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Automated segmentation errors when using optical coherence tomography to measure retinal nerve fiber layer thickness in glaucoma

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Abstract:

Purpose: To characterize the error of optical coherence tomography (OCT) measurements of retinal nerve fiber layer (RNFL) thickness when using automated retinal layer segmentation algorithms without manual refinement.
Design: cross-sectional study
***Methods*:**
Setting: glaucoma clinical practice.
Study Population: 3490 scans from 412 eyes of 213 individuals with a diagnosis of glaucoma or glaucoma suspect.
Observational Procedures: We used spectral domain OCT (Spectralis, Heidelberg Engineering, Heidelberg, Germany) to measure RNFL thickness in a 6-degree peripapillary circle, and exported the native 'automated segmentation only' results. In addition, we exported the results after 'manual refinement' to correct errors in the automated segmentation of the anterior (internal limiting membrane) and the posterior boundary of the RNFL.
Main Outcome Measures: Differences in RNFL thickness and glaucoma classification (normal, borderline, or outside normal limits) between scans with 'automated segmentation only' to scans using 'manual refinement'.
Results: 'Automated segmentation only' resulted in a thinner global RNFL thickness (1.6 μm thinner, $P<0.001$) when compared to 'manual refinement'. When adjusted by operator, a multivariate model showed increased differences with decreasing RNFL thickness ($P<0.001$), decreasing scan quality ($P<0.001$), and increasing age ($P<0.03$). Manual refinement changed 298/3486 (8.5%) of scans to a different global glaucoma classification wherein 146/617 (23.7%) of borderline classifications became normal. Superior and inferior temporal clock hours had the largest differences.
Conclusions: Automated segmentation without manual refinement resulted in reduced global RNFL thickness and overestimated the classification of glaucoma. Differences increased in eyes with a thinner RNFL thickness, older age, and decreased scan quality. Operators should inspect and manually refine OCT retinal layer segmentation when assessing RNFL thickness in the management of patients with glaucoma.