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Research Article

Mapping the Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies

MD Bahauddin Molla[1]*, Tariq Reza Ali[2] and MD Showkat Kabir[3]

[1]Assisstant Professor and Head of the Department, Department of Ophthalmology, Kurmitola General Hospital, Dhaka, Bangladesh

[2]Associate Professor, (Vitreo-Retina), Bangabandhu Sheik Mujib Medical University, Dhaka, Bangladesh

[3]Associate Professor, Department of Community Ophthalmology, Bangabandhu Sheik Mujib Medical University, Dhaka, Bangladesh

***Corresponding Author:** MD Bahauddin Molla, Assisstant Professor and Head of the Department, Department of Ophthalmology, Kurmitola General Hospital, Dhaka, Bangladesh.

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Abstract

Background: The Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies (NTS) are two widely used procedures of diagnosis in the treatment arena of ophthalmology. But we have not enough data regarding the comparative analysis between these two procedures of TOP and NTS.

Aim of the study: The aim of this study was to establish a correlation between Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies (NTS) by OCTOPUS automated visual field analyzer in diagnosis and monitoring of glaucoma and other neurological lesion.

Materials and Methods: This was a prospective observational study. The comparative case study was conducted at the National Institute of Ophthalmology and Hospital (NIO and H), Dhaka, Bangladesh during the period from January 2003 to December 2004. At the first screening glaucoma suspect patients, established glaucoma and neuro-ophthalmological patients attended at the outdoor of NIO and H were selected for this study. Finally, forty-five eyes of twenty-five subjects were defined in this study for analysis. Data were collected by predesigned questioner and analyzed by SPSS latest version.

Results: The mean time required for test in Tendency Oriented Perimetry (TOP) was 3.01 ± 0.40 minutes and in Normal Threshold (32) was 15.87 ± 2.02 minutes. In our study the comparison of mean sensitivity in tested eye by TOP and NTS (32) strategies were prepared. The mean sensitivity in TOP was 21.07 ± 7.60 and in NTS (32) was 20.01 ± 6.95. The mean defect in TOP was 7.92 ± 7.24 and in NTS (32) was 8.46 ± 7.09 and the mean difference was statistically not significant ($p > 0.05$).

Conclusion: The study concludes that Tendency Oriented Perimetry (TOP) is an alternative to Normal threshold (32) perimetric technique in the assessment of visual field. Furthermore, TOP strategy is very much time saving and has less fatigue effects both to the patients and perimetrists. So, in screening purpose we can use TOP strategy instead of NTS (32) strategy.

Keywords: Ophthalmology; Tendency Oriented Perimetry TOP; Normal Threshold Strategies

Introduction

The Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies (NTS) are two widely used procedures of diagnosis in the treatment arena of ophthalmology. But we have not enough data regarding the comparative analysis between the mentioned two procedures. The aim of this study was to establish a correlation between Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies (NTS) by OCTOPUS automated visual field analyzer in diagnosis and monitoring of glaucoma and other neurological lesion. Perimetry is a method of evaluating the visual field. Again the visual field may be described as an island of vision surrounded by a sea of darkness [1]. Visual fields are quantified by means of kinetic or static perimetry. Since its introduction nearly 30 years ago, [2] automated static perimetry has become the standard of care for the diagnosis and follow up of most visual field abnormalities. Numerous attempts have been made to improve the sensitivity, specificity and speed of data acquisition. An ideal algorithm would be one that produces the most accurate approximation of the visual field in the least amount of time. Although highly reproducible and accurate fields can be obtained with traditional techniques, the length of the test is frequently a problem because of the traditional way of approximating the threshold by a staircase approach. The patient may end up fatigued and is subsequently reluctant to take the test. In some cases, the results of the test seem to deteriorate due to the fatigue effect [3]. Recently, a new perimetric program called Tendency Oriented Perimetry (TOP) was designed to obtain an approximation of the visual field threshold in a much shorter period of time than traditional strategies. The TOP strategy is based on testing each position only once but interpolating the information to the surrounding areas [4] Morales., *et al*. 2000 [5] showed that TOP is four times faster than traditional full-threshold technique and is successful in detecting visual field abnormalities. Defects with TOP tended to be smaller, shallower, and with softer edges than with standard approach. This study compares a widely used traditional thresholding technique with the TOP program. Parameters compared include reproducibility, global indices, point by point analysis, topographical diagnosis, sensitivity/specificity indices, and clinical correlation. Gonzalez de la Roza., *et al.* 1996 [4] showed that significant time savings of approximately 80% can be obtained with the use of TOP. Tendency Oriented Perimetry method takes only $2^{1/2}$ to 3 minutes instead of the normal 12 to 20 minutes. Johnson., *et al*. 1988 [6] states that automatic static perimetry has improved the detection and differential diagnostic capabilities of clinical visual field testing. In addition, the introduction of automated visual field testing has provided a number of other advantages over conventional manual perimetry, such as the standardization of test procedures and stimulus conditions, automatic monitoring of fixation and the ability to assess quantitatively a patient's response reliability. However, automated perimetry is more demanding and has less flexibility than manual visual field test procedures. The increased effort and attentional demands present in automated perimetry may, therefore, adversely influence the sensitivity and reliability of visual field test results. The development of current test strategies for performing automated static perimetry has been conducted with the assumption that visual field sensitivity and response errors do not vary during the examination [2,7] However, time-varying changes in visual thresholds have been reported for psychophysical experiments over extended periods of time [8]. In addition, Heijl [9] has examined variations in automated static perimetry at 5,10, and150 eccentricity over a 30-minute time period. Their findings revealed a small average sensitivity loss of 1.5 dB in normal observers and slightly greater sensitivity loss over time for glaucoma patients with visual field defects. Considerable individual differences were present especially in the patient population. Heijl found no meaningful differences in sensitivity loss among the three stimulus eccentricities. His findings also revealed that visual fields sensitivity was relatively stable for the first 10 minutes of the test procedure. Rabinean., *et al*. 1985 [10] examined fatigue effects in eight normal eyes by performing four successive visual field examinations over a 1- hour time period on the octopus 200 automated perimeter. They found no appreciable visual field sensitivity changes for their eight subjects. Heijl and Drance, 1983 and Langeshorst., *et al*. 1987 have also examined fatigue effects in automated perimetry, although the emphasis of these studies has been the use of fatigue-related sensitivity changes as a diagnostic tool for early visual field changes in glaucoma. On this background I undertake a trial of Tendency Oriented Perimetry (TOP) and compare with the Normal threshold perimetry (32) strategy.

Materials and Methods

This was a prospective comparative observational study, conducted at the National Institute of Ophthalmology and Hospital (NIO and H), Dhaka, Bangladesh during the period from January 2003 to December 2004. The study was approved by the ethical committee of the mentioned hospital. Proper written consents were taken from all the participants before starting the main parts of the intervention. At the first screening glaucoma suspect patients, established glaucoma and neuro-ophthalmological patients attended at the outdoor of NIO and H were selected for this study. Finally, forty-five eyes of twenty-five subjects were defined in this study for analysis. According to the inclusion criteria of the study patients of age between 20 to 70 years, having previous experience of taking automated perimetry testing, having visual acuity 6/12 or better, with normal visual fields of glaucoma suspected, patients having glaucomatous visual fields and patients having visual fields of neuro-ophthalmological disease (Pituitary tumours) were included. On the other hand, according to the exclusion criteria of this study, cases of presence of multiple ocular pathology, cases of visual acuity worse than 6/12 and poor reliability on automated perimetry testing were excluded. The required time, mean sensitivity (MS), mean defect (MD), loss variance (LV) and Square root of loss variance (sLV) were the main parameters of study. As outcome measures, age and sex were defined as the demographic variables whereas number of the eye tested in each patient, comparison of global indices such as mean sensitivity (MS), mean defect (MD), loss variance (LV), square root of loss variance (sLV), point by point differences, reproducibility and time required to complete the test were defined as the clinical variables. Each eye was tested twice with Tendency Oriented Perimetry (TOP) strategy and twice with Normal threshold (32) strategy of Octopus 32 program on the same day. A period of 30 minutes between experimental (TOP) and standard Normal threshold (32) tests were allowed; 60 minutes were allowed for taking rest between two sets of exams. The order of testing could be interchangeable. Starting with either the TOP or the 32 program but the alteration between the two-tests was done in a way that the two possible sequences wereTOP-32-TOP-32 or 32-TOP-32-TOP. The examinations were performed with an octopus 101 perimeter (Interzeag, AG) connected to and controlled by an external personal computer (Data from each test were converted into peri-trend Octopus database format and ASCII format for analysis of all the testing locations results). To enhance the patient's ability to respond accurately the patients must know that field test is not the test of their intellectual, artistic, or physical abilities, but it is a determination of their visual function in the sense of a medical test. Only patient could say what he could or could not see. Therefore, the perimetrist task is far beyond sitting the patient at the perimeter and turning on the machine. The perimetrist must enhanced the ability of the patient to report accurately which stimuli were seen. These included placing the patient at ease, making him physically comfortable in position at the perimeter, and ensuring that he understand the task. Special instruction was given to each patient about the process of testing and Octopus visual field analyzer. It was explained to the patients that there would be a brief flash of light after which there would be an interval when the machine waits for a response. It was explained and advised to the patient to click the button when the light went off and not to feel frustrated if he failed to respond while the light is on. It was also explained to the patients that most stimuli would be quite dim, and he should respond when, they were sure. The information with patient's data e.g., name, age, sex, date of birth, visual acuity, refractive error if any, the eye which was tested, and examination data e.g., test program, strategy were entered to the Octopus visual field analyzer computer. Appropriate corrective lens power was placed in lens holder and proper lens position was ensured. The non-testing eye was covered with patch. The chin was kept on chin rest of the machine and positioned so that the plane of the face was directed straight ahead in order to put the eye in straight down gaze to see the fixation target and the testing eye was centered in front of the trial lens holder, the face was turned slightly to the left when testing the right eye, and slightly to the right when testing the left eye, so that the nose could not obstruct the nasal periphery of the field. The height of the instrument was adjusted so that the patients were comfortable and able to concentrate to the visual stimuli. During the test period the patients were instructed to look straight ahead to the central target and click the button when seeing the stimulus on the bowl of the perimeter. All patients gave their informed consent prior to their inclusion in the study. All test was performed with the same visual field analyzer. All the seven in one print out of visual fields were analyzed and interpreted as normal visual field i.e., normal eye, glaucomatous visual field, and neuro-ophthalmological visual field. Experimental findings were collected by predesigned structured data collection sheet. Statistical analysis was done by using computer software (statistical package of social science). Unpaired student t-test was done to determine the level of significance of difference between two strategies (TOP and Normal threshold) and paired t-test was done to determine significance of difference in the same strategies. Fisher's exact test was done to see the distribution of patients by number of eyes examined in patients. Correlation coefficient r-test was done to determine the correlation of MD, sLV between two strategies (TOP and Normal threshold). A probability value of equal to or less than 0.05 was considered significant.

Results

In this study, out of 25 patients, 80.0% examined double eye and 20.0% single eye. Analysis found no statistically significant difference between male and female patients ($p > 0.05$), however, the proportion of double eye examination was more in female (88.9%) than male counterparts (75.0%). We disseminated the comparison of time required for automated perimetry testing by Tendency Oriented Perimetry (TOP) and Normal threshold strategies (32). In our study the comparison of mean sensitivity in tested eye by Tendency Oriented Perimetry (TOP) and Normal threshold (32) strategies were prepared. The mean sensitivity in TOP was 21.07 ± 7.60 and in Normal threshold (32) was 20.01 ± 6.95. Analysis revealed no statistically significant mean difference between two procedures (p > 0.05). The mean defect in Tendency Oriented Perimetry (TOP) was 7.92 ± 7.24 and in Normal threshold (32) was 8.46 ± 7.09 and the mean difference was not statistically significant (p > 0.05). Scatter diagram showing the positive correlation between Tendency Oriented Perimetry (TOP) and Normal threshold (32) procedure (r = 0.983) and the correlation was statistically significant (p < 0.001). Regarding the loss variance, the mean loss variance was higher in Normal threshold (39.04 ± 6.15) than Tendency Oriented Perimetry (35.21 ± 6.46) and the mean difference was not statistically significant (p > 0.05). Analysis of square root of loss variance shows that the mean square root of loss variance was higher in Normal threshold (5.54 ± 0.43) than Tendency Oriented Perimetry (5.05 ± 0.46) and the mean difference was not statistically significant (p > 0.05). The scatter diagram showing a positive correlation between Tendency Oriented Perimetry (TOP) and Normal threshold (32) strategy (r = 0.954) and the correlation was statistically significant (p < 0.001). In this study, analysis revealed a statistically significant correlation between Tendency Oriented Perimetry (TOP) and Normal threshold (32) strategy in glaucomatous and neuro-ophthalmological eyes (p < 0.001), but no statistical significant correlation was found in normal eyes (p > 0.05). In this study, analysis revealed a statistically significant correlation between Tendency Oriented Perimetry (TOP) and Normal threshold (32) strategy in normal, glaucomatous and neuro- ophthalmological eyes (p < 0.001). Analysis revealed that the parameters examined remained statistically insignificant (p > 0.05) within the specific strategy. This indicated that both strategies are reproducible.

Number of eye	**Sex**						**p value**
	Male		**Female**		**Total**		
	n	%	n	%	n	%	
Single	4	25	1	11.1	5	20	0.621
Double	12	75	8	88.9	20	80	
Total	16	100	9	100	25	100	

Table 1: Distribution of patients by number of eyes examined in each patient (n = 45).

p value reached from Fisher's Exact test (p > 0.05).

Parameters	**N**	**MS**		**Range**	**Mean differ-ence**	**p value**
		Mean	**SD**			
TOP	45	21.07	7.6	1.20-30.00	1.05	0.496
Normal threshold (32)	45	20.01	6.95	0.90-29.20		

Table 2: Comparison of Mean sensitivity between TOP and Normal threshold (32) strategy.

p value reached from un-paired t test; 't' = 0.685; df = 88; p > 0.05.

Parameters	**N**	**MD**		**Range**	**Mean differ-ence**	**p value**
		Mean	**SD**			
TOP	45	7.92	7.24	0.15-27.45	0.5433	0.703
Normal threshold (32)	45	8.46	7.09	0.45-27.15		

Table 3: Comparison of mean defect (MD) between TOP and Normal Threshold (32) Strategy.

p value reached from unpaired t test; 't' = 0.383; df = 88; p > 0.05.

Parameters	**n**	**Loss variance**		**Range**	**Mean differ-ence**	**p value**
		Mean	**SE**			
TOP	45	35.21	6.46	0.65-171.0	3.82	0.669
Normal threshold (32)	45	39.04	6.15	3.15-159.0		

Table 4: Comparison of Loss Variance (LV) between TOP and Normal Threshold (32) strategy.

p value reached from un paired t test; 't' = 0.429; df = 88; p > 0.05.

Parameters	**n**	**sLV**		**Range**	**Mean differ-ence**	**p value**
		Mean	**SE**			
TOP	45	5.05	0.46	0.81-13.08	0.4946	0.441
Normal threshold (32)	45	5.54	0.43	1.77-12.61		

Table 5: Comparison of Square root of Loss Variance (sLV) between TOP and Normal threshold (32).

p value reached from un paired t test; 't'= 0.773; df = 88; p > 0.05.

Type of eye	Number of eyes	Correlation coefficient	p value
Normal	12	0.164	p > 0.05
Glaucomatous	14	0.975	p < 0.001
Neuro-oph-thalmological	19	0.986	p < 0.001

Table 6: Correlation of mean defect (dB) between TOP and Normal threshold (32) in different types of eye.

Type of eye	Number of eyes	Correlation coefficient	p value
Normal	12	0.817	p < 0.001
Glaucomatous	14	0.835	p < 0.001
Neuro-ophthalmological	19	0.979	p < 0.001

Table 7: Correlation of square root of loss variance (dB) between TOP and Normal threshold (32) in different types of eyes.

Discussion

The aim of this study was to establish a correlation between Tendency Oriented Perimetry (TOP) and Normal Threshold Strategies (NTS) by OCTOPUS automated visual field analyzer in diagnosis and monitoring of glaucoma and other neurological lesion. In this study 45 eyes from 25 patients were tested twice by TOP strategy and twice by Octopus Normal threshold (32) strategy, a total of 180 visual fields (16 were male and 9 were female in age group of 20 to 61 years) in which no statistically significant mean age difference was found between male and female patients. The mean age of the male patients was 43.38 years and that of the female patients was 34.33 years. Among the study patients mean age of the females was about 9 years below that of the mean age of the male counterpart. Out of 25 patients 16 were male and 9 were female. Among the male patients single eye of the 4 patients and double eye of the 12 patients were examined. Among the female patients single eye of the 1 patient and double eye of the 8 patients were examined. There is no statistically significant difference between male and female patients (p > 0.05). However, the proportion of TOP obtained the threshold approximation of the visual field in about 19% of the time required by the Normal Threshold (32) strategy i.e., time savings is 81% by the TOP strategy from the Normal threshold (32) strategy. Morales., *et al*. 2000 [5] showed that mean time taken by beta version TOP strategy was 4.05 minutes' standard deviation ± 0.55 versus the standard 32 version taking 14.65 minutes' standard deviation ± 3.75. Studies under way have demonstrated a test duration for the TOP method of approximately 2.5 to 3 minutes [5]. Such reduction of time has been obtained by decreasing the interval between stimuli presentation, which was fixed in the strategy used for this study. In this study mean sensitivity (MS) values in Tendency Oriented Perimetry (TOP) and in Normal threshold (32) were 21.07 ± 7.60 and 20.01 ± 6.95 respectively. Analysis revealed no statistically significant mean difference between two procedures (p > 0.05). The mean defect (MD) values in Tendency Oriented Perimetry (TOP) were 7.92 ± 7.24 and in Normal threshold (32) was 8.46 ± 7.09 and the mean difference was not statistically significant (p > 0.05). In this study, mean sensitivity (MS) values were found to be approximately and consistently 1 dB higher with TOP strategy than with Normal threshold (32) strategy. Conversely mean defect (MD) values were approximately 0.6 dB lower with TOP than with Normal threshold (32) strategy. I believe this disparity is based on the effect of the fatigue phenomenon. The fatigue phenomenon consists of deterioration of the responses proportional to the length of the test; and it has been well documented by several authors [3,6]. Gonzalez de la Roza and Pareja. (1997) [11] recently calculated the fatigue effect at a rate of 0.08 to 0.1 dB decrease of mean sensitivity (MS) and increase of mean defect (MD) per minute of testing. This calculated rate correlates well with the difference between two strategies observed here, considering that the test with TOP reduces testing time 12 minutes from the typical testing time required by the Normal threshold (32) strategy. A different rate of increase in MS values and decrease in MD values has been observed with different shorter programs including Delphi [12] and SITA but the tendency seems to be in the same direction for the differences in MS and MD values. This measured change in values also supports the hypothesis that decreased testing time will lead to improvement in these indices could be underestimated with shorter strategies, it is important to consider that the longer tests may be overestimating the real defects by producing a deterioration of the responses associated with fatigue factor. Even though the MD values differed between the two strategies examined in this study, an excellent correlation level (0.98) for MD was observed between those values obtained by TOP and Normal threshold (32) strategy. The TOP values consistently corresponded closely to their counterparts obtained by the traditional technique, which supports the idea that TOP seems to be estimating the thresholds accurately but at a different level. Regarding the loss variance, the mean loss variance was higher in Normal threshold (32) than TOP and the mean difference was not statistically significant ($p > 0.05$). This might be due to fatigue phenomenon. Regarding the square root of loss variance, the mean square root of loss variance was higher in Normal threshold (32) than TOP and the mean difference was not statistically significant ($p > 0.05$). This also might be due to fatigue phenomenon. The correlation for sLV was also high (0.95) which is highly significant. Correlation of MD between TOP and Normal threshold (32) strategy in different types of eyes showing the statistically significant correlation in case of glaucomatous and neuro-ophthalmological eyes ($p < 0.001$), but no statistically significant correlation was found in case of normal eyes ($p > 0.05$). Correlation of square root of loss variance between TOP and Normal threshold (32) strategy in different types of eyes showing statistically significant correlation in case of normal, glaucomatous and neuro-ophthalmological eyes. Insignificant correlation of MD in case of normal eyes might be due to artifact or observational error. Reproducibility was as good for the TOP short strategy as it was for the traditional Normal threshold (32) strategy. This correlation is evidenced by the lack of statistical differences when the test duration, threshold values (MS), MD, or sLV indices were compared between each test taken the first versus the second time. Fluctuation regarding these indices did not show significant differences, either. This distinction is important because good reproducibility is an essential factor in the ability to measure progression of visual field damage. Clinical subjective assessment corroborated what was evident with the analysis of the different global indices that TOP strategy tends to obtain fields with less pathological results than those obtained in the same patients by the Normal threshold (32) strategy. This result appeared to be true for extent and depth of scotomas and generalized damage. The question remains of whether the TOP strategy is underestimating defects and visual damage or if the longer normal threshold (32) strategy is overestimating them [5]. The TOP strategy when compared with the Normal threshold (32) strategy, clinical results is that those scotomas with sharp and abrupt edges tend to show smoother edges. It was noted in particular that those scotomas from hemianopic defects caused by retrochiasmatic lesions tend to recede slightly from the midline in the numeric scale and to advance over the midline in the Greyscale. This observation seems to be a direct result of the strategy approach of TOP, which tends to combine more adjacent values due to the influence of surrounding points over each test position. So in above discussion, it became clear that TOP is as much effective as Normal threshold strategy. Both tests give accurate result in the assessment of visual field. Furthermore, TOP strategy needs less time to complete the test. In the perspective of time saving and fatigability TOP is superior to Normal threshold strategy but in borderline or doubtful cases it may be necessary to repeat the test by Normal threshold (32) strategy. So in general practice or screening purpose we can use TOP strategy instead of Normal threshold (32) strategy.

Conclusion

The study concludes that Tendency Oriented Perimetry (TOP) is an alternative to Normal threshold (32) perimetric technique in the assessment of visual field. Furthermore, TOP strategy is very much time saving and has less fatigue effects both to the patients and perimetrists. So in screening purpose we can use TOP strategy instead of Normal threshold (32) strategy.

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