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Retinal Sensitivity with Pupil Dilatation and Without Pupil Dilatation Measured on Central Static Threshold Perimetry.

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Objective: The aim of the study was to find retinal sensitivity values with and without pupil dilatation in normal individuals.

Methods: Cohort study on 60 normal individuals was carried out. All individuals were subjected to perimetry to measure retinal sensitivity. Fixation loss, false positive, false negative, pattern defect, overall defect, fluctuations, hill of vision (HoV) slope and HoV slope 3 were examined during the test. Normal pupil range were taken as 2 - 4mm and dilated pupil was declared if it is ⩾ 6 mm. Tropicamide 10% drop was instilled in both eyes to dilate pupil. Perimetry was done before and after dilatation. Paired sample t-test applied to analyze data. P value less than 0.05 was taken as significant. Retinal sensitivity values were taken using Medmont central static threshold perimeter. This study was conducted in the month of October, November and December 2014.

Results: Out of 60 normal subjects 33 were males and 27 females. Retinal sensitivities values observed in each eye (N=120) before and after pupil dilatation were compared. Shapiro-Wilk test applied and the data were parametric. By applying paired sample t-test, there was no significant difference between Pattern defect, Overall defects, and HoV slope with and without pupil dilatation (p 0.42, p 0.28 and p 0.16 respectively). But there was marked differences between fluctuations with and without pupil dilatation ($p<0.000001$). Conclusion: There is no significant difference in retinal sensitivity before and after pupil dilatation. This study recommends that perimetry can be done with dilated pupils. Another study is required to validate this data in abnormal eyes particularly in glaucomatous eyes.

Abbreviations: VF: Visual Field. HFA: Humphrey Field Analyzer. MAP: Medmont Automated Perimeter. VA: Visual acuity. MD: Mean deviation. PSD: Pattern standard deviation. PD: Pattern defect. TDNP: Total deviation numerical plot (age-match plot). TDPP: Total deviation probability plot. PDNP: Pattern deviation numerical pot. PDPP: Pattern deviation probability plot. COAVS: College of Ophthalmology and Allied Vision Sciences. OPD: Out patient department. D: Dioptre. MS: Mean sensitivity. DME: Diabetic macular edema. OCT: Optical coherence tomography. BCVA: Best corrected visual acuity. RS: Retinal sensitivity. AMD: Age related macular degeneration. WD: With pupil dilatation. WOD: Without pupil dilatation.

Introduction:

Visual field is the part of environment that is visible to the steady fixating eye. To test visual field there are different methods e.g. kinetic and static perimetry. Static perimetry became gold standard to check visual field. Retinal sensitivities could interpret through visual field testing techniques. In kinetic or static perimetry, three dimensional visual fields are drawn. When visual field discovered kinetically beside X-Y axis, isopters are formed. And when visual field revealed statically along Z-axis the differing points of sensitivities are known. Island of hill of vision measuring along different axis in kinetic and static perimetry yield useful information. Top of the hill showed maximum retinal sensitivity that is foveal point and temporal to fovea is sharp cut down in retinal sensitivity that is optic disc point.

The yield of automated static perimetry has implemented a new access to the study of retinal function. Retinal sensitivity is an important perceptible parameter of visual field (VF) testing. Retinal sensitivity may be disclose at an earlier stage, which was not feasible with manual perimetry.[1] There were following motivations for automated perimetry. Reproducible testing conditions, data storage capability, need little skills for trustworthy results. Simple process and list of options software make automated perimetry easy.

Visual field printout shows different areas and plots that give a lot of information. At the top of printout there is information about individual's name, fixation target, fixation monitor, stimulus, background stimulus, strategy, pupil diameter, visual acuity, refraction number, date, time, age etc. Information about reliable indices is also there. There is a graph showing raw data to reflect the point sensitivity of retina. This data is then displayed in gray scale for easy visual interpretation. Total deviation numerical plot with total deviation probability plot shows overall defect in visual hill. Pattern deviation numerical plot and Pattern deviation probability plot are particularly useful in interpreting focal defects. Global indices summarize these results with p-value.

The pupils are usually equal in size in either eye of an individual. In young and adult individuals normally the size of pupil ranges from 2 - 4 mm in diameter in mesopic conditions and 4 - 8 mm in scotopic condition. Bilaterally constriction of pupil occur while seeing on close things, this is called as accommodative response. In the dark pupil dilatation occurs. When the pupil fails to enlarge in dark or fails to squeeze in bright light or accommodation then it is abnormal pupil.[2]

Miosis is a contracted pupil that is coordinated relative to the amount of light it receives. Pupil size has correlation with visual field sensitivity. A narrow pupil reduces both the sensitivity of the stimulus and that of the background. It may considerably reduce central and peripheral threshold sensitivities and increase the instability of threshold of measure. When the pupil size is 2mm or less, only I-2e isopter is most sensitive.[3] Visual field constriction recurred with correction of ciliary spasm induced myopia, implying that miosis, especially when marked, can independently alter the visual field.[4]

For the past many years, VF loss can be noted through static perimetry technique. MAP and HFA are the devices that turned into traditions. The universal keys of Humphrey Field Analyzer (HFA), Medmont shows strong interaction. There are different ways to call visual field. First of all, perimeter yields a graph of diverse sensitivities. Then correlated with age match graph and outlined naming as age match probability (TDPP) graph which tells deviation of each point from normal range. Then there is another graph which tells about the level of deep scotomas veiled by generalized dejection these are called as PDNP and PDPP. Moreover, VF can be called by universal keys. These include MD and PSD or the overall defect and PD on the HFA and MAP, respectively. MD is defined as variation between average normal sensitivity and mean sensitivity. This points out the average defect of entire visual field. It strongly encounters diffuse (homogenous) depression. PSD is defined as spread of measured sensitivity values from mean sensitivity. It is sensitive to irregularities of the visual field.[5] For comparison, this study included Medmont global indices like overall defect and pattern defect. Mean sensitivity (MS) was calculated by noting each point on the dB scale and then averaging of all twenty eight test places.[6] For this study a graph of 3 rings was used which engaged twenty eight test places and region of 11^0 including macula.[7]

In the previous studies, it has been shown that pupil size has correlation with visual field sensitivity. In these cases, mydriatic drops could be instilled prior to the examination. In the previous study, it showed that retinal sensitivity is decreased in glaucomatous individuals. Neovascular age-related macular degeneration also lessened the retinal sensitivity.

Thickening of fovea was also reduced sensitivity.[8] Previous studies also showed relationship between RNFL thickness and retinal sensitivities. Presence of subretinal tissue, choroidal neovessels and retinal layer elevation; retinal sensitivity decreased significantly. In previous study there is relationship of retinal sensitivity with DME.[9] In study macular function were calculated by computing the sensitivity, fixation pattern of the macular was observed by fundus-related micro-perimetry, then examined and evaluated the outcomes with BCVA and foveal retinal thickness quantified by OCT.

In past, there is study to associate RS in individuals with neovascular AMD with explicit quality of retinal morphology.[10] Another study was done to see retinal sensitivities values in individuals having hygienic life and those who was suffering with renal failure. In the past, a study was done to optical coherence tomography machine and perimetry to evaluate the retinal sensitivities. This study showed strong correlation between PSD and MD values of perimetry and OCT.[11]

Aims & Objectives:

To find retinal sensitivity values with and without pupil dilatation and to evaluate whether this dilatation creates differences in retinal sensitivity.

Materials and Methods:

Normal individuals more than 18 years of age belonging to both genders with corrected visual acuity of more than 0.1 logMAR were included in this study. Refractive error ranged from -5 to +3 diopters. Normal or undilated pupil was considered if pupil size was less than 4 mm. After dilatation with tropicamide, if dilated pupil was more than 3 mm than the undilated pupil, only then it was considered dilated pupil and then perimetry was repeated. Individuals with retinal disorders, diabetic retinopathy, glaucoma, macular disorders, refractive surgery, and phaco surgery, any disease in anterior and posterior segments were excluded. **Dependent variables were** fixation losses, false positive, false negative, hill of vision slope, hill of vision 3° level, pattern defect, overall defect, test duration and fluctuation. **Independent variables were** pupil diameter, age, gender, laterality, refraction, iris color, intraocular pressure, axial length and corneal curvature. Total 60 persons with 120 eyes were examined in this cohort study. Glaucoma Centre in the Department of Ophthalmology at the Mayo Hospital, Lahore, Pakistan was used to recruit individuals for this study.

Normal subjects were enrolled from students and unpaid helpers. The research was mannnered according to the guidelines of the Declaration of Helsinki, June 1964. Informed consent was taken from all subjects prior to their contribution in the investigation.

Results:

Total 120 eyes were examined. Shapiro-Wilk Test showed that the data was parametric for each measure. The descriptive statistics of findings with mean and standard deviation is tabulated in table 1. Correlation was found between dependent variables before and after dilation of pupil (Table 2). Paired sample t-test shows no significant difference in readings of perimetry before and after pupil dilatation in fixation losses, false positive, false negative, pattern defect, overall defect and HoV slope (Table 3). However, there was significant difference between the fluctuations before and after pupil dilation. But this difference does not practically affect the results of important readings like pattern defect, overall defect and HoV slope.

Overall defect was considered to be the main dependent and outcome variable. There is small correlation between with and without pupil dilatation overall defect but this correlation is not significant in practical use. Formula that shows correlation between with and without pupil dilatation overall defects is WOD overall defect=0.958 x 0.015+WD overall defect. The values are so small that the formula is not significant in practical use. So practically there was no difference in overall defect on perimetry before and after pupil dilatation. The correlation graph (Figure 1) shows the correlation of with and without pupil dilatation perimetric overall defect. There is no significant difference in with and without pupil dilatation overall defects.

There is marked difference between with and without pupil dilatation fluctuations (p=0.000001). There is no significant difference between with and without pupil dilatation pattern defect, overall defect, HoV slope.

Table: 1 Descriptive results of statistics in each group of observation

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	WOD_pupil diameter	3.00	120	.000	.000
	WD_pupil diameter	6.00	120	.000	.000
Pair 2	WOD_fixation losses	.00	120	.000	.000
	WD_fixation losses	.0 0	120	.000	.000
Pair 3	WOD_false positive	.00	120	.000	.000
	WD_false positive	.00	120	.000	.000
Pair 4	WOD_false negative	.00	120	.000	.000
	WD_false negative	.00	120	.000	.000

Pair 5	WOD_fluctuation	3.4664	120	.23600	.02154
	WD_fluctuation	2.114500	120	.4613004	.0421108
Pair 6	WOD_pattern defect	2.001250	120	.6720464	.0613492
	WD_pattern defect	1.942333	120	.4864582	.0444074
Pair 7	WOD_overall defect	.535000	120	.2639296	.0240934
	WOD_overall defect	.527583	120	.2633686	.0240422
Pair 8	WOD_HoV slope	1.891	120	.4319	.0394
	WD_HoV slope	1.973	120	.4788	.0437
Pair 9	WOD_HoV 3 level	23.00 [a]	120	.000	.000
	WD_HoV 3 level	23.00 [a]	120	.000	.000

Table: 2. Correlation between findings for perimetry results before and after dilatation of pupil.

Paired ed Samples Correlations				
		N	Correlation	Sig.
Pair 1	WOD_fluctuation & WD_fluctuation	120	.020	828
Pair 2	WOD_pattern defect & WD_pattern defect	120	.072	.434
Pair 3	WOD_overall defect & WOD_overall defect	120	.960	.000
Pair 4	WOD_HoV slope & WD_HoV s lope	120	.035	.702

Table: 3 Results of paired sample t-test to compute the difference of values of a dependennt variable before and after pupil dilation.

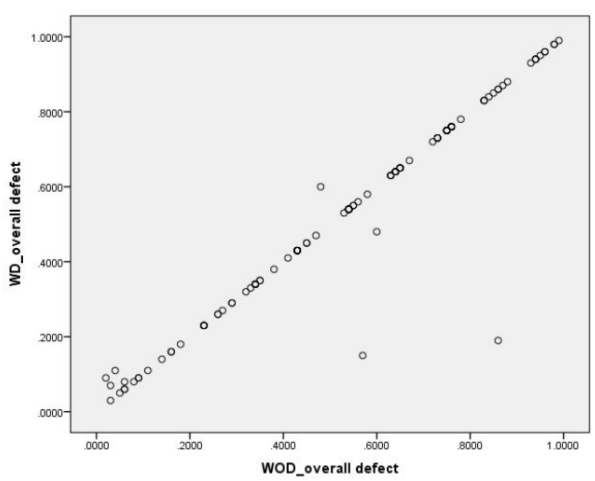

Figure 1: Graph shows correlation of with and without pupil dilatation overall defect. There is no significant difference in with and without pupil dilatation overall defects.

Discussion:

The fundamental point of this study was to evaluate the retinal sensitivities values with and without pupil dilatation. Study was completed at the glaucoma center Mayo hospital, Lahore. 60 individuals with 120 eyes, 33 males and 27 females with normal visual acuity were registered in the study, age ranged from 18-39 yrs. In the past, a study was done to know the retinal sensitivity values in constricted pupil that showed retinal sensitivity was depressed and showed marked difference in retinal sensitivities values.[4] Miosis (constricted pupil) caused marked impairs of MD and PSD indices. However, this study shows no statistical, and therefore no clinical, difference between the retinal sensitivity, pattern defect, overall defect, and HoV slope was noted. Fluctuations did show significant difference but is not of clinical value as it did not influence other outcomes.

Recommendations:

This study on retinal sensitivity with and without pupil dilatation revealed that there is no significant effect of pupil dilatation on retinal sensitivities values and after studying this it is recommended that perimetry can be done with or without dilatation of pupil. A general matter of concern is that when pupil is dilated for fundus examination and perimetry is required after that. This study strongly recommends not to deny perimetry just because of dilated pupil. The perimetry can be done even in dilated pupil and are as reliable statistically as done with normal undilated pupil. Pupil less than 3 millimeters is definitely a sign of no go for performing perimetry as other studies demonstrated.[13] Another study is required to validate this data in abnormal eyes particularly in glaucomatous eyes.

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