.[1,2] The precision and speed of the laser have virtually eliminated irregular cuts, overly thick flaps, and trauma induced by manipulation. The laser's speed is a major contributor to safety and patients' satisfaction. Femtosecond laser flaps (Figure 1) were initially associated with a higher rate of inflammatory response such as diffuse lamellar keratitis and transient light-sensitivity syndrome. These issues have been mostly resolved with the newer and higher-speed laser models.

I begin by placing the patient interface on the eye, which creates a suction to hold it still (Figure 2). The laser cone then applanates the cornea, and I check centration and make any necessary adjustments. I can move the ring after applanation if needed to ensure that the cut is located exactly where I want it on the cornea.

The diameter, bevel shape, and thickness of the flap are preset according to my plan for the individual patient. Customizinig side-cut angles creates a more biomechanically stable corneal flap. Using the iFS Advanced Femtosecond Laser (Abbott Medical Optics), I create an inverted bevel-in side cut (reverse side cut) at 150° to increase the flap's stability.[2] This architecture permits me to tuck the flap and position it so there is virtually no movement. I find that this type of flap structure prevents shifting that may cause macrostriae or the development of a gutter that may encourage epithelial ingrowth. Furthermore, tucking the flap is another protective measure against the chance of patient-induced trauma such as eye rubbing.

The flap's thickness is determined by the patient's prescription and the residual stromal bed. I prefer a 120-µm flap. If the patient has a high amount of myopia or the predicted residual stromal thickness is on the low side, I

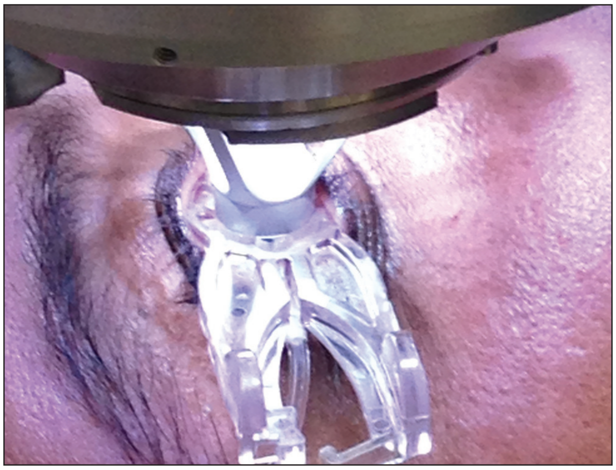

Figure 2. The iFS interface.

may choose a 10- to 20-µm thinner flap. I program this information into the laser before applanation. Creating the LASIK flap takes about 10 seconds per eye.

The patient is under the machine for less time, and the eye experiences less trauma due to a shorter manipulation time than with the microkeratome. Additionally, the architecture of the flap with the femtosecond laser is more uniform and may result in fewer higher-order aberrations as compared to the microkeratome-created flap.[3] As the speed of the available laser systems has increased and the energy per pulse has decreased, the incidence of complications from inflammation, such as diffuse lamellar keratitis, has decreased.[1]

The risk of infection also decreases when surgery involves less manipulation of the eye. The femtosecond laser patient interfaces are all disposable and require no sterilization, as they are used one time. This eliminates the possibility of sterilization errors and infection risks.

Once the patient is in position under the surgical microscope, I gently and smoothly lift the flap. If I see any gas bubbles, I use the same instrument to gently massage the stromal bed, which releases them. This leaves the cornea clear for accurate iris registration. After excimer laser ablation, I replace and smooth the flap and tuck the edges into the rim, and the case is completed.

PRECISION AND FINE-TUNING

Because I practice at a university tertiary care center, I often receive complicated cases and data to analyze. Many of the post-LASIK ectasia cases that I have seen have been a result of inadvertently thick flap cuts by a microkeratome. Anterior segment optical coherence tomography has revealed wide variation in the thickness of flaps made with a microkeratome.[4] In many cases, what was thought to be a 130- to 150-µm flap was actually 200 µm. Predictable flap-thickness knowledge is essential to accurate residual stromal bed calculation. A residual stromal bed of less than 250 µm is associated with a higher risk of ectasia.[5] With the femtosecond laser, variability in the flap's thickness is consistently less than 10 µm,[4] which substantially reduces the risk of a thinner residual stromal bed than desired. As a surgeon, this level of predictability gives me great confidence in managing borderline high-correction cases in which every micron matters.

High precision also allows small adjustments to the flap's diameter and the hinge's placement to have a significant impact on surgical outcomes. Reports suggest that decreasing trauma to peripheral nerves may reduce the long-term dry eye effect and the decreased corneal sensation from LASIK flaps.[6] I have therefore reduced the flap's diameter on myopic patients from 9 to 8 mm, a precise change made easily with the femtosecond laser. Once the laser is on the eye and the cornea is applanated, I can adjust my target and center the cut exactly where I want. Achieving perfect centration is important to minimizing higher-order aberrations from the flap's edge.

SUMMARY

The femtosecond laser's precision allows me to make technical microadjustments that increase the predictability and consistency of a successful outcome, thus improving both safety and patients' satisfaction. Although the microkeratome remains a viable and successful method for performing LASIK surgery, today's patients are willing to pay more to reduce the potential for complications related to human error, flap manipulation, and infection. ■

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1. Santhiago MR, Kara-Junior N, Waring GO IV. Microkeratome versus femtosecond flaps: accuracy and complications. *Curr Opin Ophthalmol*. 2014;25(4):270-274.
2. Farjo AA, Sugar A, Schallhorn SC, et al. Femtosecond lasers for LASIK flap creation: a report by the American Academy of Ophthalmology. *Ophthalmology*. 2013;120(3):e5-e20.
3. Karabela Y, Muftuoglu O, Gulkilik IG, et al. Intraoperative and early postoperative flap-related complications of laser in situ keratomileusis using two types of Moria microkeratomes [published online ahead of print February 17, 2014]. *Int Ophthalmol.* doi:10.1007/s10792-014-9919-7.
4. Kanellopoulos AJ, Asimellis G. Three-dimensional LASIK flap thickness variability: topographic central, paracentral and peripheral assessment, in flaps created by a mechanical microkeratome (M2) and two different femtosecond lasers (FS60 and FS200). *Clin Ophthalmol.* 2013;7:675-683.
5. Binder PS. Analysis of ectasia after laser in situ keratomileusis: risk factors. *J Cataract Refract Surg.* 2007;33(9):1530-1538.
6. Donnenfeld ED, Ehrenhaus M, Solomon R, et al. Effect of hinge width on corneal sensation and dry eye after laser in situ keratomileusis. *J Cataract Refract Surg.* 2004;30(4):790-797.