SCORE: An Algorithm for Ectasia Screening

Optimized for use with the ANTERION. | DAMIEN GATINEL, MD, PHD

Post-LASIK ectasia is the most dreaded complication after refractive surgery. Evidence-based screening tools can be used successfully, but some are considered controversial because they do not incorporate the latest advances in diagnostics. In attempt to improve our detection capacities, my colleagues and I set out to devise a simple, efficient, and objective algorithm for ectasia screening. The Screening Corneal Objective Risk of Ectasia (SCORE) Analyzer is AI software designed to aid in clinical decision-making and detecting forme fruste (asymmetrical) keratoconus and ectasia. The SCORE software will be integrated into the ANTERION Ectasia Display by Heidelberg Engineering. The expected release is spring 2022.

BACKGROUND AND DESCRIPTION

Several topographical parameters can discriminate for ectasia, including corneal thinning from the periphery to the center, irregularity at 3 mm, vertical decentration of the thinnest point, and differences between central and thinnest pachymetry and mean inferior and superior keratometry measured 5 mm from the vertex. No indice should be used independently to screen for ectasia because each one alone cannot differentiate, with sufficient sensitivity and specificity, normal from irregular corneas. Taken collectively, like with SCORE, however, they can be used to produce a sensitive and specific diagnostic test for both forme fruste keratoconus and ectasia.

SCORE uses 12 of the most discriminant indices for ectasia. The software can classify ectasia according to the degree of similarity with corneas that are likely to progress to ectasia. The algorithm is based on measurements from 265 patients split into two groups—a control group of 189 eyes with at least 4 years of documented unremarkable history for ectasia and a keratoconus group of 76 eyes with forme fruste keratoconus. The normal eyes of the control group were matched with the least-affected eye of patients with asymmetrical keratoconus (ie, one eye with frank keratoconus and the other eye with minor abnormalities but within the classical topographic limits of detection).

In our experience, SCORE can detect about 75% of the corneas that are at risk for post-LASIK ectasia. The graphic user interface of the investigational ANTERION Ectasia Display is shown in
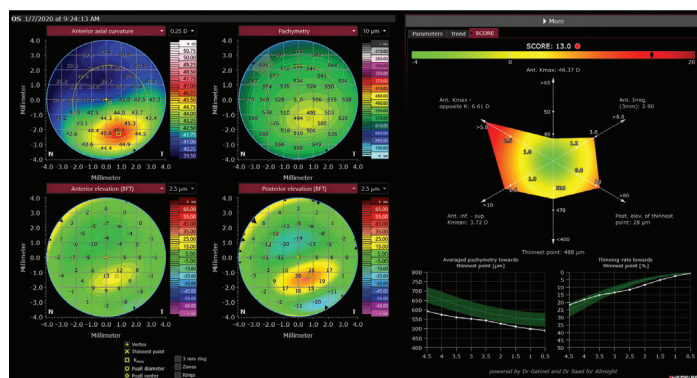

Figure 4. ANTERION Ectasia Display showing customizable corneal maps and SCORE. The SCORE tab presents the SCORE value, a radar map and pachymetry diagrams (powered by Dr. Gatinel and Dr. Saad). The SCORE value consists of different parameters that describe the magnitude of corneal steepening, thinning, and asymmetry to assist clinicians in detecting and monitoring ectatic changes. *(The image shows investigational software that is currently under development.)*

Figure 4. The measurements are combined in a linear discriminant function, and all relevant metrics are multiplied by a coefficient to discriminate forme fruste keratoconus from normal corneas.

ANTERION Ectasia Display includes different corneal maps that can be customized. The SCORE tab includes the SCORE value and diagrams for average pachymetry and the thinning rate toward the thinnest point. The lower the curves, the more discriminant of ectasia. The software's RADAR map also allows direct and intuitive visualization of values for some of the parameters used for the SCORE. The score is shown as a value; a normal cornea is scored as -0.5 or below.

CONCLUSION

The ANTERION Ectasia Display is currently under development and is expected to be released in spring 2022. Our SCORE formula has been optimized for use with the ANTERION. The incorporation of this software will improve the quality of the corneal measurements obtained with the device and will provide modern methods for screening for keratoconus and other ectatic diseases. ∎

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