Choroidal thickness comparison between deep learning and multilayer segmentation

Julian Bolter, MSc [1]; Thomas Callan, OD [1]; Homayoun Bagherinia, PhD[1]; Jie Lu, PhD[2]; Yingying Shi, MD[3]; Philip Rosenfeld, MD, PhD[3]; Ruikang Wang, PhD[2]

[1] Carl Zeiss Meditec, Inc., Dublin, CA, USA; [2] University of Washington, Seattle, WA, USA; [3] Ophthalmology, Bascom Palmer Eye Institute, Miami, FL, USA

Poster #1119 - C0213

PURPOSE

- Segmentation of the choroid layer in optical coherence tomography (OCT) continues to be valuable in the analysis of retinal diseases.
- A novel approach using deep learning (DL) to identify the choroidal-scleral junction (CSJ) was previously described by Bagherinia [*IOVS* 2022; 63(7):2060].
- A similar approach was used to segment Bruch's membrane (BM).
- This study utilizes a DL and multilayer segmentation (MLS) algorithm to compare performance to manual choroidal segmentation for determining choroidal thickness.

METHODS

- Patients were scanned with the Angio 12 mm x 12 mm x 3 mm scan (500 x 500 x 1536 pixels) on the PLEX® Elite 9000 (ZEISS, Dublin, CA) swept-source OCT.
- 35 scans from 28 patients (one or both eyes) were used; all patients had retinal disease and most had age-related macular degeneration (AMD).
- Choroidal thickness maps (CTM) were generated and defined as distance between the BM and the CSJ (Fig. 1).
- Necessary adjustments to a different prototype BM and CSI developed based on computer vision techniques were made manually by two human graders (JL and YS). An agreement was reached between graders.
- The CTM based on manual segmentation was compared to the CTM generated by DL and MLS algorithms.

A deep learning based model may improve choroid segmentation

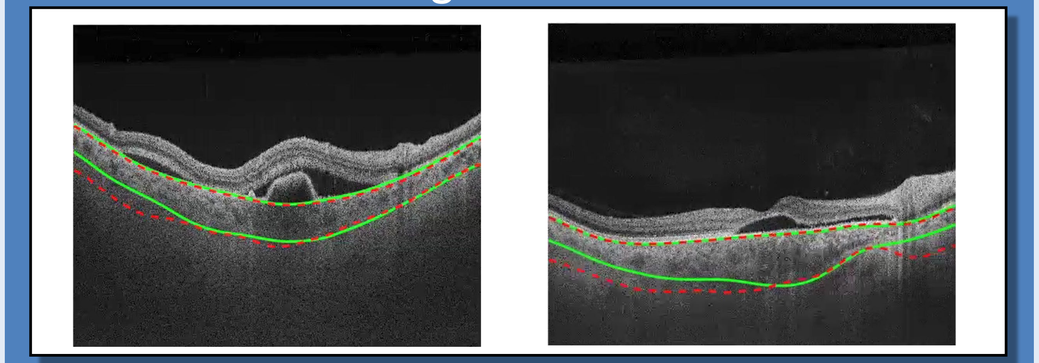

Figure 1: Examples of choroidal segmentation from 2 eyes. DL: green line; MLS: red dashed line

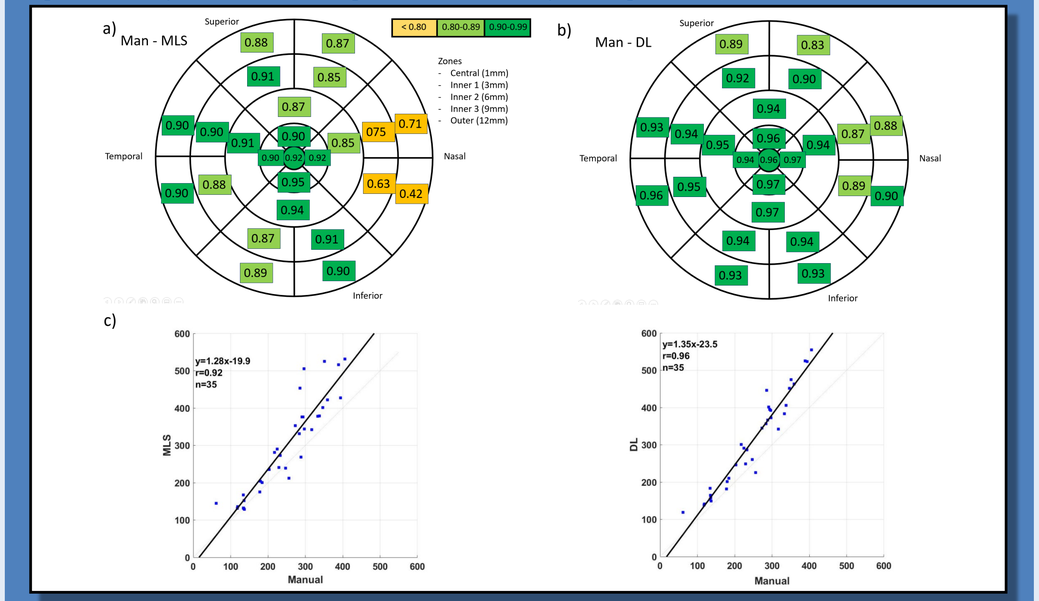

Figure 2: ETDRS zones and correlations (r) between a) Manual and MLS, b) Manual and DL, and c) examples of regression and Bland-Altman plots of the same comparisons for the Central Subfield zone (microns).

- The performance of the algorithm was reported using the correlation between manual and automated methods for each subfield of the ETDRS grid (Fig. 2). Regression plots of the central subfield were reported.

RESULTS

- Figure 2 shows the ETDRS grid and the choroidal thickness correlations for 35 datasets between manual and DL/MLS.
- Significant correlation (>0.85) between manual and automated measurements can be found in most ETDRS subfields.
- Overall, the DL method performs better than MLS. This is especially true in the nasal region where the optic nerve head (ONH) creates a challenge for layer segmentation.

CONCLUSIONS

- In this study we compared DL and MLS algorithms for segmenting the choroid.
- The DL algorithm performed better than MLS algorithm, particularly in the ONH region, when compared to reference manual segmentations.
- DL-based segmentation may improve automatic choroidal thickness calculation and may be a valuable diagnostic tool for retinal diseases.

Email: julian.bolter@zeiss.com

Disclosures: JB (E), TC (E), HB (E), JL (N), YS (N) PR (F): Carl Zeiss Meditec, Inc., Alexion, Gyroscope Therapeutics, Stealth Bio Therapeutics; PR (C): Annexon, Apellis, Bayer, Boehringer-Ingelheim, Carl Zeiss Meditec, Inc., Chengdu Kanghong Biotech, InflammX, Ocudyne, Regeneron, Unity Biotechnology; PR (I): Apellis, Ocudyne, Valitor, Verana Health., RW (C): Carl Zeiss Meditec, Inc.; RW (F): Carl Zeiss Meditec, Inc., Colgate Palmolive Company, Estee Lauder Inc; RW(P): US8,750,586, US8,180,134, US9,282,905, US9,759,544, US 10,354,378, US10,529,061