

Artemis epithelial thickness mapping helps to detect keratoconus



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EPITHELIAL thickness mapping may enable LASIK to be performed in eyes that get excluded due to topographically suspect keratoconus. A majority of suspect keratoconic eyes by topography in a recent study were confirmed to be non-keratoconic by epithelial thickness mapping,

and demonstrated equal stability and refractive outcomes as control eyes, at six to 12 months.

"Forme fruste keratoconus is defined as cases which show demonstrable topographic abnormalities consistent with keratoconus in the absence of other clinical evidence of keratoconus. In 2005, an AAO/ISRS Ectasia Committee suggested that patients with abnormal, but stable, topography could be offered PRK with special informed consent provisions. However, there are a number of reported cases of ectasia after PRK, so I feel that an abnormal topography should still be regarded as a contraindication even for surface ablation. The ideal solution would be to possess a diagnostic technique that tells us if keratoconus is present, in which case we would not perform corneal surgery, or tells us if keratoconus is completely absent, in which case not only PRK, but LASIK can be done. Artemis very high-frequency digital ultrasound technology appears to give us this information," said Dan Reinstein MD MA (Cantab) FRCSC DABO FRCOphth during the presentation he gave at the XXV Congress of the ESCRS. The Artemis can measure the epithelium over a 10mm diameter with 1 µm precision and map the epithelial thickness profile in three dimensions.

In a retrospective analysis of 1,352 consecutive myopic eyes, 104 (7.7 per cent) eyes were deemed to be suspicious of keratoconus, forme fruste keratoconus or simply had an equivocal topography according to Atlas placido and Orbscan II slit-scanning

topography despite no other clinical signs of keratoconus. Prof Reinstein used epithelial thickness mapping to characterise corneas with suspected keratoconus. Of the 104 eyes, 14 (17 per cent) were confirmed as keratoconus by Artemis epithelial thickness mapping and were rejected for surgery. A diagnosis of keratoconus was excluded by Artemis epithelial thickness mapping in the remaining 90 eyes (83 per cent) and all these eyes underwent LASIK.

The investigator used a matched controlled group that was within 0.50 D of the sphere, cylinder, and spherical equivalent of the study patients. The refractive outcomes and stability of the spherical equivalent and cylinder were compared between the study and control groups. Prof Reinstein found that the stability of spherical equivalent and cylinder over one year to be the same between the study and control groups. The refractive results between the two groups were statistically identical. The average change in the spherical equivalent between three months and one year was -0.03 D for the suspect keratoconic group and -0.09 D in controls. The spherical equivalent changed by more than 0.50 D between three months and one year in a higher percentage of eyes in the control group (6.8 per cent) than the study group (5.3 per cent), although the difference was not statistically significant, he observed. There was also no statistically significant difference in spherical equivalent or cylinder vector analysis between the groups at three months and one year.

Prof Reinstein confirmed a diagnosis of keratoconus if the epithelial thickness profile showed relative epithelial thinning coincident with the location of the topographically suspected cone.

In a separate study of 40 confirmed keratoconic eyes, Artemis analysis revealed that there was an infero-temporal region of thin epithelium surrounded by a zone of epithelial thickening.¹ This pattern was coincident with the cone on topography, demonstrating how the epithelium thins and thickens as it tries to compensate for stromal surface irregularity produced by a bulging cone.

This pattern observed in keratoconus was distinct from the pattern found in normal corneas. In another study, Prof Reinstein examined epithelial thickness profile in a population of 110 normal eyes, using mirror symmetry to show temporal and nasal characteristics, and found that the average profile was about 6 µm thicker inferiorly than superiorly.²

Prof Reinstein observed that in early stages of keratoconus, the epithelium is able to compensate fully for the sub-surface cone, topographically evident on the back surface, resulting in an apparently normal anterior surface topography. These early epithelial changes that occur in keratoconus are detectable by Artemis epithelial mapping, he said.

Keratoconic eyes show detectable changes on epithelial thickness profile maps enabling refractive surgeons to identify patients in whom corneal ablative procedures are contraindicated, as well as patients who are suitable for surgery despite topographic findings suggestive of keratoconus. He postulated that the reason for the confusion clinically as to whether PRK was safe on suspect keratoconic eyes was that only some of the eyes treated were keratoconic, while most of them were not. "Empirically, it may take clinicians another 10 years to determine that this was actually the fact. Nonetheless, looking at epithelial thickness profiles appears to allow us to distinguish these two groups, rule out keratoconus, and do LASIK," he said.

1. Reinstein DZ, Archer TJ, Gobbe M. Exclusion of keratoconus initially diagnosed by Orbscan using epithelial and stromal layer thickness mapping. AAO. Las Vegas, 2006.

2. Reinstein DZ, Archer TJ, Gobbe M, Silverman RH, Coleman DJ. Epithelial Pachymetric Topography of the Normal Cornea. *J Refract Surg. [In Press]*.

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