Corneal Flap Architecture

Femtosecond versus microkeratome creation can make a difference in flap morphology.

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The stromal flap in LASIK can be created with either a mechanical microkeratome or a femtosecond laser. The architecture, or morphology, of femtosecond laser and microkeratome flaps differ, especially in the periphery, as a result of the different means of flap creation. The application of femtosecond laser technology to LASIK surgery has led to improvement in flap thickness reproducibility, reduction of induced higher-order aberrations (HOAs), increased stromal bed quality and biomechanical response,[1] better control over flap diameter, independence from concerns regarding corneal contour and diameter, and lower risk of free and buttonhole caps.[2] This article compares the morphology of LASIK flaps created by a femtosecond laser and mechanical microkeratome.

FLAP FORMATION

A femtosecond laser flap is formed by laser photodisruption parallel (main flap) and perpendicular (sidecut) to the corneal surface. Microkeratome flaps are created by a single continuous mechanical cut. The femtosecond laser flap depends little on the nature of the treated cornea, except for corneal scars and opacifications, whereas mechanical interaction takes place between the microkeratome and the cornea.[3] With microkeratomes, the course of the lamellar cut depends on the opening gap of the blade, its oscillation speed, the consistency of compression during forward movement of the blade, and the steepness and stiffness of the cornea.[3]

FLAP SHAPE

To prevent keratectasia after LASIK, central flap thickness accuracy is crucial; residual stromal thickness must be at least 250 µm. Femtosecond lasers are designed to make thinner LASIK flaps with a tighter range. They also tend to be more uniform in thickness from the center to the periphery than microkeratome flaps.[1] With mechanical microkeratomes, flap shape is typically thicker in the periphery and thinner in the center, thus creating a meniscus-shaped flap. This shape increases the incidence of buttonhole perforation and introduces lower-order aberrations such as astigmatism and HOAs such as trefoil.[3] Flaps created with the a femtosecond laser are more uniform in thickness, producing a planar shape.[1] This more regular shape induces less visual disturbance than microkeratome flaps.[3]

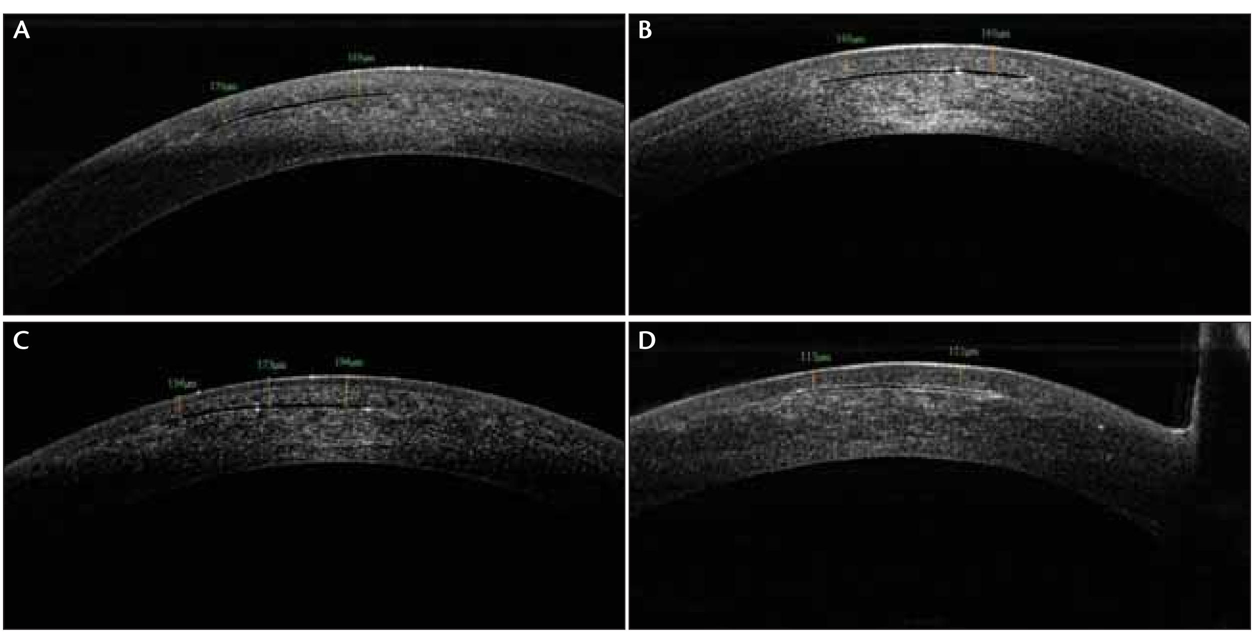

Figure 1. The architecture of (A,B) flaps created with femtosecond laser was more regular and accurate than that of (C,D) flaps created with a mechanical microkeratome.

TAKE-HOME MESSAGE

- The morphology of femtosecond laser and microkeratome flaps differ, especially in the periphery.
- Femtosecond laser flaps make thinner LASIK flaps with a tighter range than microkeratome flaps.
- Flaps created with a femtosecond laser are more regular and accurate compared with flaps created with a microkeratome.

COMPARING FLAPS

Four years ago, we performed our first cases with the PresbyLens (ReVision Optics, Inc., Lake Forest, California) corneal inlay, which is implanted under a LASIK flap in plano presbyopic patients.

For the first 2 years of the study, we created flaps using the Hansatome microkeratome (Bausch + Lomb, Rochester, New York). For the last 2 years, we created flaps with the 60-kHz IntraLase femtosecond laser (Abbott Medical Optics Inc., Santa Ana, California). We used anterior segment optical coherence tomography to evaluate all patients for the past 3 years.

The architecture of flaps created with the IntraLase was more regular and accurate compared with flaps created with the microkeratome (Figure 1).

CONCLUSION

Flap preparation is a crucial part of the LASIK procedure, and with the advent of corneal inlays it will become an important part of these procedures as well. Regularity and reproducibility of flap morphology improve the safety and visual outcomes of corneal refractive surgical procedures.[3]

Based on our results to date with the PresbyLens, we recommend flap creation with a femtosecond laser for implantation. Flap thickness should be targeted for 150 µm. ■

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