FEMTOSECOND LASER LASIK
Laser for flap creation affords numerous benefits, but also trades some old problems for new
by Cheryl Guttman Krader in Vienna

Femtosecond laser for LASIK flap creation offers many advantages, but it does not overcome all of the issues associated with mechanical microkeratomes, said Joseph Colin MD, at the 2nd EuCornea Congress. Dr Colin, chairman, Department of Ophthalmology, Bordeaux University Medical School, reviewed the differences in characteristics of flaps created using a femtosecond laser and mechanical microkeratome.

He concluded that while mechanical microkeratomes can create high-quality flaps, results from a number of studies establish the superiority of the laser for creating better quality flaps with more predictable thickness and smoother stromal beds. In addition, the femtosecond laser creates flaps with a more desirable, planar morphology compared with a mechanical microkeratome, which enables better positioning to reduce risks of epithelial ingrowth and striae formation.

The laser also offers greater customisation. Hinge location can be varied, which can be helpful in some eyes, flap shape can be oval, which may decrease resection of corneal nerves, and side-cut angulation can be bevel-in, which has the potential to improve flap stability and decrease epithelial ingrowth.

Benefits for improved flap geometry and for limiting many intraoperative flap complications of mechanical microkeratomes have contributed to the increased popularity of femtosecond laser LASIK. In addition, outcomes data show that relative to eyes with a mechanical microkeratome flap, femtosecond laser flap eyes have less loss of low contrast visual acuity, and, in most studies, less induced high order aberrations. Better clinical outcomes have reduced enhancement rates and helped offset the cost of the laser, said Dr Colin.

“However, our experience and others’ show that there are still some safety issues. As reported by Moshfegi et al, while the femtosecond laser and mechanical microkeratomes differ in their complication profiles, with major epithelial defects and dislocated flaps more common using mechanical microkeratomes and the laser being associated with more diffuse lamellar keratitis (DLK), the total complication rate is similar. In addition, an advantage for reducing the incidence of epithelial ingrowth with the laser has not yet been corroborated by clinical evidence, and while thin-flap LASIK (sub-Bowman’s keratomileusis) helps preserve stroma and so may reduce the incidence of corneal ectasia, it seems to be associated with an increased incidence of interface haze.”

Dr Colin noted that a study by Michael Knorz MD, showed improved flap adhesion with femtosecond laser-created flaps having a bevel-in side cut. However, using the Ocular Response Analyzer (Reichert) to measure corneal biomechanical properties, Dr Colin and colleagues found no differences in corneal hysteresis or corneal resistance factor values between eyes with bevel-in femtosecond laser versus mechanical microkeratome flaps.

Thicker flap Intraoperative problems associated with the mechanical microkeratome that still occur using the femtosecond laser include suction loss leading to an incomplete flap and creation of an irregular flap. However, with an incomplete laser flap, the procedure can usually be completed with a second laser pass at the same thickness level, and an irregular flap is very rare, occurring particularly in eyes with a previous corneal scar. Management for this complication involves creating a thicker flap at a later time using a mechanical microkeratome.

DLK still occurs with the femtosecond laser and seems to be more common than with mechanical microkeratomes. However, according to two published studies, the risk of epithelial ingrowth is greater after an enhancement procedure (~2 per cent) and is extremely rare using the femtosecond laser in primary femtosecond laser LASIK (incidence zero per cent and 0.3 per cent).

“In one study, the risk of clinically significant ingrowth was especially increased if the flap lift was after three or more years. So in this situation, surface ablation with or without mitomycin-C may be preferred for retreatment,” Dr Colin said.

Unique intraoperative issues accompanying use of the femtosecond laser include opaque bubble layer (OBL), anterior chamber bubbles, and epithelial breakthrough. OBL, a collection of gas bubbles in the intralamellar spaces above and below the resection plane, may make flap lifting more difficult, impede some excimer laser trackers, and possibly change the rate of tissue ablation, resulting in some induced astigmatism. Bubbles in the anterior chamber occur very rarely and also interfere with infrared pupil trackers. In these eyes, the surgery can proceed without active pupil tracking or after waiting a few hours for the bubbles to disappear.

Epithelial breakthrough, in which gas bubbles break through the epithelium within the flap margin prematurely, has an estimated incidence of 0.1 per cent and is most likely if the flap thickness is programmed to be 100 microns or less or in eyes with a focal break or scar in Bowman’s membrane. However, in most cases, the flap can still be lifted and the ablation performed safely.

Unique postoperative complications of femtosecond laser flap creation include transient light sensitivity (TLS), in which patients develop photophobia two to six weeks after an uneventful procedure, and rainbow glare, where patients perceive a spectrum of coloured bands radiating from a white light source in darkness.

“Rainbow glare is not serious, but it can cause complaints from patients who expect perfect results,” Dr Colin said.

Results of a retrospective safety analysis including 1200 consecutive eyes that underwent femtosecond laser LASIK at Bordeaux University show the rate of intraoperative and postoperative flap complications was similarly low (~0.7 per cent). Intraoperative complications included two cases each of anterior chamber gas bubbles interfering with laser pupil tracking and premature breakthrough of gas bubbles through the epithelium, three incomplete flaps due to suction loss, and one irregular flap in an eye with a previous corneal scar.

Six eyes developed DLK, which was stage three to four in two eyes, and there were three cases of TLS.