Subclinical Keratoconus Detection by Multiparametric Corneal Biomechanical Characterization with the Ocular Response Analyzer

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Categories: Ophthalmology
Keywords:

How to cite this poster

Abstract

Purpose: To compare corneal waveform descriptors of the Ocular Response Analyzer (ORA) in healthy and subclinical keratoconus eyes to assess their diagnostic capacity.

Methods: 95 eyes from 95 healthy subjects in group 1 and 70 fellow eyes from 70 unilateral manifest keratoconus patients were evaluated with ORA, corneal topography, aberrometry and anterior segment optical coherence tomography. Corneal hysteresis (CH), corneal resistance factor (CRF) and other 41 parameters were obtained from the corneal waveform curves and compared between groups. Linear regression was used to correct for the effect of central corneal thickness (CCT) on correlated parameters and diagnostic performance was assessed by receiver-operating characteristic curve analysis. Results: 29 of the 41 additional biomechanical parameters, along with corneal hysteresis (CH) and corneal resistance factor (CRF), showed statistically meaningful differences between the groups (p<0.05, Student’s t test). Six parameters, including CH and CRF, were significantly correlated with CCT in both groups. The parameters CRF, TimeIn, H2, H21 and Dive2 had the best performances (area under the curve, AUC), and only CRF’s was improved after correcting for CCT. Combinations of these parameters had better diagnostic yields (error rate < 20%) than when considered individually, the highest being the combination of the 10 best parameters (AUC=0.82). These results applied also to eyes with normal higher-order 5-mm anterior corneal surface aberrations (<0.544 µm, taken from mean±1 SD of group 1), outperforming corneal topography. Conclusions: Multiparametric biomechanical analysis with the ORA can detect a higher proportion of eyes with subclinical keratoconus than corneal topography, with a better diagnostic yield than CH and CRF when considered individually.