Pattern Electroretinogram P50 to N95 Amplitude Compared with Spectral-Domain Optical Coherence Tomography Macular Parameters in Normal and Glaucoma Eyes

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Footnotes

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Abstract

Purpose : This study aims to evaluate the pattern electroretinogram P50 to N95 amplitude (PERG), an objective functional parameter, and compare it to the macular parameters of the Spectral-Domain Optical Coherence Tomography (SD-OCT) in normal controls and glaucomatous eyes.

Methods : Subjects with glaucoma presenting typical optic nerve head (ONH) findings, high intraocular pressure with or without visual field (VF) damage and normal controls were included. Patients underwent 24-2 perimetry (SITA standard; Humphrey Field Analyzer; Zeiss), SD-OCT (Spectralis; Heidelberg Engineering) and PERG (Roland Consult^{tm}). PERG was performed with 100% of contrast, reverse pattern in black-and-white with stimulus height of 4 cm. Automated individual layers and the summation of layers from the SD-OCT were checked for proper segmentation and plotted using the average of the sectors from the ETDRS Grid circles (diameters: center 1mm, inner circle 3mm, outer circle 6mm). Statistical analysis was performed using generalized estimating equations to allow for cluster observations and Spearman Rho for correlations.

Results : 72 eyes (45 subjects) qualified for the study. The mean age was 64.4±14.5. The number of eyes in each group was: 11 in the control group and 61 in the glaucoma group respectively. Controls and glaucomatous eyes had significantly different PERG, mean deviation (MD), retinal nerve fiber layer (RNFL) and parameters from inner retina, except for inner nuclear layer (table 1). MD, RNFL and macular parameters, except for inner nuclear layer (outer ETDRS grid circle) and outer plexiform layer (inner and outer ETDRS grid circles), were significantly associated with PERG (table 2).

Conclusions : Objective functional evaluation with PERG demonstrated to be significantly associated with the inner layers of the macula measured with SD-OCT. These layers are usually involved in glaucomatous neurodegenerative damage. Longitudinal studies evaluating the structure-function correlation between these parameters are needed to determine their impact on glaucoma clinical decisions.

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Table 1– Comparison of pattern electroretinogram P50 to N95 amplitude, mean deviation of the visual field (MD), circumpapillary retinal nerve fiber layer (RNFL) and macular parameters between control and glaucoma groups

Parameter	Control n=11	Glaucoma n=61	P value
PERG (μV)	9.13 (3.72)	4.06 (1.76)	**<0.001**
MD (dB)	-0.547 (0.89)	-8.44 (7.79)	**<0.001**
RNFL (μm)	99.18 (4.38)	72.31 (17.21)	**<0.001**
CMT (μm)	279.91 (12.72)	264.87 (19.80)	**0.006**
GCL inner (μm)	50.75 (4.29)	39.14 (9.78)	**<0.001**
GCL outer (μm)	33.14 (3.18)	27.98 (4.90)	**<0.001**
IPL inner (μm)	41.32 (3.01)	34.46 (5.75)	**<0.001**
IPL outer (μm)	27.43 (2.35)	24.80 (3.09)	**0.004**
GCIPL inner (μm)	92.07 (7.17)	73.59 (15.41)	**<0.001**
GCIPL outer (μm)	60.57(5.48)	52.76 (7.82)	**<0.001**
INL inner (μm)	40.07 (2.24)	38.91 (4.24)	0.176
INL outer (μm)	31.68 (1.45)	32.28 (3.14)	0.496

PERG= Pattern Electroretinogram P50 to N95 amplitude; MD = mean deviation; RNFL= retinal nerve fiber layer; CMT= central macular thickness; GCL = ganglion cell layer; IPL = inner plexiform layer; GCIPL = ganglion cell layer/inner plexiform layer; INL = inner nuclear layer; Inner and outer refer to the inner and outer circle of ETDRS grid (3mm and 6mm, respectively). Parameters are summarized by mean and standard deviation. P-values were obtained via generalized estimating equations allowing for the effect of clustered eyes. Statistically significant values appear in bold face.

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Table 1

Table 2 – Association of the pattern electroretinogram P50 to N95 amplitude with mean deviation of the visual field (MD), circumpapillary retinal nerve fiber layer (RNFL) and macular parameters

Parameter	Correlation Coefficient (r) n=72	P-value
MD (dB)	0.40	0.020
RNFL (µm)	0.43	0.005
CMT (µm)	0.25	0.052
GCL inner (µm)	0.36	0.003
GCL outer (µm)	0.25	0.016
IPL inner (µm)	0.38	0.001
IPL outer (µm)	0.22	0.029
GCIPL inner (µm)	0.37	0.002
GCIPL outer (µm)	0.24	0.017
INL inner (µm)	0.22	0.011
INL outer (µm)	0.04	0.901
OPL_inner	0.04	0.878
OPL_outer	0.03	0.616
ONL_inner	0.24	0.010
ONL_outer	0.31	0.010

MD = mean deviation; RNFL= retinal nerve fiber layer; CMT = central macula thickness; GCL = ganglion cell layer; IPL = inner plexiform layer; GCIPL = ganglion cell layer/inner plexiform layer; INL = inner nuclear layer; OPL = outer plexiform layer; ONL = outer nuclear layer. Inner and outer refer to the inner and outer circle of ETDRS grid (3mm and 6mm, respectively). Correlation coefficient was calculated using Spearman Rho. P-value for the overall association between PERG and the parameters above obtained via generalized estimating equations allowing for the effect of clustered eyes. Statistically significant values appear in bold face.

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Table 2