n the effort to optimize LASIK surgical outcomes, the sidecut has come under scrutiny. Advances in femtosecond laser technology allow the creation of ever more ablation patterns, and surgeons are left to determine the supremacy of one over another. This article discusses the recent evolution of the sidecut angle.

**RESEARCH**

Historically, mechanical microkeratomes create a fixed sidecut angle of between 25º and 30º.1 The mechanical microkeratome automatically slants the sidecut from the site of the blade’s entrance through the epithelium and then inward toward the visual axis so that the diameter of the flap at its base is smaller than at the epithelial surface. The sidecut angle is fixed by the manufacturer. The length of the wound depends on several factors including the intraocular pressure (IOP), the blade’s sharpness and oscillation speed, the translation speed of the microkeratome across the cornea, and—to a lesser degree—the corneal curvature. This oblique sidecut often gapes for several hours after the flap’s creation, and it also tends to gape in synchrony with the patient’s heartbeat, which changes the IOP. Histopathologic studies of excised lamellar refractive specimens from mechanical microkeratomes2 demonstrate the presence of epithelium within one-third to one-half of these wounds that never heal. Their oblique nature seems to create a path that the epithelium follows without difficulty, which leaves a wound that is easily opened.3

Previous iterations of the IntraLase femtosecond laser’s software (Abbott Medical Optics Inc., Santa Ana, California) allowed users to select a sidecut angle between 30º and 90º. In their in vitro biomechanical studies using laser shear speckle interferometry, Knox-Cartwright and Marshall demonstrated that increasing the sidecut angle from the standard 30º to an inverted bevel of 150º improved the incision’s resistance to deformation (data on file with Abbott Medical Optics Inc.).

Subsequent in vivo studies by Knorz and coworkers using the IntraLase iFS laser software (Abbott Medical Optics Inc.)4 in a rabbit model found that using an inverted sidecut angle of up to 150º significantly increased the wound’s strength. In a clinical study by Chayet, patients received a 70º oblique sidecut in one eye and a 150º inverse sidecut in their other eye (data on file with Abbott Medical Optics Inc.). The flaps were not lifted at the time of surgery. Ten weeks later, however, the surgeon, who was unaware of the type of sidecut used, lifted the flaps. Chayet graded the difficulty with which the flap was elevated and found that the inverted sidecut was more difficult to open (Figure 1). It is unclear, however, whether augmented wound healing will decrease the risk of post-LASIK ectasia.

**ADVANTAGES**

Theoretically, because changes in IOP will tend to close an inverted sidecut, it should gape less than an oblique sidecut. Moreover, because the diameter of the wound at the site of epithelial entrance is smaller than
the diameter at its base, fewer anterior lamellar and corneal nerves will be severed than with an oblique cut (Figure 2). Even fewer corneal lamellae would be affected if the inverted sidecut were combined with an elliptical flap of up to 12% using software available only on the IntraLase iFS laser. (A flap that is 9 mm in diameter with a 12% overlap would translate as a flap of approximately 8 X 9 mm in diameter.)

DISADVANTAGES

Are there disadvantages to an inverted sidecut of up to 150º? The diameter of the epithelial wound is smaller than that of the stromal wound at the base of the flap. As a result, the greater the angle of the inverted sidecut is, the smaller is the available diameter at the epithelial aperture through which to perform excimer laser ablation. For example, using an inverted sidecut target of 150º and a flap that is 9 mm in diameter would mean an anterior diameter of 8.4 mm, which could be too small for some hyperopic treatments. The surgeon would therefore have to attempt to increase the planned diameter of the flap or decrease the inverted sidecut angle. Because of the limitations on maximum flap diameter created by the anatomy of the individual eye and orbit of the patient, it might not be possible to achieve flaps with diameters greater than 9.2 mm. Under these circumstances, the surgeon could reduce the sidecut angle to 120º, thereby increasing the flap’s anterior diameter to 8.65 mm.

It takes longer to create an inverted versus an oblique sidecut. With an attempted diameter of 9 mm and a 7 X 8 spot-line separation, creating an inverted sidecut of 150º will take 17 seconds versus 11 for a 120º sidecut. The requirement of an oval flap will lengthen this time. Of course, the surgeon can further increase the spot-line separation to hasten the flap’s creation but at the cost of a rougher stromal bed and a flap that is more difficult to lift. In general, increasing the line separation has a greater benefit in terms of higher speed compared with increasing the spot separation. With the current IntraLase iFS laser, the maximum spot separation is 7 µm, and the maximum line separation is 9 µm. The spot-line separation are, as always, the surgeon’s choice. For the initially installed lasers, the settings and optimization ranged from 5 X 5 µm to 7 X 8 µm.

CONCLUSION

The theoretical and practical advantages of the inverted sidecut outweigh the disadvantage of the time required for its creation. With the IntraLase iFS laser, the surgeon now has the options of maximizing the sidecut with an oval flap to minimize structural damage to the cornea and decreasing the planned diameter of the flap. To augment the speed of the procedure, the ophthalmologist can increase the spot-line separation and decrease the inverted sidecut from 150º to 120º or less and maintain the benefit of the incision’s configuration. Unfortunately, other currently available femtosecond lasers do not have the software and hardware to permit these new sidecut angles. Because another manufacturer’s femtosecond laser uses technology that is akin to that of microkeratomes, the sidecut angles are similar to those created by a mechanical microkeratome. □

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