CORNEAL SURGERY
Epithelial thickness profiles may prove to be useful diagnostic tool in screening for keratoconus

by Dermot McGrath in Paris

A device capable of accurately measuring epithelial thickness may prove beneficial in the planning of corneal refractive surgery as well as being a potentially useful tool in screening for suspect keratoconus, according to Georges Baikoff MD.

Dr Baikoff told delegates attending the annual meeting of the French Implant and Refractive Surgery Association (SAFIR) that the ability to characterise the epithelial thickness profile may help to increase the accuracy of corneal refractive surgery as epithelial changes are known to play a role in refractive regression.

“Everything in OCT is good. Dan Z Reinstein MD has paved the way with his studies with the Artemis on the importance of epithelial dynamics. We now know that epithelium absorbs a vacuum and its refractive effect should be taken into account when planning surgery. The epithelial pachymetric maps complete the topographic information and should also be borne in mind for the diagnosis of suspect keratoconus,” said Dr Baikoff who is in private practice in Marseille, France.

Explaining the principle behind epithelial thickness mapping, Dr Baikoff said that a thickness map is derived from the corneal power scan using the RTVue SD-OCT device (Optovue Inc). Each corneal power scan contains five consecutive sets of pachymetry scans of eight meridians of the cornea. A scanning algorithm then detects the epithelial interface based on averaged data, and uses this information to build up epithelial profile maps. He presented data from a retrospective study of scans of 145 myopic eyes, 67 hyperopic eyes and 106 keratoconic eyes.

He noted that in normal eyes the average thickness of the corneal epithelium, including tear film, is about 52 microns with a standard deviation of about three or four microns.

For myopic eyes treated by LASIK, the epithelial maps showed that the thickness of the central zone typically increased compared to the periphery.

“The epithelial pachymetry map is therefore concordant with the treatment zone. This raises several questions: is it constant? Is there a correlation with the initial extent of the myopia? Is there a correlation with the initial keratometry value? And is there a relation in cases of regression?” he asked.

Looking at the myopic LASIK treatments, the mean postoperative central epithelial thickness was 57 microns compared to 52 microns before LASIK, a statistically significant difference, said Dr Baikoff.

“In myopic LASIK, the thickness of the central epithelium and the delta value, which denotes the difference between the maximum and minimum thickness values, vary according to the extent of the refractive treatment. However, the thickness of the central epithelium and the delta value are independent of the preoperative keratometry,” he said.

Turning to corneal regression, Dr Baikoff noted that the thickness of the central epithelium was found to increase in cases of refractive regression and that being able to distinguish epithelial from biomechanical causes of regression may help in planning retreatment surgery. “In this particular case, for instance, we see that there would be no benefit in retreating with a transepithelial PRK, effectively treating 15 microns on an epithelium that is greater than 50 microns,” he said.

Epithelial thickness profiles may also prove to be a useful diagnostic tool in screening for keratoconus, as it is known that the epithelium thins over the region of the cone in keratoconus, sometimes leading to epithelial breakdown.

As it is difficult for the surgeon to distinguish forme fruste keratoconus from other types of mildly irregular corneal topographies, the pachymetry map can provide important additional data to confirm or reject the diagnosis and determine if the patient is a good candidate for refractive surgery, said Dr Baikoff.

“Our scans showed an almost perfect concordance between the summit of the cone, the thinning of the corneal stroma and the thinning of the epithelium,” he said.

The potential benefits of using OCT pachymetry intraoperatively in LASIK patients were also highlighted in a separate study by Jean-Luc Febbraro MD.

Dr Febbraro’s prospective study evaluated the central corneal thickness and flap thickness in 66 eyes of 49 myopic and 17 hyperopic patients who underwent femto-LASIK procedures using the Wavelight Alcon FS200 and EX500 excimer laser.

The myopic patient group had a mean preoperative spherical equivalent of -4.53 D and astigmatism of -0.56 D, while the hyperopic patients had a preoperative mean of +2.56 D and astigmatism of -1.29 D. Flap thickness was programmed for 120 microns for all patients, with a 9.2mm flap diameter for myopes and 9.5mm for hyperopes.

Results showed the mean achieved post-LASIK flap thickness for the hyperopic group was 127.94 microns, with a standard deviation of 22.30 microns after treatment compared to 94.94 microns before treatment. For the myopic group, the flap thickness was 119.26 microns after treatment, with a standard deviation of 43.56 microns, compared to 102 microns before treatment.

Although the flaps for both the myopic and hyperopic treatments were slightly thinner than programmed, intraoperative pachymetry should still prove to be an invaluable addition to the refractive surgeon’s toolkit in the future, said Dr Febbraro. “Our study showed that the intraoperative pachymetry measurements seem to be viable and include information on total corneal thickness, flap thickness and residual corneal bed. With this data to hand, we can then customise the ablation depth and ensure more accurate and safer surgery,” he said.