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Evaluation of two Humphrey perimetry programs: Full threshold and SITA standard testing strategy for learning effect

Ö. YENICE, A. TEMEL

Department of Ophthalmology, Marmara University School of Medicine, Istanbul - Turkey

PURPOSE. *To compare learning effect of Swedish interactive threshold algorithm (SITA) standard strategy with full threshold testing.*

METHODS. *Thirty-nine medical students with no experience in visual field testing had full threshold (FT) and SITA standard for either right or left eyes. They were chosen in such a way that 20 (Group I) had FT for right and SITA for left eyes and 19 (Group II) had SITA standard for right and FT for left eyes. It was designed to have both strategies on same person whereby eliminating inter-individual variability. Visual field testing was repeated in the same week of the first test on the same subject with the same strategy that was chosen for that eye.*

RESULTS. *The authors found an improvement in mean deviation (MD) and pattern standard deviation (PSD) of first and second testings correspondingly for FT (MD from –3.04 to –2.55; PSD from –2.60 to –2.29) and SITA standard (MD from –2.86 to –2.20; PSD from 2.25 to 2.10) and changes were statistically significant ($p<0.05$). To analyze learning effect of visual field testings, we calculated percentage change in MD and PSD for full threshold and SITA standard strategy. The percentage changes in visual field parameters were significantly lower in SITA standard strategy testing for MD ($p=0.02$) and PSD ($p=0.01$).*

CONCLUSIONS. *This study shows that a learning effect is present for both strategies and SITA standard may have a reduced learning effect compared to FT. (Eur J Ophthalmol 2005; 15: 209-12)*

KEY WORDS. *Learning effect, Full threshold, SITA*

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INTRODUCTION

Visual field analysis and optic nerve visualization are critical features used in diagnosis and management of glaucoma. Full threshold (FT), white-on-white automated static perimetry is currently the gold standard for diagnosis, grading, and detection of progression in glaucomatous visual field defects (1-3). However, standard FT method for measuring visual field is time consuming for patients and is subject to fatigue and learning effect, which has been shown to produce poorer results (4-6).

A between-examination learning effect, whereby improvement in threshold response of a given eye is recorded with increasing familiarity of test, has been shown in retrospective studies of normal and glaucoma subjects (7-10). Within examination fatigue effect for a given eye, whereby sensitivity decreases with increasing duration of the test, has been found for ocular hypertensive and glaucoma patients (4, 11). Additionally, there is a known fatigue effect with better threshold values of the first eye being tested are present in the literature (12, 13).

There are many studies in the literature comparing

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visual field programs of FT and SITA for time, and sensitivity to detect glaucomatous defects. They suggest usage of SITA instead of FT (14-18). However, there is no study comparing learning effects of these two programs on normal subjects with eliminating interindividual variability which may contribute an additional view of preference of one of either.

METHODS

Fifty-two normal subjects were included in the study. All were medical students and volunteered after open invitation. The following exclusion criteria were used: family history of glaucoma, medical history of diabetes mellitus, neurologic or psychiatric illness, use of central nervous system depressants or topical eye treatment, past history of eye disease or contact lens wear. Each subject underwent a full ophthalmologic examination to confirm the following inclusion criteria: visual acuity of 10/10 in both eyes, intraocular pressures of less than 20 mm Hg measured by Goldmann applanation tonometry, healthy symmetrically cupped optic discs, and healthy retinas viewed by direct and indirect ophthalmoscopy. Those with refractive errors requiring more than ±6.00 diopters and/or ±2.00 cylinder for correction were excluded.

To eliminate the effect of beginning either with FT or SITA, subjects were divided into two groups: Group I (n = 20) and Group II (n = 19). Group I had FT for right and SITA standard for left eyes and Group II had SITA standard for right and FT for left eyes. Then each subject underwent a second visual field testing in the same week of the first procedure to evaluate learning effects with the algorithm that was chosen for that eye. The order and type of algorithm (SITA or FT) were held constant within a patient's eye for two visits.

Subjects underwent standard FT and SITA test using program 30-2 and a size III white stimulus on a white background (31.5 apostilbs of Humphrey Field Analyzer II). Calculations of global indices (mean deviation [MD] and pattern standard deviation [PSD]) were derived using STATPAC, version A10.1. Test using a particular algorithm was performed with the same visual field machine, and each subject had visual field testing with the same technician in repeated tests.

Visual fields with any abnormal reliability parameter (fixation losses >33%, false-positive responses >33%, or false-negative responses >33%) were excluded from the study. Data analysis was performed using SPSS for Windows (release 10.0; SPSS Inc., Chicago, IL). Paired samples t-test was used for analyzing differences in test time and visual field indices (MD and PSD) within each algorithm between two visits. The differences between visit comparisons (first and second visit) were analyzed by calculating the percentage of change (MD1–MD2/MD2) where MD1 means the MD value of the first session and MD2 means MD value of second session for each algorithm. The same calculations were made for PSD.

RESULTS

Among 52 students, 5 were using contact lenses, 2 had myopia >6 D, and 2 had cylindric errors >2 D; additionally, 4 subjects with abnormal reliability indices (2 had fixation losses greater than 33% and 2 had false-positive responses >33%) were excluded from the study. Our study group was composed of 39 (19 male and 20 female) medical students (age 23 ± 3.5 years) with the same degree of education and approximately the same intellectual level.

The results of global indices produced by the STATPAC program for the first and second testing for FT and SITA standard are presented in Table I. When evaluating the learning effect of FT, the difference between MD (p=0.001) and PSD (p=0.02) of the first and second tests was statistically significant. This was also valid for SITA strategy; differences between MD (p=0.0001) and PSD (p=0.02) of the first and sec-

TABLE I - GLOBAL INDICES OF FIRST AND SECOND TESTING

		First testing	Second testing	p
FT				
	MD	-3.04± 1.40	-2.55±1.53	0.001*
	PSD	2.60±-1.19	2.29±1.14	0.02*
	Test time	14.02±1.90	13.06±1.74	0.09
SITA standard				
	MD	-2.86± 3.5	-2.20±1.68	0.0001*
	PSD	2.25± 1.04	2.10±1.13	0.02*
	Test time	6.32± 0.7	5.98±0.5	0.07

*p<0.05 indicates statistical significance.
FT = Full threshold; MD = Mean deviation; PSD = Pattern standard deviation; SITA = Swedish interactive threshold algorithm (SITA)

ond tests were statistically significant. When we compared durations of first and second testing for FT, 14.02 min/13.06 min (p=0.09), and for SITA, 6.32 min/5.98 min (p=0.07), although the durations of second tests were shorter, the differences were not statistically significant. Comparing the learning effects of both tests between each other, the calculated percentage changes for MD (p=0.02) and PSD (p=0.01) were significantly less in SITA standard strategy compared to FT testing.

DISCUSSION

FT algorithm has been the gold standard for detecting and following glaucomatous visual field defects for 15 years, but FT perimetry decreases in sensitivity as a function of increasing test time (2, 3). Rapid thresholding programs like FASTPAC saved up to 36% of the test time, but resulted in a decreased estimate of field loss severity and a greater intratest variance (19, 20).

SITA is a new computer program that has been developed for the Humphrey visual field analyzer II (Humphrey Systems, Dublin, CA) that reduces test-taking time. The SITA standard program has been shown to reduce test-taking time by approximately 50% compared with FT testing (18). Overall, the number of stimuli actually presented is reduced by 29% in normal fields and 26% in glaucomatous fields. This is accomplished using a combination of techniques including the use of information about surrounding points, information about threshold values in age-matched controls and glaucoma patients at each location, changes in the pacing of the test, elimination of retest trials for the 10 points used to calculate short-term fluctuation in the FT algorithm, changing the way in which false positive and false negative reliability parameters are determined, and the use of a maximum likelihood procedure for estimating threshold (21, 22).

In Sekhar et al's (15) study of 48 glaucoma patients using FT as the gold standard, the SITA standard algorithm yielded a sensitivity of 95%. Sharma et al (16) reported the sensitivity for detecting a glaucoma defect and specificity of SITA standard in 102 patients as sensitivity from 83% to 93%, depending on the criteria used for identifying glaucomatous defects, and specificity 79% to 96%. Perimetric sensitivity decreases with increasing test duration in both normal and glaucoma patients (5, 11, 23, 24). Increasing time causes patient fatigue and compromises the reliability of the test. Results of our study showed MD and PSD to be slightly better in the SITA standard algorithms compared with FT. This can be related to the longer test duration in FT and fatigue of the patient. This study confirms that threshold perimetry in normal subjects results in a decrease in sensitivity as a function of increasing test time.

Wild et al (12) noted an improvement in sensitivity of the first eye between examination sessions, but found a lack of improvement in sensitivity of the second eye between eye and between examination sessions due to transfer of a fatigue effect from the first eye. In this study we started half of Group I with either of the strategies and the remaining had the other strategy for left eye to eliminate this effect.

A between-examination learning effect, whereby improvement in the threshold response of a given eye is recorded with increasing familiarity of the test, has been shown in retrospective studies of normal (7) and glaucoma subjects (7-10). In this study, both of the test algorithms, MD, and PSD values were better and period was shorter in the second trial. This can be the result of learning effect of the patient.

This study performed on healthy subjects, and they had both strategies so that no confounding factor for the encountered subjects were present as these either right or left eye of the same person. Another striking point is some had started with FT with right eye and some had SITA standard of right eye. This cross-design eliminates the possibility of the first eye having a learning or the second eye a fatigue effect. Therefore, by eliminating these complicated confounding factors, the results of our study focused on learning effect or how the experience with visual field changed parameters of second testing.

SITA standard strategy compared with FT has good sensitivity and repeatability. Although further studies are necessary, SITA standard strategy may be easier for patients to learn and take a shorter time.

Reprint requests to:
Özlem Yenice, MD
Avcılar C, Eser Apt, 27/10 Idealtepe
Istanbul, Turkey
yeniceozlem@yahoo.com

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