

Optic Nerve Head Deformation in Glaucoma: The Temporal Relationship between Optic Nerve Head Surface Depression and Retinal Nerve Fiber Layer Thinning

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OBJECTIVE: To investigate the temporal relationship between optic nerve head (ONH) surface depression and retinal nerve fiber layer (RNFL) thinning measured by confocal scanning laser ophthalmoscopy (CSLO) and spectral-domain optical coherence tomography (SD-OCT) , respectively, during the course of glaucoma progression.

DESIGN: Prospective, longitudinal study.

PARTICIPANTS: A total of 146 eyes of 90 patients with glaucoma and 70 normal eyes of 35 healthy individuals followed for an average of 5.4 years (range, 48.0-76.6 months) .

METHODS: Eyes were imaged by CSLO (Heidelberg Retinal Tomograph <http://HRT>; Heidelberg Engineering, GmbH, Dossenheim, Germany) and SD-OCT (Cirrus HD-OCT; Carl Zeiss Meditec AG, Dublin, CA) at approximately 4-month intervals for measurement of ONH surface topography and RNFL thickness, respectively. Significant ONH surface depression and RNFL thinning were defined with reference to Topographic Change Analysis (TCA) with HRT and Guided Progression Analysis (GPA) with Cirrus HD-OCT, respectively. The survival probabilities were compared with a Cox proportional hazards model.

MAIN OUTCOME MEASURES: Number of eyes with progressive ONH and RNFL changes and the sequence of changes.

RESULTS: A total of 3238 OCT and 3238 CSLO images obtained in the same follow-up visits were analyzed. At a specificity of 94.3% (4 eyes showed ONH surface depression and 4 eyes showed RNFL thinning in the normal group) , 57 eyes (39.0%) had ONH surface depression, 46 eyes (31.5%) had RNFL thinning, and 23 eyes (15.8%) had evidence of both in the glaucoma group. Among these 23 eyes, 19 (82.6%) had ONH surface depression detected before RNFL thinning, with a median lag time of 15.8 months (range, 4.0-40.8 months) . Although only 7.0% of eyes (4/57) had RNFL thinning at the onset of ONH surface depression, 45.7% (21/46) had ONH surface depression at the onset of RNFL thinning. The survival probability of eyes with ONH surface depression was significantly worse than eyes with RNFL thinning ($P = 0.002$) .

CONCLUSIONS: With reference to the HRT TCA and OCT GPA, ONH surface depression occurred before

RNFL thinning in a significant proportion of patients with glaucoma. A time window for therapeutic intervention may exist on detection of ONH surface depression before there is observable RNFL thinning in glaucoma.

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