

When Is SBK Better Than LASIK?

Corneal characteristics may be the best criteria for deciding the appropriate thickness of refractive surgery flaps.

BY WILLIAM W. CULBERTSON, MD

The terminology used to describe cornea-based refractive surgeries can sometimes be confusing, especially when more than one name is used for the same procedure. For example, sub-Bowman's keratomileusis (SBK) is sometimes called *thin-flap LASIK*, because the flaps created during this procedure are between 90 and 110 μm thick versus 120 to 180 μm with traditional or normal-flap LASIK.

In the end, however, a surgical procedure's name is not as important as its ability to safely correct refractive errors. This article discusses the merits of SBK versus traditional LASIK, and it provides guidelines for choosing patients who can benefit from thinner flaps.

FROM ACCIDENTAL TO INTENTIONAL THIN-FLAP LASIK

Several years ago, my colleagues and I noticed that a particular lot of mechanical microkeratomes (CB; Moria, Antony, France) produced thinner flaps than usual (94 vs 152 μm). We decided to reserve these blades for patients who had thin corneas or a high risk of developing postoperative dry eye. None of the 14 patients (27 eyes) we treated with these blades had complications such as buttonholes, abrasions, or epithelial ingrowth, and most of them (78%) saw 20/20 postoperatively. We concluded that thinner (75- to 115- μm) flaps were not only acceptable but also produced good visual outcomes and had recovery times similar to those of standard 160- μm flaps. Thus, we felt that thin-flap LASIK was a viable alternative to PRK, LASIK, and refractive

lens exchange for patients whose corneas were too thin for standard LASIK.

When I presented the results of this informal study to the Refractive Surgery Interest Group during the AAO Annual Meeting in 2001, my colleagues expressed doubt about the safety of thin-flap LASIK. Nevertheless, thinner flaps seemed to make sense, because they conserve tissue in the stromal bed and cut fewer corneal nerves. The ability to produce thin flaps consistently, however, was limited by the unpredictability of the currently available mechanical microkeratomes. The thickness of a flap created with these devices depends on corneal curvature and pachymetry, how quickly the blade passes across the cornea during the flap's creation (translation), as well as the sharpness and length of the blade. For example, a long, sharp blade is more likely than a short, dull one to create a thick flap. The same model of microkeratome set to the same depth will not create identical flaps in two different eyes due to variations in corneal curvature and thickness.

MORE ACCURATE FORMATION OF THE FLAP

Consistently achieving thin flaps became possible only after the introduction of the IntraLase FS laser (Advanced Medical Optics, Inc., Santa Ana, CA). This device allows surgeons to program a flap's thickness and customize the configuration of its edges from a centralized control screen. Because the femtosecond laser focuses its power on a specific corneal plane, the thickness of the flaps it creates does not depend on a blade's translation

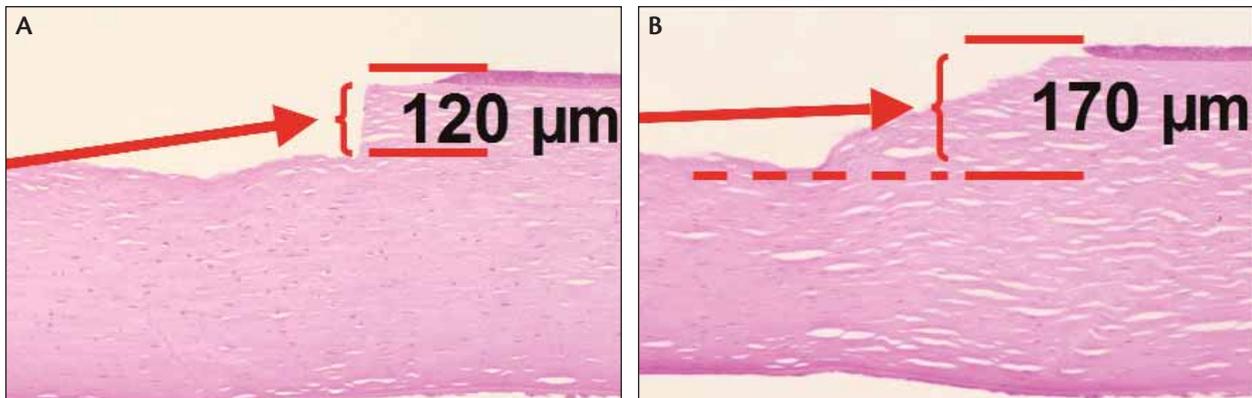


Figure 1. The edges of 120- μm -thick flaps created with the IntraLase femtosecond laser (A) and a mechanical microkeratome (B).

speed, corneal curvature, or pachymetry, all of which affect the morphology of flaps created with mechanical microkeratomers. Studies have shown that flaps produced by the IntraLase FS are usually within 10 μm of their intended thickness.^{1,2}

Typically, mechanical microkeratomers create meniscus-shaped flaps (ie, thicker peripherally than centrally). If a surgeon used a mechanical microkeratome to produce a flap that had the same diameter and central thickness as one produced with a femtosecond laser, he would make a substantially deeper cut in the peripheral cornea (Figure 1). As a result, he would likely sever more sensory nerves and collagen fibers than he would with the femtosecond laser, theoretically causing more deinnervation, keratopathy, and a greater loss of corneal strength (Figure 2).

Whenever possible, surgeons try to minimize the flap's diameter and the depth of its resection into the cornea in order to prevent excessive weakening of the corneal surface. Daniel G. Dawson, MD, showed that the anterior one-third of the cornea supports 42.5% of stress to the eye wall (oral communication, March 2007). His results are consistent with those of Jaycock et al, who showed that the cornea's anterior and peripheral regions are more resistant to stress and strain than its central and posterior regions, because they have a more optimized density and arrangement of collagen fibers.³

Recently, the FDA approved another femtosecond laser for clinical use, the Visumax (Carl Zeiss Meditec, Inc., Dublin, CA). A study presented by Dan Z. Reinstein, MD, at a sponsored symposium during the 2007 ASCRS Symposium on Cataract, IOL and Refractive Surgery in San Diego, showed that flaps created by this laser had a 6.04- μm standard deviation for an intended thickness of 110 μm . Dr. Reinstein's results were comparable to those reported by Stephen Slade, MD, and Daniel Durrie, MD, who found that they could predictably and safely create

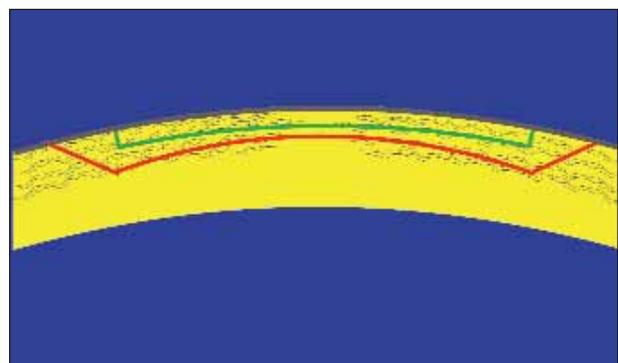


Figure 2. A thinner flap created with a femtosecond laser during SBK (green) severs fewer sensory nerves than a thicker flap created with a mechanical microkeratome during traditional LASIK (red).

LASIK flaps measuring between 90 and 110 μm with the IntraLase femtosecond laser.⁴

FLAP THICKNESS AND VISUAL OUTCOMES

The availability of technology that consistently creates thin flaps does not mean that standard LASIK no longer has a place in refractive surgery. Conventional-thickness LASIK flaps are still appropriate for the majority of cases with adequate corneal thickness and a low risk of dry eye.

Surgeons should avoid using a femtosecond laser to make thin flaps in corneas that have areas of weakness or thinning associated with a superficial corneal scar, because the gas created inside the cornea during the flap's formation could break through the corneal surface anteriorly and become trapped under the laser's appplanation plate. The trapped gas could block the laser's application, resulting in a flap with a localized area of incomplete dissection. In this situation, it would probably be safer to create a thicker flap with the femtosecond laser or a mechanical microkeratome.

COVER STORY

According to Steven C. Schallhorn, MD, the type of microkeratome used to create the corneal flap and the flap's thickness do not significantly affect the outcomes of wavefront-guided LASIK.⁵ Although the flaps created by the IntraLase were much thinner (96 μm) than those created by the Hansatome (Bausch & Lomb, Rochester, NY) and the Amadeus (Advanced Medical Optics, Inc.) microkeratomes (144 and 129 μm , respectively), the flaps' thickness did not appear to adversely influence refractive outcomes or the change in contrast acuity under photopic conditions.⁵ These findings suggest that the decision to perform SBK versus standard LASIK should not be based on the ability of either procedure to achieve a better result but on which approach works best with a patient's corneal structure.

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CONCLUSIONS

Compared with mechanical microkeratomes, femtosecond lasers offer more options for customizing the flap's position, shape, diameter, and orientation during refractive surgery. In addition to allowing surgeons to individualize ablation strategies for different corneal anatomies, the femtosecond laser may be better for creating thin flaps than mechanical microkeratomes, because it leaves stronger residual corneas and is likely to cause less deinnervation keratopathy. ■

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