Advancing anterior segment OCT beyond epithelium mapping: Anterior surface and subepithelium topography

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Purpose
To quantify and compare the keratometry and wavefront aberration of the anterior corneal surface (ACS) and Epithelium-Bowman's layer interface (EBI) using anterior segment swept source optical coherence tomography (SS-OCT)

Methods
The study included 25 normal and 25 keratoconus (KC) eyes. All subjects underwent topographic measurement (25 radial scan mode) using Pentacam (OCULUS Optikgerate Gmbh, Germany). Corneal imaging was performed using SS-OCT (DRI-Triton Plus, Topcon Systems, Japan). The device acquired 12 radial scans from 0º to 180º at A-scan rate of 100,000 lines per second. The ACS and EBI edge were detected in radial scans of OCT and curvature was computed. Since OCT scans were of 6 mm diameter, Pentacam data was truncated to 6 mm. The keratometry and wavefront aberrations (Zernike analyses up to 6th order) were computed with net refractive index of 1.3375.

Results
Figure 1 shows example of a normal (top row) and KC eye (bottom row) axial curvature. The 1st, 2nd and 3rd columns shows the Pentacam anterior surface, OCT ACS and OCT EBI topography, respectively. The remarkable similarity between the measurements is evident. The figure also shows the simulated keratometry. In KC, there is nearly 1.8D steepening in simulated keratometry from ACS to EBI. In normal eyes, keratometry of ACS OCT and EBI OCT was similar ($p>0.05$). Further, the flat axis (K1) and maximum keratometry (Kmax) of ACS OCT was significantly different from Pentacam ($p<0.05$). Among wavefront aberrations, defocus, spherical aberration and astigmatism 0º of ACS OCT was statistically different from EBI OCT in normal eyes ($p<0.05$). In KC eyes, keratometry of ACS OCT and Pentacam was similar ($p>0.05$). The K1and Kmax of ACS OCT was significantly different from EBI OCT ($p<0.05$). Further, defocus, horizontal coma, spherical aberration, astigmatism 45º of ACS OCT was similar ($p>0.05$) to EBI OCT. (Figure 2) The Kmax of ACS OCT correlated with EBI OCT in normal ($r=0.92$; $p<0.001$) and KC eyes ($r=0.98$; $p<0.001$). Also, (Figure 2) the mean keratometry of ACS OCT correlated with EBI OCT in normal ($r=0.93$; $p<0.001$) and KC eyes ($r=0.98$; $p<0.001$).

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Conclusions

A new method of corneal tomography was developed. This method can significantly alter the planning of surgeries and assessment of disease. Since most treatments are intended on the stroma, topography of EBI OCT before surgery could deliver improved therapeutic outcomes.

Financial disclosure: None

Figure 1

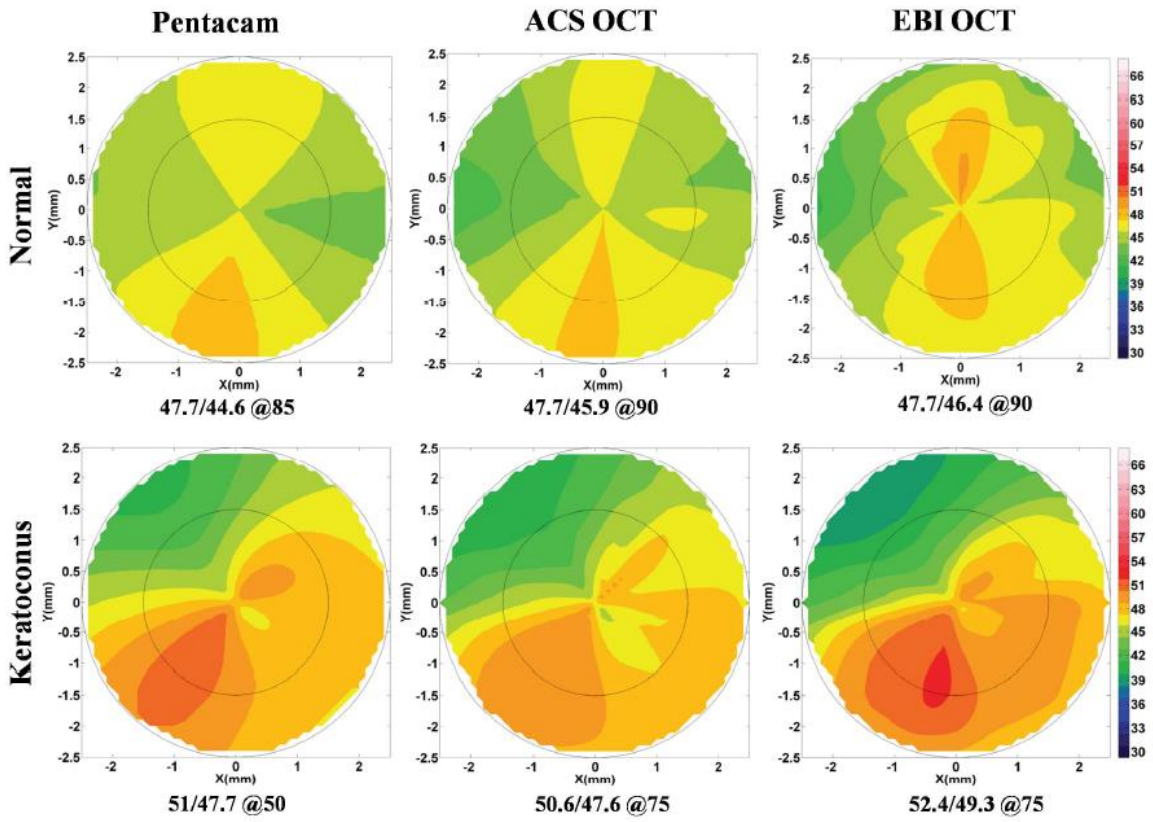

Figure 1: Axial curvature from Pentacam, anterior corneal surface (ACS OCT) and Epithelium-Bowman's layer interface (EBI OCT) of one normal and one keratoconus eye

Figure 2

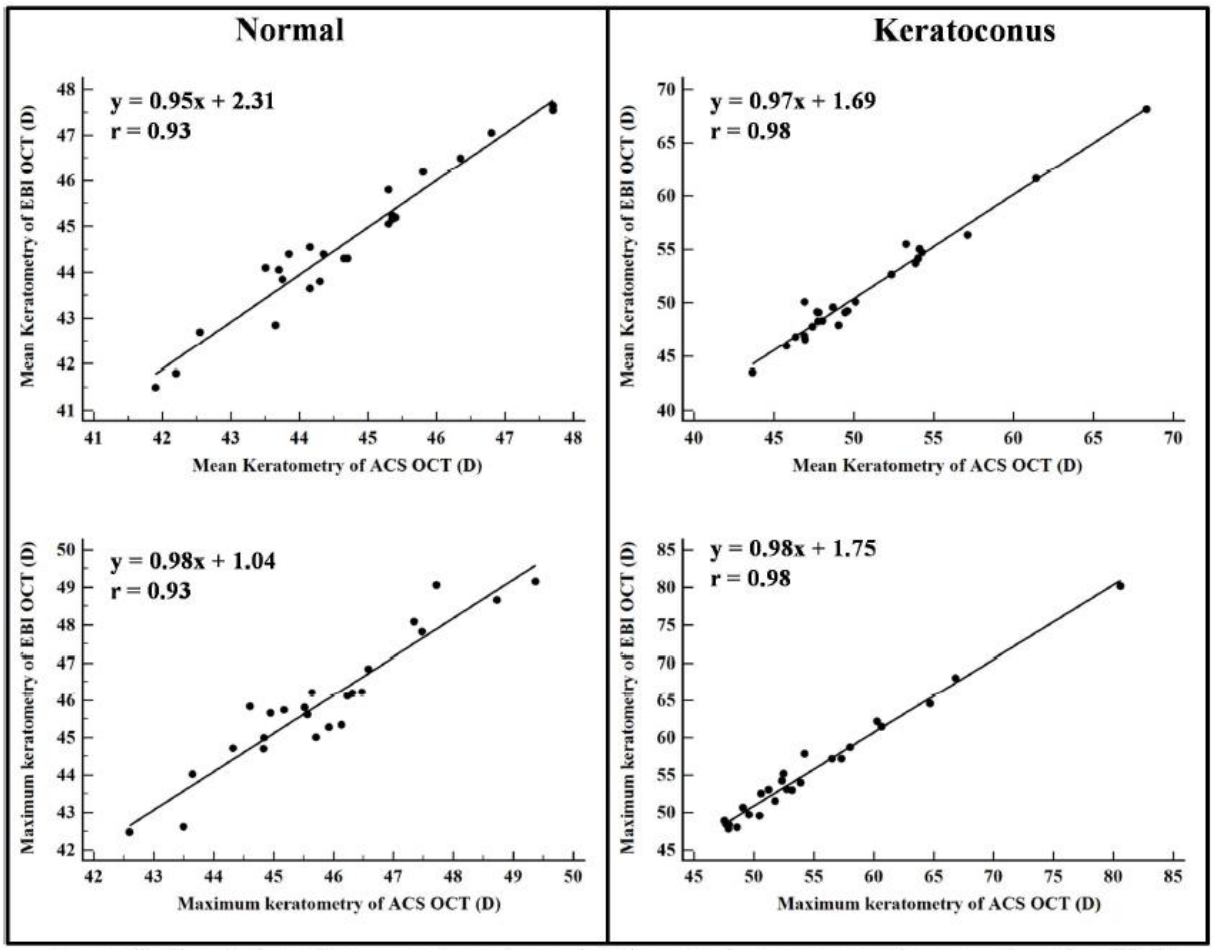

Figure 2: Correlation of mean and maximum keratometry between anterior corneal surface (ACS OCT) and Epithelium-Bowman's layer interface (EBI OCT) in normal and keratoconus eyes