Application of new imaging technologies in high myopic eyes

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PURPOSE

High myopia is a growing epidemic world-wide. Development and progression of myopia is the subject of extensive scientific efforts. The tools available to researchers to assess anatomy, function, and dynamic changes are mostly limited to refractive error, axial length, central choroidal thickness, and peripheral refraction. These tools provide mainly single measurement points, are difficult and time-consuming to administer, have limited availability, or are expensive. We demonstrate how new ophthalmic imaging technologies can provide better data for high myopic eyes over a large 90-degree field of view (FOV), including choroidal thickness, retinal curvature, and peripheral refraction maps.

METHODS

- **Choroidal thickness** was assessed using a prototype 200kHz swept-source optical coherence tomography system (OCT).
- **Relative peripheral refraction** was measured as the difference between refractive error at 30˚and 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).
- **Retinal curvature** was assessed using a prototype 200kHz swept-source optical coherence tomography system (OCT) with a 90-degree FOV and prototype segmentation software. Retinal curvature was estimated using the method described by Steidle in Photonic Solutions for Better Health Care VI (2018).
- To validate the results, we created models of individual human eyes by customizing the Arizona Eye Model using measured axial eye length, refractive error, corneal power, and retinal curvature

CONCLUSION

Widefield fundus imaging and OCT enable new methods for measuring large FOV choroidal thickness, peripheral refraction, and retinal curvature. These technologies will help to further advance our knowledge of high myopia, myopia progression, and myopia treatment.

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RESULTS

A total of 42 eyes of 21 subjects were enrolled in the study ranging in axial length from 21.92 to 29.81mm. 90-degree FOV OCT scans were acquired in 26 eyes of 13 subjects. Central choroidal thickness ranged from 93 to 440 microns, retinal radius of curvature from 10.8 to 16.0mm. Peripheral refraction was measured in 42 eyes of 21 subjects and ranged from -2.15 to +9.0 diopters. Simulation and measurement of peripheral refraction were matched within +/- 3D.

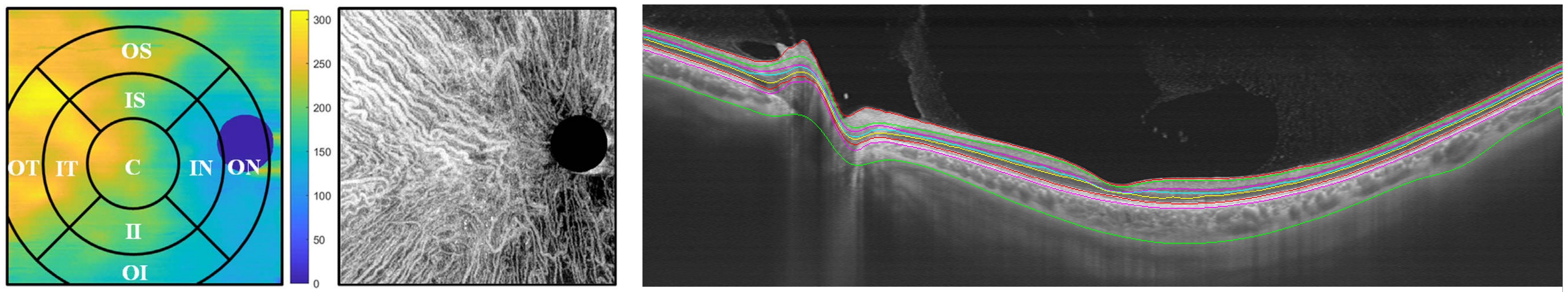

Figure 1: **Choroidal thickness** map (in microns) of a right eye over a 12x12mm field of view (left). Choroidal vasculature map (center) and multi-layer segmentation overlaid on a B-Scan (right). From: Bagherinia, ARVO 2019.

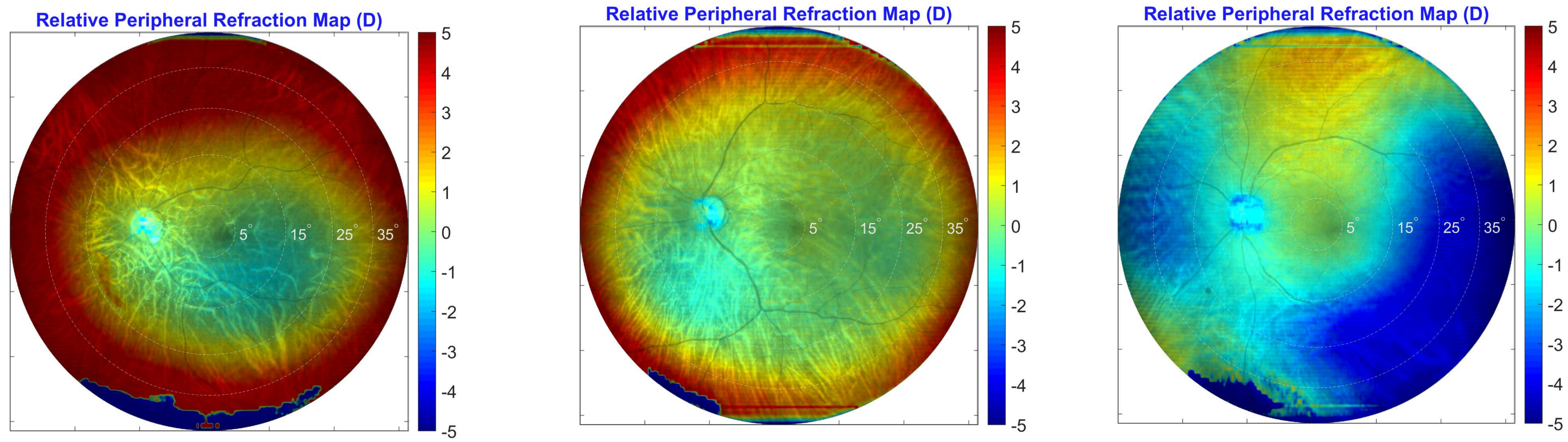

Figure 2: **Relative peripheral refraction** maps over a 90-degree field of view: (left): high myope OS -8.75 / -1.00 x 162 (center): mild myope OS -3.25 / -0.75 x 110; (right) hyperope with strong cylinder OS +4.00 / -2.75 x 158

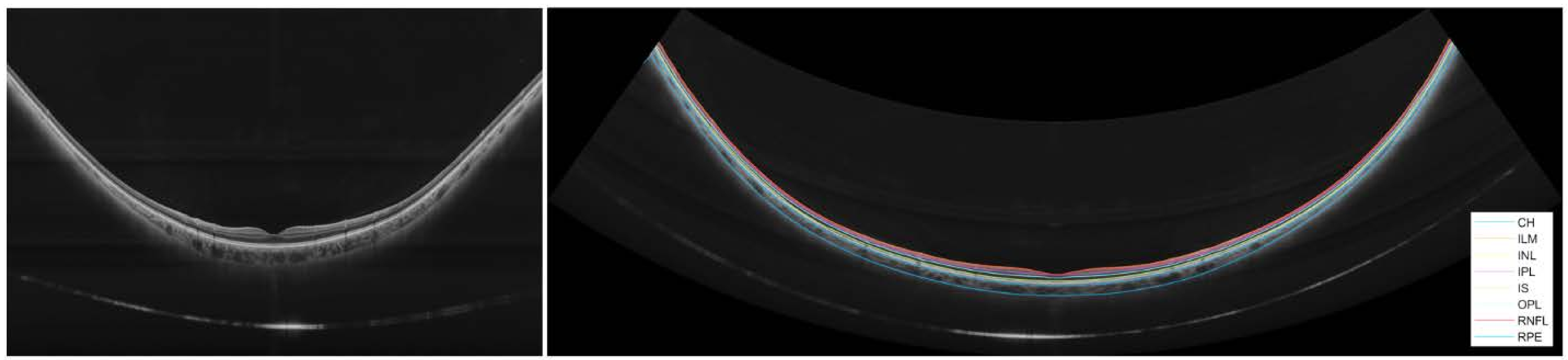

Figure 3: Estimation of **retinal curvature**. Left: Widefield OCT scan of a mildly myopic eye. Right: corrected retinal shape.