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Assessment of Retinal Nerve Fiber Layer Using Optical Coherence Tomography and Scanning Laser Polarimetry in Progressive Glaucomatous Optic Neuropathy

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Abstract

Purpose—To describe a case of progressive glaucomatous optic neuropathy using scanning laser polarimetry with fixed (SLP-FCC) and variable corneal compensation (SLP-VCC) and optical coherence tomography (OCT).

Design—Observational case report.

Methods—A 21-year-old male with juvenile primary open-angle glaucoma developed progression because of noncompliance with therapy. The patient underwent dilated stereoscopic examination and photography of the optic disk, standard automated perimetry (SAP), OCT, and SLP imaging with FCC and VCC at the baseline examination and after four years of follow-up.

Results—Optic disk, retinal nerve fiber layer (RNFL) atrophy, and SAP progression was observed. Reduction in mean RNFL thickness (average, superior, inferior) was 18, 18, and 27 microns (OCT); 22, 40, and 17 microns (SLP-FCC); and 6, 12, and 12 microns (SLP-VCC), respectively.

Conclusions—This case demonstrates that digital imaging of the peripapillary RNFL is capable of documentation and measurement of progressive glaucomatous RNFL atrophy.

The glaucomas represent a group of diseases that result in progressive retinal ganglion cell death, producing a specific pattern of retinal nerve fiber layer (RNFL) atrophy and optic nerve head and visual field (VF) damage. Optical coherence tomography (OCT) and scanning laser polarimetry (SLP) are posterior segment imaging technologies that provide reproducible, quantitative measurements of the RNFL. In contrast to earlier instruments that employed fixed corneal compensation (FCC), the latest commercial SLP has an integrated variable corneal compensator (VCC) that determines and neutralizes eye-specific corneal birefringence, providing greater discriminating power for glaucoma detection.^{1,2} We describe a case of progressive glaucomatous optic neuropathy using SLP-FCC, SLP-VCC, and OCT.

A 21-year-old male of African ancestry presented with advanced progressive juvenile open-angle glaucoma in both eyes because of noncompliance with topical therapy four years after initial diagnosis. Informed consent was obtained by means of a consent form approved by the Institutional Review Board for Human Research of the University of Miami Miller School of

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Medicine in agreement with the provisions of the Declaration of Helsinki. Examination of the left eye demonstrated a visual acuity of 20/20 and the intraocular pressure measured 39 mm Hg. SAP revealed progressive visual field deterioration and optic disk examination demonstrated progressive atrophy of the neural rim and RNFL, particularly in the superior region (Figure 1). OCT, SLP-FCC, and SLP-VCC were performed at the time of diagnosis and follow-up (Figure 2). Reduction in mean RNFL thickness (OCT, SLP-FCC, and SLP-VCC, respectively) was 18, 22, and 6 microns (average thickness); 18, 40, and 12 microns (superior thickness), and 27, 17, and 12 microns (inferior thickness). Trabeculectomy with antifibrosis therapy was subsequently performed.

Limited reports have described progressive glaucomatous RNFL atrophy using OCT³ and SLP.⁴ To our knowledge, this is the first comprehensive assessment of RNFL atrophy associated with documented progressive glaucomatous optic neuropathy with comparisons across several technologies. This case emphasizes several important points. As proposed by others,⁵ the gold standard with which diagnostic imaging technologies should be compared is progressive optic disk cupping. Second, the anatomic and functional damage in glaucoma may not appear or evolve simultaneously. This patient developed marked superior neural rim atrophy with visual field progression noted in both superior and inferior hemifields. Unfortunately, sequential measurements were not available for this patient to better demonstrate the stages of progression. Third, structural changes measured with imaging devices may disagree, in part from differences in technologic principles, axial and lateral resolution, and measurement reproducibility. It is of particular interest to note the differences in progression detected using SLP-FCC and SLP-VCC. Differences in the corneal compensation strategies may affect the amount and localization of birefringence loss detected over time. Finally, it is difficult to differentiate instrument variability from progression. Wollstein³ defined OCT progression using a prototype device as a decline of at least 20 microns in average RNFL thickness, similar to that observed in our patient (18 microns). This case demonstrates that digital imaging of the peripapillary RNFL is capable of documentation and measurement of progressive glaucomatous RNFL atrophy.

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FIGURE 1.

A glaucomatous left eye optic disk with diffuse progressive thinning of the neuroretinal rim, particularly in the superior region (Top black arrows), and progressive superior retinal nerve fiber layer atrophy (RNFL, white arrows) as compared with the baseline photograph that demonstrates early slit defects in the superotemporal RNFL. Note also the development of increased visualization of the vascular root (Bottom black arrow) at the nasal portion of the disk coincident with progressive atrophy of the neural rim. Standard automated perimetry (SAP, Bottom) demonstrates progression of glaucomatous visual field defects and increase in the pattern standard deviation (PSD) from 5.4 to 12.0 dB (decibel).

FIGURE 2.

Progressive glaucomatous optic neuropathy demonstrated by imaging technologies. Scanning laser polarimetry with fixed corneal compensation (SLP-FCC, Left), variable corneal compensation (SLP-VCC, Middle), and optical coherence tomography (OCT, right) were performed at the time of diagnosis (2002, Top row) and follow-up (2006, Middle row). Reduction in mean RNFL thickness (average, superior, inferior) was 18, 18, and 27 microns (OCT); 22, 40, and 17 microns (SLP-FCC); and 6, 12, and 12 microns (SLP-VCC), respectively. Serial analysis plots (Bottom row) demonstrate the reduction in RNFL thickness (blue) compared with baseline measurements (yellow SLP-VCC, red OCT).