Asian Journal of Research and Reports in Ophthalmology

3(4): 41-47, 2020; Article no.AJRROP.59679

SITA Algorithms Performance for Optopol PTS 910 Automated Perimeter

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Authors' contributions

This work was carried out in collaboration between both authors. Author DD managed the literature searches and performed the statistical analysis. Author CA designed the study and wrote the protocol and the first draft of the manuscript. Both authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Panagiotis Tsikripis, University of Athens, Greece.
Reviewers:
(1) T. R. Ganesh Babu, Muthayammal College of Engineering, India.
(2) Amit Kumar Mourya, Mangalmay Institute of Engineering & Technology, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/59679

Short Research Article

Received 16 June 2020
Accepted 22 August 2020
Published 01 September 2020

ABSTRACT

A variety of different types of automated perimeters are in use around the world, although all types follow the main characteristics of Humphrey (Carl Zeiss) or Octopus (Haag-Streit Diagnostics) perimeters.

Purpose: To compare perimetric test duration using SITA Standard and SITA Fast algorithms in Optopol PTS 910 Automated Perimeter, for normal healthy subjects. As the subjects were healthy it was expected to demonstrate less variability than the glaucoma patients, as the group was of younger age and consequently demonstrated less fatigue and variability during the test that could bias less the results.

Methods: Present study included visual field control tests that were performed to 24 normal subjects, without any vision problem or disease.

Results: The test results led to the conclusion that the time duration was the same for SITA Standard and slightly increased for SITA Fast, with Optopol PTS 910 perimeter.

Keywords: Visual field; SITA standard; SITA fast; optopol perimeter.

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1. INTRODUCTION

The visual field refers to the amount of information that is perceived by human optical system when one has a fixed point-oriented gaze. Perimetry is examining the visual field in order to detect vision problems and facilitate treatment options. Perimetry results are essential in the diagnosis and management of glaucoma and other eye diseases. Various perimetric strategies have been developed to assess the visual field using different types of perimeters.

Nowadays is very well known that early diagnosis of glaucoma is critical to prevent permanent structural damage and irreversible vision loss. Detection of glaucoma typically relies on measurements of visual function combined with examination of structural damage to the optic nerve. To aid the clinician in evaluation of visual function, testing includes standard automated perimetry [1].

Determining a visual field with an automated perimeter is a time-consuming task for technician and patient, especially for patients with an advanced glaucomatous loss [2]. Therefore faster strategies have been developed over the last years. SITA (Swedish Interactive Threshold Algorithm) Standard and SITA Fast are among the most frequently used perimetric strategies [3].

The algorithm was designed to decrease the test duration without any loss of quality in results' evaluation. A visual field model for normal fields is constantly updated during the test. The software estimates the threshold-value and also the certainty to which the threshold is known at each point [4].

The test holds on at each point and everywhere the certainty level has reached a predetermined level finishes. The threshold-value and the certainty-value of each point is influenced by the values of the neighbouring points, so the test can be re-opened in each point. Each test subject starts initially with the same visual field model (corrected for the age). During the test, the model changes shape. As the assessment continues each function is adjusted continuously (following the positive or negative response to each individual stimulus presentation), and the shape of each function repeatedly alters as the test progresses [3,4].

Another characteristic of the SITA-strategy is the time pacing. The patient can determine the time interval between two stimuli. Initially this interval is the same for all test subjects; as the test proceeds the time interval becomes more adapted to the patient [2,3].

The Swedish Interactive Threshold Algorithms (SITA) include two available algorithms: the SITA Standard, which is analogous to the Full Threshold algorithm, and the SITA Fast, which is analogous to the FASTPAC algorithm, both introduced in 1997 for Standard Automated Perimetry (SAP) with the Humphrey Field Analyser (HFA). The SITA algorithm was designed to reduce testing time, while still providing a sufficient test of visual sensitivity, in order to increase attention and result in a more reliable test. SITA Standard uses 4 dB and 2 dB steps and was designed to replace the Full Threshold program (e.g. Full Threshold 30-2), and SITA Fast uses a 4dB step only and was designed to replace FASTPAC, which is a simplified Threshold program [4,5,6].

Taken as a whole, the SITA Standard and SITA Fast algorithms demonstrate good sensitivity and specificity for the detection of glaucomatous visual field loss [7,8], and involve a significant reduction in the examination duration, in comparison to the older algorithms [9].

However, according to Barkana and colleagues (2012) the confidence limits for normality are greater for the SITA Fast algorithm than for the SITA Standard algorithm. The between examination variability of the SITA Fast algorithm is also greater than that of the SITA Standard algorithm [6].

For sensitivities above 25 dB the SITA Standard algorithm illustrates better test- retest variability than Full Threshold, but below 25 dB the SITA Fast shows slightly poorer test-retest variability. In general, this improvement of test-retest variability is credited to the reduction in perimetric fatigue effect due to decreasing the test duration [8,10]

2. PATIENTS AND METHODS

Before the examination, detailed written information was given to each examinee regarding the stages of the procedure to be followed. It is very important to familiarize the examinee with the steps of the test, in order to ensure that the test is performed correctly and without errors that may lead to patient fatigue and, consequently, to make the results invalid. In general, visual field test is a painless procedure, which does not require any special preparation of the examinee. Only concentration is needed and good collaboration with the examiner.

A variety of optometric tests were performed in order to determine if there were any underlying diseases as the cause of various vision problems and if there were conditions that could adversely affect the test results. Initially a detailed medical record took place followed by visual acuity test (VA >6/9). Next a slit lamp test included systematic inspection of eye optical media. Fundus photography used then to clarify that retina was healthy and next each patient underwent automated perimetric testing at 2 separate clinic visits. The acceptable time interval between clinic visits was between 1 and 2 hours. At each visit, patients were tested in the right eye or the left eye randomly with SITA Standard and SITA Fast with program 24-2, all performed by automated perimeter Optopol PTS 910.

3. STATISTICAL ANALYSIS OF RESULTS

3.1 Paired Samples Statistics

The Paired T-Test was performed in order to assess the duration of the test between the SITA Standard and SITA Fast strategies with the Optopol PTS 910 perimeter. Table 1 demonstrates the averages and standard deviations of the test duration values between the strategies.

3.2 Paired Samples Correlations

Table 2, illustrates the pairwise control of the variables with 95% Confidence Interval and demonstrate a probability of 0.184 > 0.05 that states a non-statistically significant correlation of values.

3.3 Paired Samples Test

Table 3 refers to the Levene test for equality of variations. Depending on the value of the importance of this test, the hypothesis of equal variations or not may be accepted. Here the power of the hypothesis of unequal variations is 0.053, marginally greater of the p= 0.05. Consequently, the alternative hypothesis must be accepted that the average value of the variables in the population performed the test do not differ significantly, which probably indicates that the subjects were healthy in terms of visual field and the marginality of the values show an unstable correlation. If we had glaucoma patients due to visual field losses it would be expected to have more difficulty in one of the two strategies.

In Figs. 1 and 2, the Box and Whiskers present the mean deviation (MD) and the Pattern Standard Deviation (PSD) distribution,

Table 1. Paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	FST Dur	328,5714	24	164,45093	43,95136
	STD Dur	419,0000	24	106,27540	28,40330

FST = SITA Fast Algorithm, STD = SITA Standard Algorithm, Dur = Test duration

Table 2. Paired samples correlation

		N	Correlation	Sig
Pair 1	FST Dur & STD Dur	24	,377	,184

FST = SITA Fast Algorithm, STD = SITA Standard Algorithm, Dur = Test duration

Table 3. Paired samples test

	Paired differences							
				95% Confidence Interval of Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig 2-tailed
Pair 1 FST Dur-STD Dur	-90,42857	158,59465	42,38620	181,99840	1,14125	-2,133	13	,053

FST = SITA Fast Algorithm, STD = SITA Standard Algorithm, Dur = Test Duration respectively. It is obvious that the mean deviation between Standard and Fast is similar but on the other hand the pattern standard deviation distribution demonstrate significant increase with SITA Fast algorithm.

In Table 4, the ANOVA analysis, confirms the significance of the PSD difference between the two strategies, since the p value for between algorithms is 0,021 < 0,05.

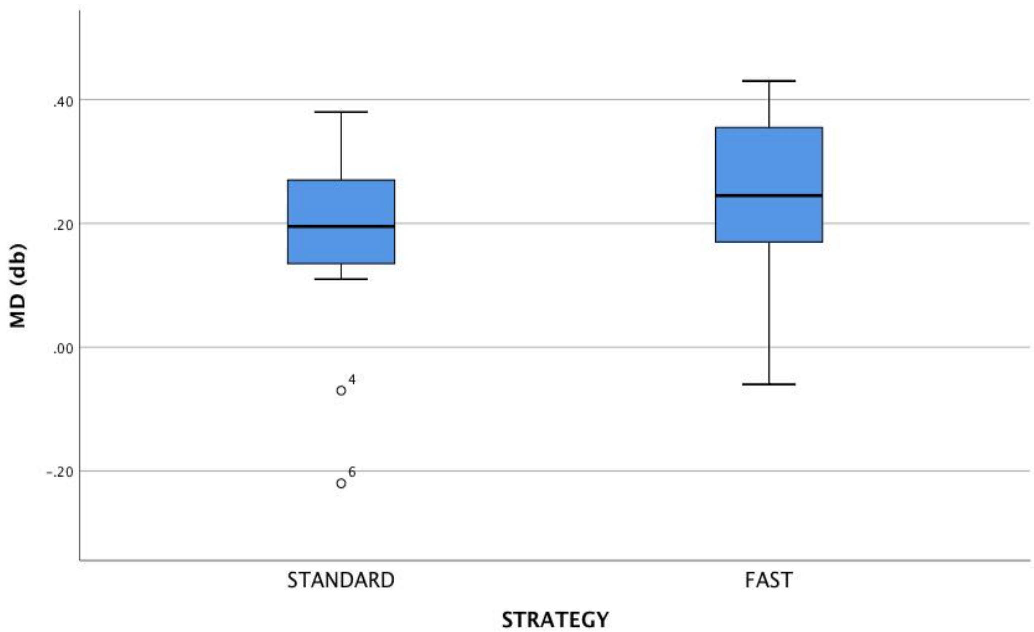

Fig. 1. The box and whiskers plots illustrate the mean deviation (MD) of sensitivity values distribution for SITA standard and SITA fast strategies

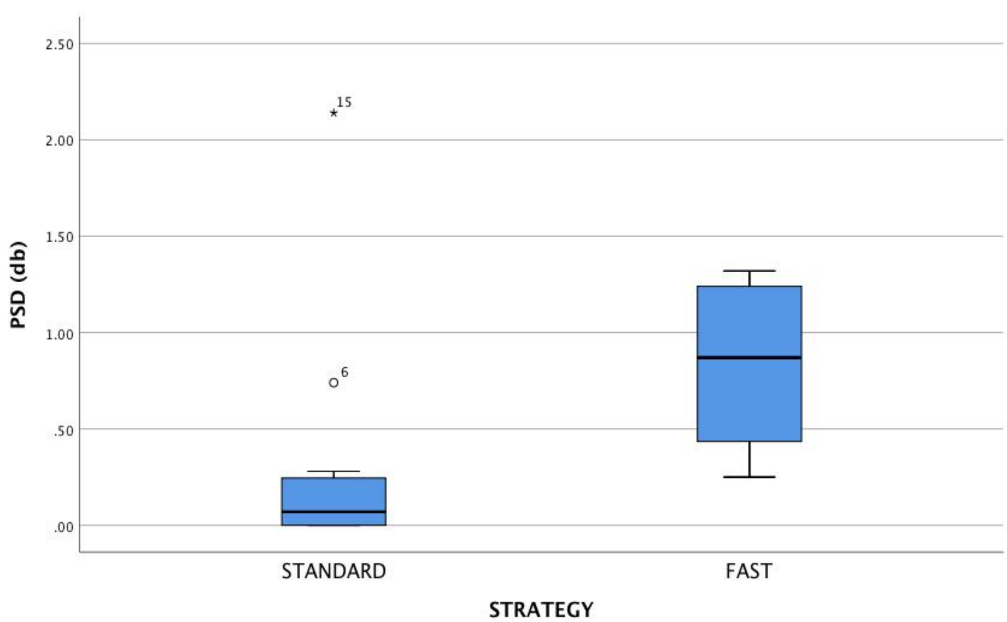

Fig. 2. The box and whiskers plots illustrate the pattern standard deviation (PSD) of sensitivity values distribution for SITA standard and SITA fast strategies

Table 4. Illustration of the ANOVA analysis results for the study

		Sum of squares	df	Mean square	F	Sig.
Age	Between Groups	1.042	1	1.042	.095	.761
	Within Groups	240.917	22	10.951		
	Total	241.958	23			
Duration (s)	Between Groups	20827.042	1	20827.042	1.021	.323
	Within Groups	448877.917	22	20403.542		
	Total	469704.958	23			
MD (Db)	Between Groups	.025	1	.025	.954	.339
	Within Groups	.585	22	.027		
	Total	.610	23			
PSD (Db)	Between Groups	1.701	1	1.701	6.141	.021
	Within Groups	6.095	22	.277		
	Total	7.796	23			

Table 5. Test duration comparison between humphrey field analyser (HFA) and optopol PTS 910, with SITA algorithms

Algorithm	Humphrey Field Analyzer	Optopol PTS 910
SITA Standard	7	7
SITA Fast	4	5,5

4. DISCUSSION

Bengtsson and Heijl (1999) conducted a study to compare the results of visual field test using SITA Fast and SITA Standard, in relation to the Humphrey Full Threshold program [11]. The measurements were taken at Malmo University Hospital in Sweden. The study tested the visual field of an eye in 44 patients with glaucoma four (4) times using Humphrey Full Threshold, SITA Standard and SITA Fast algorithms.

The average sensitivity was higher with the Fast algorithm and lower with the Humphrey Full Threshold strategy. In addition, the size of the visual field loss as defined by the MD value did not differ from each other for the examined algorithms. In glaucoma patients, both SITA algorithms showed a considerably higher number of significant depressed points than the Humphrey Full Threshold strategy [12,13].

In a relevant study by Sekhar and colleagues (2000) the sensitivity was assessed, time-saving, repeatability and extent of defect measurement using Fast and Standard SITA algorithms in relation to the Full Threshold strategy. The sample for the study consisted of 40 glaucoma patients and was used the 30-2 program for the performed tests. The sensitivity was found to be equal to 95.12% and 92.68% for Standard and Fast respectively. The saved time of the examination for SITA Standard and Fast was 53.12 ± 9.51% minutes and 70.69 ± 8.81% minutes respectively. The repeatability estimated to be high for SITA Standard algorithm and between excellent and poor for the SITA Fast [14].

Respectively, in a related study Roggen and his colleagues (2001) examined the time duration of the test and the quality of the performed measurements using the Fast and Standard algorithms compared to the FASTPAC strategy [2]. Furthermore, the research has shown that there is a significant reduction in test time using SITA Standard and SITA Fast compared to the FASTPAC program, for comparable MD and PSD values. On average, the duration of the SITA Fast test was half that of FASTPAC. However, the particular research demonstrated that for all algorithms, the duration of the test increases as the size of the visual field loss increases for the specific examined patient [15].

SITA Standard was developed in order to replace the Full Threshold program and SITA Fast to substitute FASTPAC. When designing SITA Fast, they hence created the test to be less precise than SITA Standard, and this was also shown by many researchers in clinical tests [13,16]. On the other hand, differences were small, and some investigators concluded that the shorter test was an attractive alternative in clinical practice and for screening [15,16]. Later results have shown that SITA Fast and SITA Standard are equally effective for glaucoma detection, and analysis of a very large clinical perimetry database indicated that despite the fact that SITA Fast is slightly less precise in test points with poor sensitivity, this is unlikely to make a sizeable difference in the time needed to detect progression. SITA Fast has therefore become a commonly used test program [5].

Recently, Heijl and associates (2019) introduced a new timesaving threshold visual field–testing strategy— SITA Faster, which is intended to replace SITA Fast [16]. This clinical study demonstrated that SITA Faster saved considerable test time. According the study, SITA Faster and SITA Fast gave almost identical results. There were small differences between SITA Faster and SITA Standard, of the same nature as previously shown for SITA Fast vs SITA Standard. for the time being, SITA Faster was not integrated to Optopol PTS 910 perimeter.

5. CONCLUSION

Automated perimeter Optopol PTS 910 is a modern diagnostic instrument for precise and fast testing of field of vision by means of static stimuli. Depending on chosen test strategy it could be used either for detecting visual field losses in periphery for glaucoma detection and follow-up or in central visual field inspection for macula degeneration. In order to minimize the test duration uses the well-known SITA algorithms and as result produces less fatigue to the patients and more accuracy to the measurement results.

This study tested randomly the right or left eye of 24 young and healthy people, with normal vision, in order to compare the test duration for different SITA algorithms in this perimeter. The results, as expected, were similar to the results of previous studies and as a general conclusion presented a decrease of time duration for SITA Fast algorithm.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

All patients who agreed to participate in the research, before any other action, were given an explanatory booklet for the purpose and terms of the research, for the protection of medical confidentiality and sensitive personal data as well as a form / statement that have been informed of the explanatory note and agree without reservation to participate in that research, in accordance with the Helsinki Declaration of the WMA (1954), as updated in Edinburgh (2000) and the approval of the Commission of Ethics of the University of West Attica.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59679