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BEST PAPER OF ALL GLAUCOMA SESSIONS

Comparison of 3.4 mm vs. 2.27x Proportional Scanning Protocols of Optical Coherence Tomography for Measuring RNFL Thickness in Different-sized Optic Nerve Heads

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Retinal Nerve Fiber Layer (RNFL) thickness measurement by optical coherence tomography (OCT) is a useful adjunct for early glaucoma diagnosis. The most frequently used "Standard" and "Fast" RNFL Thickness scan protocol employs a fixed 3.4 mm diameter scan circle around the optic disc. Since the RNFL thickness decreases with increasing distances from the ONH, larger discs would be likely to demonstrate thicker RNFL values than smaller discs simply because of the lesser distance from the edge of the ONH where it is measured. Using the 3.4 mm scan protocol for large-size discs may thus lead to fallaciously thick RNFL measurements.

The optimum scan diameter of 3.4 mm is 2.27 times the size of an average disc measuring approximately 1.5 mm. The Stratus OCT has a proportional scan protocol RNFL Thickness (2.27xdisc), which acquires a single circle scan around the optic disc which is 2.27 times the radius of the aiming circle. Though the scan diameter would differ in different sized discs, all scan circles would be at a distance 2.27 times the diameter of that particular optic nerve head.

This study was carried out to compare RNFL measurements using Fast RNFL Thickness (3.4) scan protocol employing 3.4 mm diameter scan circle, and the RNFL Thickness (2.27xdisc) proportional scan protocol in normal, disc suspect and glaucomatous eyes with different-sized optic nerve heads.

Materials and Methods

This was a prospective observational cross-sectional study including normal subjects, disc suspects and patients with Primary open angle glaucoma (POAG) presenting to the Glaucoma Clinic of the Department of Ophthalmology, Postgraduate Institute of Medical Education and Research, Chandigarh, India.

Each subject underwent a comprehensive ophthalmic examination including best corrected visual acuity (BCVA), intraocular pressure (IOP) measured by Goldmann Applanation tonometry, slit lamp biomicroscopy, gonioscopy, and stereoscopic fundus evaluation on the slit lamp using a 90.0 D lens. All subjects underwent baseline Standard Achromatic Perimetry (SAP) on the Humphrey's Field Analyzer HF A 750 II, using the 24-2 testing protocol by SITA Standard strategy.

To be eligible for inclusion, normal subjects were required to fulfill the following criteria in both eyes: BCVA 20/40 or more (refractive error ± 5.0 D spherical and ± 3.0 D cylinder); Intraocular pressure (lOP) less than 21 mm Hg on at least two successive measurements

spaced two weeks apart at approximately the same time of day; open angles on gonioscopy and normal appearing optic disc. The visual fields were to be normal, which was defined as MD and PSD values within 95% confidence interval and a Glaucoma Hemifield Test (GHT) classified as "within normal limits". Disc suspects were included if they fulfilled the same lOP and gonioscopy features of normal subjects, but with any feature suggestive of glaucomatous optic neuropathy as detailed above. POAG patients were included if they had lOP> 21 mm Hg on at least two successive measurements spaced two weeks apart at approximately the same time of day; open angles on gonioscopy; characteristic glaucomatous optic neuropathy, and repeatable abnormal visual field tests. Patients were excluded if they had any history of ocular disease or intraocular surgery, or if they were detected to have any ocular disease during examination. All included subjects were scanned with the Zeiss Optical Coherence Tomographer Stratus OCT® version 4.0.1. The peripapillary RNFL was scanned using the Fast RNFL Thickness (3.4) scanning protocol, and

Table-1: RNFL thickness measurements in normal subjects

Disc size	RNFL Thickness (µ) (Fast 3.4 mm circle scan protocol) (Mean ± SD)	RNFL Thickness (µ) (2.27 x proportional scan protocol) (Mean ± SD)	P* (Fast vs. proportional protocol)
Average (n=17)	102.70±8.14	88.85 ± 9.66	0.003
Large (n=15)	102.32 ± 9.73	78.91 ± 10.94	0.001
Total (n=32)	102.52 ± 8.77	84.19 ± 11.3	
P# (Average vs. large-sized disc)	1.000	0.008	

P* (Wilcoxon signed ranks test), p# (Mann-Whitney-U)

Table-2: RNFL thickness measurements in Disc suspects

Disc size	RNFL Thickness (µ) (Fast 3.4 mm circle scan protocol) (Mean ±SD)	RNFL Thickness (µ) (2.27 x proportional scan protocol) (Mean ±SD)	P* (Fast vs. proportional protocol)
Average (n=26)	87.94 ± 9.07	73.04± 11.72	0.000
Large (n=36)	99.92 ± 11.7	76.39 ± 9.05	0.000
Total (n=62)	95.33 ± 12.34	74.98 ± 10.30	
P#(Average vs. large-sized disc)	0.000	0.094	

p* (Wilcoxon signed ranks test), p# (Mann-Whitney-U)

Table-3: RNFL thickness measurements in Glaucomatous eyes

Disc size	RNFL Thickness (µ) (Fast 3.4 mm circle scan protocol) (Mean ±SD)	RNFL Thickness (µ) (2.27 x proportional scan protocol) (Mean ±SD)	P* (Fast vs. proportional protocol)	Mean Deviation on Visual Fields (dB) (Mean ±SD)
Average (n=23)	56.64 ± 18.13	52.18 ± 15.43	0.023	-14.64 ± 7.15
Large (n=13)	70.07 ± 18.36	52.23 ± 13.7	0.002	-7.76 ± 3.85
Total (n=36)	61.49 ± 19.11	52.19± 14.63		-12.16 ± 6.96
P#(Average vs. large-sized disc)	0.04	0.79		0.005

P*(Wilcoxon signed ranks test), P# (Mann-Whltney-U)

the RNFL Thickness (2.27xdisc) proportional circle scanning protocol. The disc size was measured using the Fast Optical Disc scanning protocol.

The results were analyzed using the SPSS for Windows software, Version 1 0.0, ©SPSS Inc., Chicago, US.

Results

32 eyes of 32 normal subjects, 62 eyes of 62 disc suspects, and 36 eyes of 36 glaucoma patients were analyzed. RNFL measurements in normal subjects are depicted in Table-1. Using the standard scanning protocol, RNFL measurements were similar in optic discs of different sizes (p=I.00). Using the proportional scan protocol, average RNFL measurements were significantly less in large-sized discs compared to average-sized discs (p=0.008). RNFL measurements in disc suspects are depicted in Table-2. RNFL measurements of the same optic nerve head were significantly thinner when scanned by the proportional scanning protocol compared to the standard 3.4 mm protocol in both average- and large-sized discs (p=O.OOO). Using the proportional scan protocol, average RNFL measurements were similar in average and large-sized discs (p=0.094).

RNFL measurements in glaucomatous eyes are depicted in Table-3. RNFL measurements were significantly thinner when the same disc was scanned by the proportional scanning protocol compared to the standard 3.4 mm protocol in both average- and large-sized discs (p=0.23 and 0.002 respectively). Using the standard scanning protocol, RNFL measurements in large discs were significantly thicker compared to average-sized discs (p=0.04).

Discussion

The most commonly used "Fast" RNFL scanning protocol employs a fixed 3.4 mm scan circle around the disc. This scan circle measures the RNFL thickness close to the disc margin in larger optic discs, and further away in smaller discs. This, and the reportedly large number of axons in large discs have been implicated in studies that demonstrate a correlation between disc size and RNFL thickness measured by OCT and scanning laser polarimetry (GDx) in normal eyes.[1-4]

In our study we found no correlation between the optic disc size and RNFL thickness measurements, which were similar in average and large-sized optic discs using the 3.4 mm scan circle in normal subjects. However, the 2.27xdisc scanning protocol yielded thinner RNFL measurements in larger discs. This agrees with the study by Hougaard et aI,[5] who found no correlation between optic disc size and RNFL thickness measured by OCT. This may indicate that the RNFL thickness is dependant upon the distance from the centre of the optic disc rather than the point of exit from the scleral canal, as hitherto believed. Our study indicates that disc size may not matter while measuring RNFL thickness by OCT using fixed-diameters scans. In large discs, proportional scan protocols may yield fallacious results by virtue of measuring RNFL further away from the disc and therefore should be avoided.

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