Assessment of retinal curvature, choroidal thickness, and peripheral refraction over a 90-degree field of view in emmetropic and myopic human eyes

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PURPOSE

The purpose of this pilot study is to evaluate novel tools for myopia research. We acquired data on human eyes using new tools to estimate retinal curvature, and to measure choroidal thickness and peripheral refraction.

METHODS

- Retinal curvature and choroidal thickness were assessed using a prototype 200 kHz swept-source optical coherence tomography system (OCT) with a 90-degree field of view and a prototype multilayer segmentation algorithm.
- Retinal curvature was estimated using the method described by Steidle in Biophotonics: Photonic Solutions for Better Health Care VI (2018).
- Relative peripheral refraction was measured as the difference between refractive error at 30° and the central foveal refractive error. We used a CLARUS™ 500 fundus imager (ZEISS, Dublin, CA) with prototype software using the method described by Everett (ARVO 2018).
- OCT scans were acquired in 26 eyes of 13 subjects.
- Relative peripheral refraction was measured in 42 eyes of 21 subjects.

RESULTS

- Figure 1 shows retinal OCT scans with choroidal segmentation.
- Figure 2 shows axial eye length vs. refractive error, relative peripheral refraction, central choroidal thickness and retinal curvature.
- Refractive errors ranged from -14.5 to +4.0 diopters, axial length from 21.92 to 29.81mm, central choroidal thickness from 93 to 440 µm, peripheral refraction from -2.15 to +9.0 diopters and retinal radius of curvature from 10.8 to 16.0mm.
- We found a strong correlation between axial eye length and refractive error (OD: r=-0.86, 95% CI -0.94 to -0.70, *p<0.01;* OS: r=-0.83, 95% CI -0.94 to -0.69, *p<0.01*) and a moderate correlation between axial eye length and relative peripheral refraction (OD: r=0.80, 95% CI 0.56 to 0.92, *p<0.01;* OS: r=0.60, 95% CI 0.23 to 0.82, *p<0.01*).
- We found a weak correlation between axial eye length and central choroidal thickness or retinal curvature.

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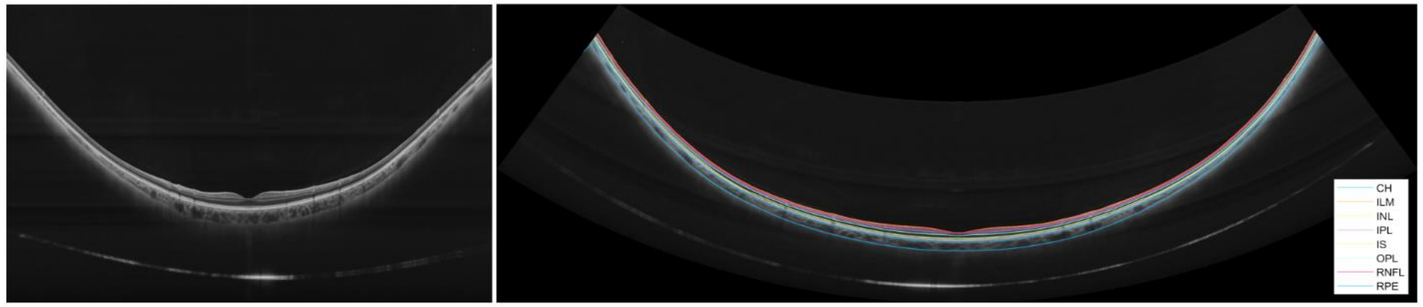

Figure 1: Estimation of retinal curvature and choroidal thickness. Left: Original widefield OCT scan of a mildly myopic eye. Right: Corrected scan showing the retinal shape and an overlay of the segmentation layers.

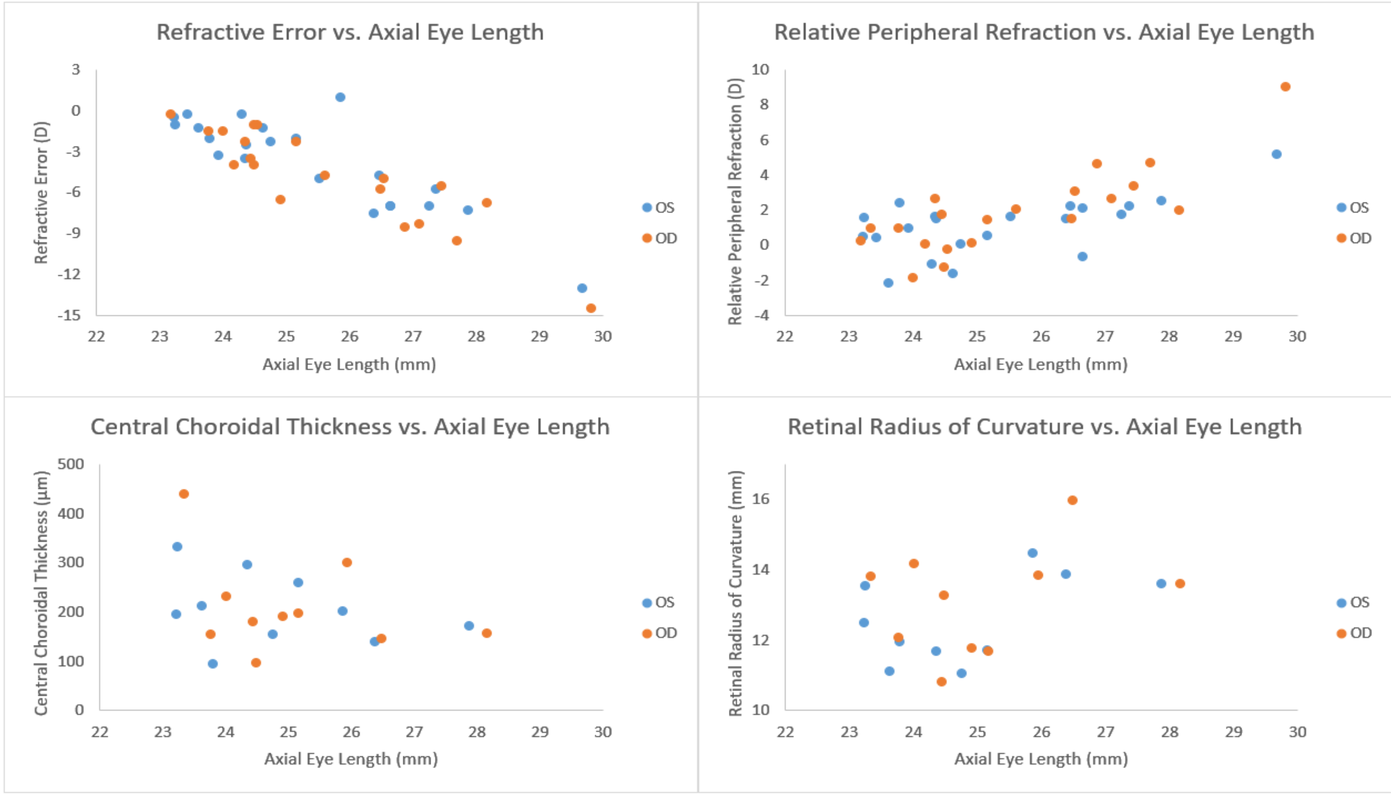

Figure 2: Axial eye length vs. refractive error, peripheral refraction, central choroidal thickness and retinal radius of curvature.

CONCLUSION

Our pilot study has shown that we can measure peripheral refraction, estimate retinal curvature, and measure choroidal thickness of the human eye up to a field of view of 90 degrees using our novel tools. These tools can be useful for research in the anatomy of the human eye and as diagnostic tools in myopia control.