

Anterior segment dewarping using swept-source OCT (SS-OCT) cube scans



Nelson Tate; Homayoun Bagherinia, PhD; Zahra Nafar, PhD
Carl Zeiss Meditec, Inc., Dublin, CA, USA

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PURPOSE

SS-OCT anterior segment scans may create images that do not accurately represent the anatomy due to beam geometry and refraction through the cornea. Dewarping is important to reduce errors in iridocorneal angle measurements for accurate diagnosis of narrow angle glaucoma. The purpose of this study is to determine the error induced by warping (and corrected by dewarping) in cube scans.

METHODS

- A flat checkerboard test eye was scanned at three axial positions (top, middle, bottom).
- From those scans the anterior surface refractive correction and the equal optical path length deviation, also called sagittal heights (SAG), were identified.
- Using those values in combination with the field of view (FOV), dewarping parameters were calculated for five fast B-scans (at 1 to 5 mm in slow scan direction) to interpolate for all B-scans in the cube.
- 5 subjects (one or both eyes, multiple scans) were scanned using the PLEX® Elite 9000 SS-OCT system (ZEISS, Dublin, CA) with a front-mounted external lens to focus the OCT beam on the irido-corneal angle with a FOV of 6x6x6 mm cube scans (3072x500x500 pixels corresponding to axial x fast scan direction x slow scan direction).
- By using the anterior and posterior sclera, cornea, and iris surface segmentations, changes in refractive indices were accounted for.
- Using ImageJ's protractor tool, an expert grader manually measured the irido-corneal angle on three images at 1.5 mm, 3 mm, 4.5 mm that were extracted from the cube scan before and after dewarping.
- The regression and mean differences of the measurements were plotted and the statistics of angle measurement errors were reported.

CONCLUSIONS

Correctly dewarped images are critical to having more accurate irido-angle measurements for anterior segment biometry. When not corrected, image warping can lead to significant over-estimation of iridocorneal angle measurements, which is important for glaucoma diagnosis.

Email: nelson.tate@zeiss.com

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RESULTS

Figure 1 shows an example of the iridocorneal angle image before and after dewarping. The mean and standard deviation of the absolute measurement error are 4.9° and 2.4° respectively. The regression and mean difference plots (Figure 2) show that while correlation remains high (0.91), a mean difference of -4.8° was observed.

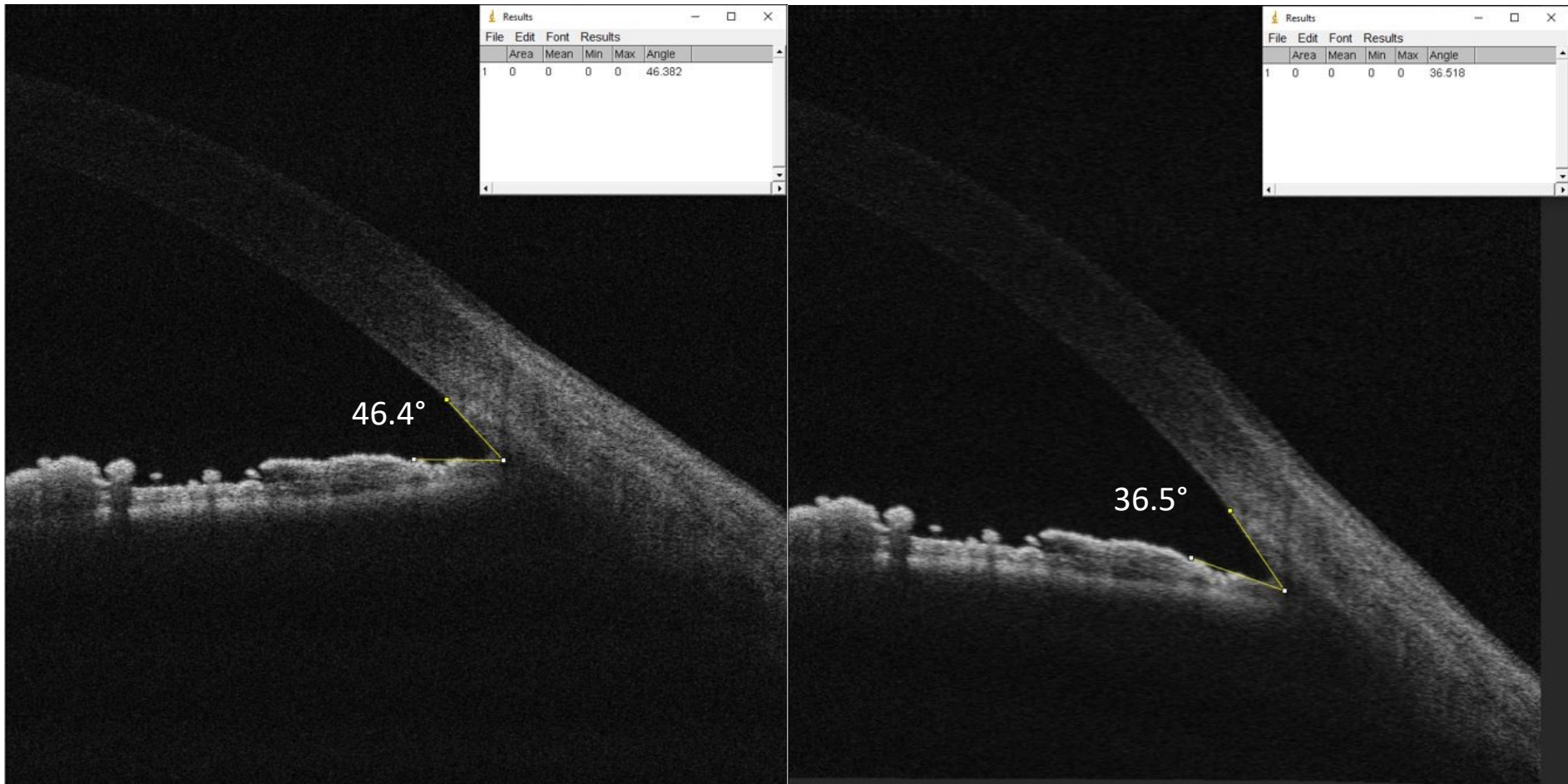


Figure 1: Example of irido-corneal angle measurement before and after dewarping

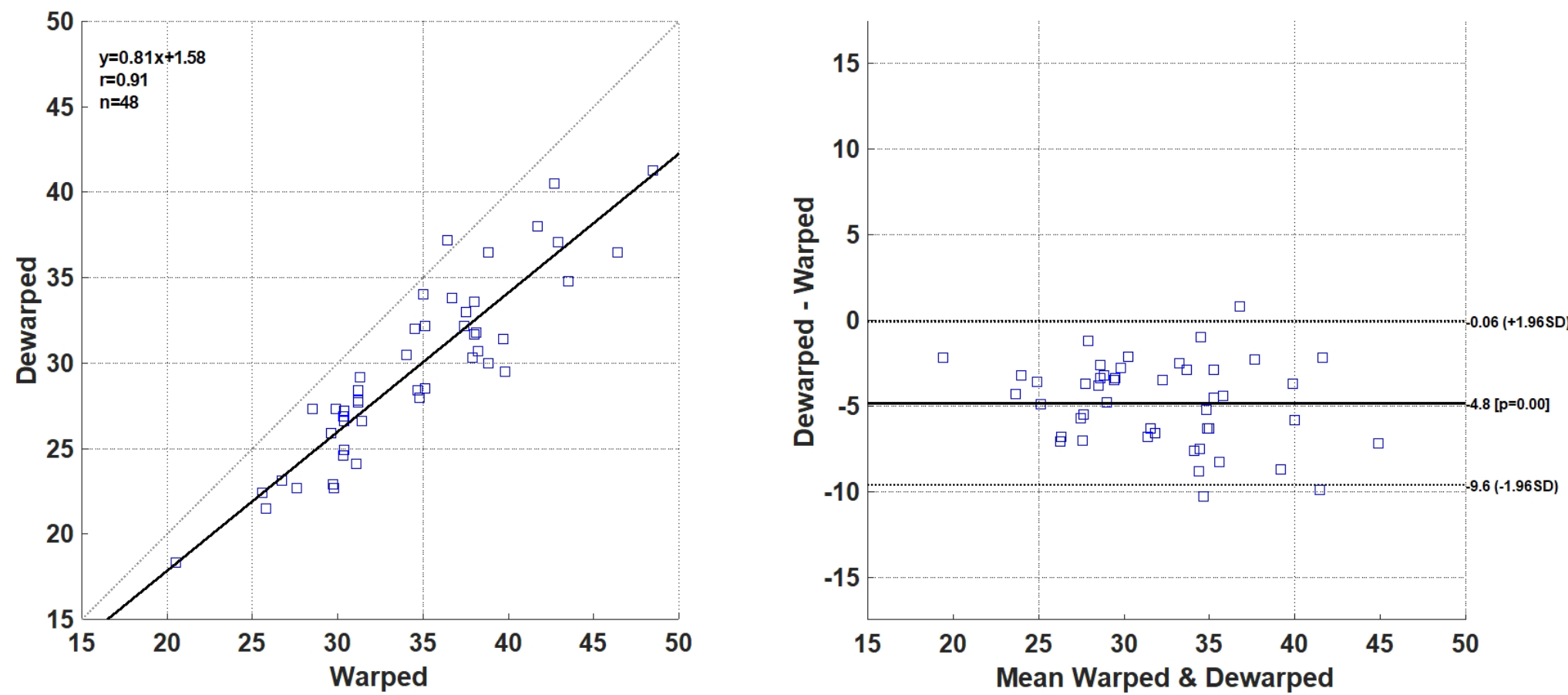


Figure 2: Regression and mean difference plots of irido-corneal angle measurement before and after dewarping