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Original Article

Ophthalmology Section

Comparative Analysis of Visual Field Plotting by Octopus Interzeag 1-2-3, Humphrey Field Analyser II and Frequency Doubling Perimetry in Glaucoma Patients in South Indian Population

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ABSTRACT

Purpose: Standard achromatic perimetry tests the differential light sensitivity whereas the frequency doubling technology tests the contrast sensitivity. The aim of this study was to compare and correlate the visual field indices with three different types of perimeters namely frequency doubling perimetry (FDP), Humphrey field analyser (HFA) and Octopus Interzeag 1-2-3 (OI) for detecting glaucomatous field defects.

Design: Prospective cross-sectional observational study.

Materials and Methods: Hundred eyes of 50 glaucoma patients were studied. All the patients underwent visual field examinations by Octopus Interzeag 1-2-3, Humphrey field Analyser II and Frequency Doubling perimetry (FDP). The correlations of the global indices were compared. The time taken to perform the test with the three perimeters was analysed.

Results: The visual field plotting by the perimeters were comparable and significant positive correlation was observed. The time taken to perform visual field test by Octopus Interzeag 1-2-3 was shorter than the other two methods.

Conclusion: The visual field plotting by Octopus Interzeag 1-2-3, Humphrey field analyser and frequency doubling technology perimetry were comparable and Octopus field plotting takes lesser time than the rest two methods.

Keywords: Field defects, Frequency doubling technology, Standard achromatic perimetry, Time duration, Visual field indices

INTRODUCTION

Glaucoma is an important cause of preventable blindness worldwide [1]. The disease is characterised by loss of retinal ganglion cell axons which result in abnormalities in the visual field. The visual field defects usually appear only after 30-50% of the axons are lost [2]. The standard achromatic (white on white) perimetry is the most widely used method for detection of the visual field abnormalities. The early selective loss of M ganglion cells in Glaucoma and the preferential testing of this subtype of retinal ganglion cells have made frequency doubling perimetry a very useful tool in detection of early glaucoma [3]. Frequency doubling perimetry presents low spatial frequency sinusoidal gratings that are counter phase flickered at a high temporal frequency which creates a frequency doubling illusion where it appears as though the gratings have double the number of bars. This stimulus selectively tests the M retinal ganglion cells which are damaged early in Glaucoma making this test a useful screening tool for detection of glaucoma [4-7].

The purpose of this study was to compare the visual field analysis of the two standard achromatic perimeters namely the Octopus Interzeag 1-2-3 and Humphrey field analyser with that of the Frequency doubling perimetry.

MATERIALS AND METHODS

This prospective cross-sectional observational study was conducted between January 2006 and May 2007on glaucoma patients who attended the glaucoma clinic in a tertiary care ophthalmic hospital. The Institutional ethics committee approval was obtained. The patients were selected using random tables and informed consent was obtained from all the patients.The authors chose a convenient sample comprising of 50 subjects with bilateral disease (Glaucoma) for the present study. Accordingly, 100 eyes of 50 subjects were analysed in this study.

Inclusion Criteria: The patients who were included for the study were established Primary open angle glaucoma or normotensive glaucomatous patients on treatment with topical medications in both eyes and on routine follow up. We chose patients who had documented visual field defects on two or more reliable perimetric evaluation at previous visits, significant characteristic glaucomatous changes in the optic nerve head with or without raised intraocular pressure by Goldmann applanation tonometry. All the patients had a best corrected visual acuity of 6/12 or better.

Exclusion Criteria: Primary Narrow Angle Glaucoma, Secondary Glaucomas, Patients who underwent intraocular surgeries/Laser treatment, Congenital Glaucoma and patients with ocular diseases showing similar visual field defects (non-glaucomatous visual field defects) and media opacities were excluded from the study.

All the patients were subjected to a comprehensive ophthalmological examination including detailed medical and family history, visual acuity assessment and measurement of intra ocular pressure by Goldmann applanation tonometry, fundus examination by slit lamp bio-microscopy with the help of +90D lens and Gonioscopy with Goldmann Single Mirror.

All the patients underwent visual field examinations by Octopus Interzeag 1-2-3 Tendency oriented perimetry (Interzeag, Schlieren, Switzerland), Humphrey field Analyser II (Zeiss Humphrey Systems, Dublin, California, USA) Central 30-2 threshold test (SITA-Standard) and full threshold C-20 by frequency Doubling perimetry (Zeiss Humphrey Systems, Dublin, California, USA) within a period of one week by trained personnel. These tests were done in random order and sufficient interval between two tests to equalise the effects of stress and fatigue among these tests. Since the patients were previously experienced with computerised visual field testing, there was no effect of learning curve. The tests were termed reliable with< 30% fixation losses, false positives and false negatives. Standard criteria were used for analysis of the results. In case the fields were not found to be reliable, or the patients were not co-operative in the initial testing, they were called after a week and reassessed. All the patients had reliable fields based on the above criteria and each of them had all their three visual field examinations included in the study.

The global indices of each type of perimetry were analysed. The indices namely Mean Deviation and Loss Variance/Pattern Standard Deviation of both eyes were compared and correlated between these three Perimeters (i.e. Octopus & Humphrey, Humphrey & Frequency Doubling perimetry and Octopus & Frequency Doubling perimetry) using the Pearson correlation. Linear regression analysis was used to calculate the correlation coefficients. Statistical comparisons between groups were performed using unpaired 2-tailed t-test. P-value of < .05 was taken to be statistically significant.

The average time taken to perform each test was also analysed.

RESULTS

A total 100 eyes of 50 glaucoma patients were included in the study of which 34 were males and 16 were females. The average age of the patients was 49.8 years (35-70 years). The results were analysed for right eye and left eye separately.

Right Eye

The global indices of the right eye were compared between the two SAP, Octopus & FDP and Humphrey & FDP.

Mean Deviation

Octopus Mean Deviation significantly and negatively correlated with Humphrey and Frequency Doubling Technology Perimetry. Similarly Humphrey Mean Deviation significantly and positively correlated with Frequency Doubling Technology Perimetry [Table/Fig-1a]. [Table/Fig-1b] shows the correlation of right eye MD using Pearson's correlation.

Loss Variance /Pattern Standard Deviation

Octopus loss variance significantly and positively correlated with pattern standard deviation of Humphrey and Frequency Doubling Technology Perimetry. Similarly Humphrey Pattern standard deviation significantly and positively correlated with Frequency Doubling Technology Perimetry [Table/Fig-1c] and [Table/Fig-1d] shows the Pearson's correlation of the same.

Left Eye

The comparison of the left eye mean deviation and loss variance also showed results similar to that of the right eye.

Mean Deviation

Octopus Mean Deviation significantly and negatively correlated with Humphrey and Frequency Doubling Technology Perimetry. Similarly Humphrey Mean Deviation significantly and positively correlated with Frequency Doubling Technology Perimetry [Table/Fig-2a] and the Pearson's correlation of the same is as shown in [Table/Fig-2b].

Loss Variance/Pattern Standard Deviation

Octopus loss variance significantly and positively correlated with pattern standard deviation of Humphrey and Frequency Doubling Technology Perimetry. Similarly Humphrey Pattern standard deviation significantly and positively correlated with Frequency doubling Technology Perimetry [Table/Fig-2c]. [Table/Fig-2d] shows the Pearson's correlation of the left eye LV/PSD.

Time duration to perform test

The average time taken to perform the test for each eye was taken separately for all the three perimeters [Table/Fig-3].

DISCUSSION

Visual field analysis is one of the standard methods of assessment of disease severity and progression of glaucoma. The HFA and Octopus are two widely used methods for assessment of visual fields. This study was done to compare the two methods (SAP) with another technology namely the FDP. This study revealed comparable results

1	O-MD VS H-MD	r = -0.520	p<0.001
2	O-MD VS F-MD	r = -0.723	p<0.001
3	H-MD VS F-MD	r = 0.628	p<0.001

		O_rt	F_rt	H_rt
O_rt	Pearson correlation Sig. (2-tailed) N	1 . 50	-.723(**) .001 50	-.526(**) .001 50
F_rt	Pearson correlation Sig. (2-tailed) N	-.723(**) .001 50	1 . 50	.628(**) .001 50
H_rt	Pearson correlation Sig. (2-tailed) N	-.526(**) .001 50	.628(**) .001 50	1 . 50

[Table/Fig-1a&b]: Right Eye Mean Deviation
(**)- Correlation is significant at the 0.01 level (2-tailed)
O – Octopus; H – Humphrey; F – FDP; MD – Mean Deviation; rt – Right eye

1	O-MD VS H-MD	r = -0.581	p<0.001
2	O-MD VS F-MD	r = -0.648	p<0.001
3	H-MD VS F-MD	r = 0.683	p<0.001

		O_lt	F_lt	H_lt
O_lt	Pearson correlation Sig. (2-tailed) N	1 . 50	-.648(**) .001 50	-.580(**) .001 50
F_lt	Pearson correlation Sig. (2-tailed) N	-.648(**) .001 50	1 . 50	.683(**) .001 50
H_lt	Pearson correlation Sig. (2-tailed) N	-.580(**) .001 50	683(**) .001 50	1 . 50

[Table/Fig-2a&b]: Left Eye Mean Deviation
(**)- Correlation is significant at the 0.01 level (2-tailed)
O – Octopus; H – Humphrey; F – FDP; MD – Mean Deviation;lt – Left eye.

1	O-LV VS H-PSD	r = 0.312	p<0.002
2	O-LV VS F-PSD	r = 0.283	p<0.05
3	H-PSD VS F-PSD	r = 0.427	p<0.002

		O_rt	H_rt	F_rt
O1_rt	Pearson correlation Sig. (2-tailed) N	1 . 50	.283 .05(*) 50	.312 .002 50
FR1_rt	Pearson correlation Sig. (2-tailed) N	.283 .05(*) 50	1 . 50	.427(**) .002 50
HR1_rt	Pearson correlation Sig. (2-tailed) N	.312 .002 50	.427(**) .002 50	1 . 50

[Table/Fig-1c&d]: Right Eye Loss Variance
(**)- Correlation is significant at the 0.01 level (2-tailed)
O/O1 – Octopus; H/HR1 – Humphrey; F/FR1 – FDP; LV – Loss Variance; PSD – Pattern standard deviation;rt – Right eye.

1	O-LV VS H-PSD	r= 0.544	p<0.001
2	O-LV VS F-PSD	r= 0.568	p<0.001
3	H-PSD VS F-PSD	r= 0.650	p<0.001

		O1_lt	HR1_lt	FR1_lt
O1_lt	Pearson correlation Sig. (2-tailed) N	1 . 50	.544(**) .001 50	568(**) .001 50
HR1_lt	Pearson correlation Sig. (2-tailed) N	.544(**) .001 50	1 . 50	.650(**) .001 50
FR1_lt	Pearson correlation Sig. (2-tailed) N	.568(**) .001 50	.650(**) .001 50	1 . 50

[Table/Fig-2c&d]: Left Eye Loss Variance
(**)- Correlation is significant at the 0.01 level (2-tailed)
O/O1 – Octopus; H/HR1 – Humphrey; F/FR1 – FDP; LV – Loss Variance; PSD – Pattern standard deviation; lt – Left eye.

PERIMETER	RE (minutes)	LE (minutes)
Octopus	2.27	2.29
HFA	8.09	8.08
FDP	3.81	3.70

[Table/Fig-3]: Average Time taken for visual field plotting

in detecting visual field defects in subjects with all the three methods of testing. There was a high degree of agreement among these tests in identifying the defects. The p-value of < 0.001 signifies the degree of correlation among these different methods. The average time to perform the test was lesser in Octopus perimeter for both eyes.

Several studies have shown a good concordance of results when comparing FDP with the standard white on white perimetry though they test different components of the visual system [8-13].

King et al., had compared the SITA fast with TOP and showed a similar sensitivity and specificity among these two in detection of visual field defects in patients with perimetry experience [8]. They showed that both the methods were equally efficacious and useful in assessing the visual field defects. Further, they had also shown that TOP takes lesser time taken to complete among these two fast strategies. Both these fast strategies though comparable, TOP strategy was found to overestimate global sensitivity loss and underestimate focal sensitivity loss than SITA fast. In addition they had discussed the use and the inaccuracies which are possible when using the conversion formulae to convert Octopus decibels to Humphrey and vice versa. Leeprachanon et al., in their study of comparison of FDP and SAP (SITA Full threshold) concluded that both are comparable in their accuracy of detecting the defects in the visual field in early and moderate glaucomas [9]. Similar results were also shown by Serguhn et al., [10]. They also showed that FDP had sufficient reproducibility in all stages of glaucoma and because of shorter test duration, it could be used as a screening modality for detecting field defects. A comparison of FDP with Octopus parameters by Lester et al., also showed a statistically significant positive correlation as observed in our study [11]. A comparison of FDP with SITA Standard, SITA Fast and TOP concluded that time taken by FDP was least and that in perimetrically inexperienced individuals all these methods show only moderate sensitivity and specificity in detection of abnormalities in visual field [12]. The visual field indices, size, severity and location of the defects in Matrix were found to be overall comparable to SAP (Octopus). Matrix was shown to report higher values for visual field indices, visual field score and worse grading of defects when compared to Octopus by Lan et al., [13].

Comparison of FDP, Octopus and HFA-SITA Fast in established glaucoma patients by Wadood et al., showed that FDP has lower sensitivity but higher specificity than Octopus or SITA Fast. Also, they showed that the time taken for FDP and Octopus were 1/4 and 1/2 of that for SITA Fast [14].

In contrary to the above mentioned results, there are some discrepancies as reported by Patel A et al., [15]. The matrix test was shown to be less than optimal when compared to SITA fields. The matrix did not detect 36% of the abnormal SITA fields and matrix delineated defects smaller and deeper than shown by SITA. The fact that these tests are based on testing different aspects of the visual system, the larger size of the Matrix stimulus and sub-optimal normative database were considered as possible causes for the above mentioned results [15].

The main strength of the present study is that the two standard white on white perimeters were compared with the FDP in the same sample. The differences observed between the present study and the previous studies could be explained by patient heterogeneity and differences in study design. This was a cross-sectional study and not designed as longitudinal study and hence progression of visual field defects by these methods was beyond the scope of this study. This study was done on established glaucoma patients with perimetry experience and hence the comparison of sensitivity and specificity of these methods as a screening tool was not assessed.

CONCLUSION

The global indices of all the three perimeters are comparable and visual field plotting by Octopus was less time consuming compared to the other two methods. Longitudinal studies are needed to observe how visual field progression varies with these different perimeters in established glaucoma patients.

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