Original Research Article

Comparing the effects on the visual fields following pre and post pupillary dilatation

Rajitha Kondam[1*], Phaniraj Kathuri[2]

Department Ophthalmology, Malla Reddy Institute of Medical Sciences, Hyderabad, INDIA.
Email: drrajithakondam@gmail.com

Abstract

Aim: To compare the visual fields plotted by automated perimetry without and with pupillary dilation. **Methods:** This was a prospective, comparative, non interventional, single center observational study at the hospital settings. This study was conducted at Sarojini Devi Eye Hospital, Hyderabad between November 2006 and October 2007. Normal subjects were included in this study. The main endpoints was to measure visual fields with and without pupillary dilatation. Data analysis was done with the single field analysis printouts were collected and the data tabulated and analyzed using the paired Student's *t* test. $p \leq 0.05$ was considered statistically significant. **Results:** Overall, 35 eyes from the 19 subjects were included in this study, 10 were male (52.6%) and 9 were female (47.4%). The age ranged from 17 to 35 years, with mean of 22.9 years (males: 24.9 years and females: 20.7 years). Following the dilation with the phenylephrine eye drops 74.28% (n = 26) of the subjects had pupillary dilation of 7 to 8 mm in diameter, 20% (n = 7) had 6 mm dilation and 5.72% (n = 2) had 9 mm dilation with mean dilation of 7.28 ± 0.86 mm in diameter. The worsening of mean deviation (MD) was more in eyes with variation of pupil size by 5 mm (MD = -0.36 dB) compared to lower dilatations of 3 (MD = -0.1509 dB) and 4 (MD = -0.3053 dB) pupil sizes. The mean difference in MD was statistically significant worsening with 0.27 (with SD: 0.45; p = 0.001). The mean ± SD, pattern standard deviation (PSD) value at baseline was -2.14 ± 0.93 dB and after dilation was 1.64 ± 0.40 dB. The mean difference in PSD was improved without statistically significance difference of 0.10 ± 0.45 (p = 0.199). The increase in dilation of the pupil the MD worsened in 90.9% eyes of Δ5 mm of pupil size (p = 0.0038). However, the improvement in the PSD was noted in 72.2 % eyes with a 5 mm dilation of pupil from the baseline pupil size. There was a decrease in the foveal threshold (FT) by a mean of 0.14±1.91 dB after dilation which was again not statistically significant. **Conclusions:** There was statistically significant worsening of the MD (p < 0.01) after pupillary dilation. There was no statistically significant change in the PSD and FT threshold after pupillary dilation. Hence this study emphasizes the importance of consistent pupil diameter in serial visual field testing. Further comparative studies may be required on normal and glaucomatous subjects.

Key Words: visual fields, automated perimetry, pupillary dilation, mean deviation, pattern standard deviation, foveal threshold.

[*]**Address for Correspondence:**
Dr. Rajitha Kondam, Assistant Professor, Department of Ophthalmology, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana.
Email: drrajithakondam@gmail.com
Received Date: 16/05/2017 Revised Date: 02/06/2017 Accepted Date: 10/07/2017
DOI: https://doi.org/10.26611/10031111

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 24 July 2017

INTRODUCTION

In today's world with advanced ophthalmological treatment and diagnostics, options especially with pharmacological therapies either local or systemic use has associated with many undesired effect. These undesired effects could be sub-clinical temporary effects, like restriction of visual field. In recent years it has been noticed that pharmacologically induced miosis can cause constriction of visual field. Because of perceived restrictive visual field the ophthalmologist have different and conservative approach in examination methodology of eyes. Some ophthalmologist may choose to do visual fields examination after pupillary dilation and in few conditions such as central media opacities may

How to cite this article: Rajitha Kondam, Phaniraj Kathuri. Comparing the effects on the visual fields following pre and post pupillary dilatation. *MedPulse International Journal of Ophthalmology*. July 2017; 3(1): 40-44. https://www.medpulse.in/Ophthlmology/

necessitate the same. Hence the effect of active pupillary dilation on visual field performance is of concern to the ophthalmologists.

Visual fields are affected by various factors that can be due to physiologic and psychological factors which include age, effect size of the pupil, refractive error fatigue effects, etc,. Regarding the pupil size, there are several reports showing constrictions of visual field or decrease of threshold values after papillary constriction in normal subjects as well as glaucoma patients.[1-5] Although the effects of miosis were well documented to constrict the visual field or decrease the threshold values in both, normal and glaucoma subjects.[6,7] The effect of dilation on the other hand between normal and glaucoma subjects were rather not much studied.[8- 11] Hence we studied to explore the effects on normal subjects with an aim to compare the visual fields plotted by automated perimetry without and with pupillary dilation.

MATERIALS AND METHODS

Study design

This was a prospective, comparative, non interventional, single center observational study at the hospital settings. This study was conducted at Sarojini Devi Eye Hospital, Hyderabad between November 2006 and October 2007. This study included subjects presenting to the outpatient department for routine ophthalmic examination, who are been labeled as normal subjects. This study was approved by ethics committee and written informed consent was obtained from each subject entering the study. Following consent, subjects' demographic and baseline characteristics are recorded like, subject's age, gender, comorbidities, baseline ophthalmic examination including; visual acuity assessment for distance and near, slit lamp examination, visual fields by automated perimetry without and with pupillary dilation and direct ophthalmoscopy.

Inclusion and exclusion criteria

Normal subjects were included in this study. The subjects who had a history of eye disease, diabetes, ocular surgery, or ocular hypertension, and using any medications known to affect vision were excluded from this study.

Study assessments: Our study main endpoints was to measure by recording visual acuity for near and distance with and without pupillary dilatation, undilated pupil size, dilated pupil size, visual fields before pupillary dilation, visual fields after pupillary dilation.

Study procedures: After baseline ophthalmic examination the subjects were given instructions about the automated perimetry procedure. Each subject underwent refraction before dilation. The required data was entered into the automated perimeter and a baseline automated perimetry was done on each eye of all the subjects. After the completion of visual fields with undilated pupil, the pupil was dilated using 10% phenylephrine eye drops in both eyes, 3 times every 10 min. The post mydriatic automated perimetry was done on each eye 10 min after administration of last drop. Before each test, refractive error for near was corrected using the Humphrey trial frame. Before testing the miosed eye, the pupil diameter measurement and refraction for near were repeated and the optical correction modified as required. Humphrey Field Analyzer (HFA II) central-30-2 threshold program and Swedish interactive threshold algorithm (SITA)-Standard strategy was used with foveal threshold 'on'. The basic global field indices are calculated for mean deviation (MD) and pattern standard deviation (PSD).The criteria for abnormality MD or PSD were labeled abnormal by the instrument.

Data analysis

Data analysis was done with the single field analysis printouts were collected and the data tabulated and analyzed using the paired Student's *t* test, $p \leq 0.05$ was considered statistically significant. The basic global field indices are calculated for MD and PSD.

RESULTS

Overall, 35 eyes from the 19 subjects were included in this study, 10 were male (52.6%) and 9 were female (47.4%). The age ranged from 17 to 35 years, with mean of 22.9 years (males: 24.9 years and females: 20.7 years). Majority of females were less than 20 years of age and males were between 21 to 25 years (Table 1).

Table 1: Age distribution of the subjects

Age group (yrs)	Male	Female	Total in each age group
≤ 20	1	6	7
21-25	5	2	7
26-30	3	1	4
≥ 30	1	0	1
Total	**10**	**9**	**19**

The 71.43% (n = 25) of the eyes had baseline pupil size of 3 mm in diameter and 28.57% (n = 10) had 4 mm with the overall mean ± standard deviation (SD) baseline pupil size of 3.28 ± 0.46 mm diameter (Table 2). Following the dilation with the phenylephrine eye drops 74.28% (n = 26) of the subjects had pupillary dilation of 7 to 8 mm in diameter, 20% (n = 7) had 6 mm dilation and 5.72% (n = 2) had 9 mm dilation with mean dilation of 7.28 ± 0.86 mm in diameter.

Table 2: Distribution of pupil size at baseline and after dilation

Pupil size (mm)		N= 35 n (%)
Baseline	3 mm	25 (71.43%)
	4 mm	10 (28.57%)
Post dilation	6 mm	7 (20%)

7 mm	13 (37.14%)
8 mm	13 (37.14%)
9 mm	2 (5.72 %)

The mean difference in the pupil size before and after dilation was 4.00 mm in diameter. The mean MD value was -2.14 decibels (dB) (with SD: 0.93) at baseline and following dilatation was -2.41 dB (with SD: 1.07). The mean difference in MD was statistically significant worsening with 0.27 (with SD: 0.45; p = 0.001). The mean ± SD, PSD value at baseline was -2.14 ± 0.93 dB and after dilation was 1.64 ± 0.40 dB. The mean difference in PSD was improved without statistically significance difference of 0.10 ± 0.45 (p = 0.199). There was a decrease in the foveal threshold (FT) by a mean of 0.14±1.91 dB after dilation which was again not statistically significant (Table 3).

Table 3: Comparison of pupil size and SITA from baseline and dilated pupil

Parameters	Baseline mean ± SD	Dilated mean ± SD	Mean difference mean ± SD	P values
Pupil Size (mm)	3.28 ± 0.46	7.28 ± 0.86	4.00	-
FT (dB)	36.03 ± 2.74	35.89 ± 1.97	0.14 ± 1.91	0.661
MD (dB)	-2.14 ± 0.93	-2.41 ± 1.07	0.27 ± 0.45	0.001
PSD (dB)	1.74 ± 0.52	1.64 ± 0.40	0.10 ± 0.45	0.199

dB, decibels; SD, standard deviation; SITA, Swedish interactive threshold algorithm; FT, foveal threshold; MD, mean deviation; PSD, pattern standard deviation.

The mean overall difference in the pupil size before and after dilatation was 4.00 mm in diameter. The 31.42% (n = 11) of the eyes had difference in the pupil size of 3 mm in diameter, 37.14% (n = 13) had 4 mm difference and 31.42% (n = 11) had 5 mm difference (Table 4). Therefore, increase in pupil size of 4 mm was noted in most of the eyes (37.14%). The worsening of MD was more in eyes with variation of pupil size by 5 mm (MD = -0.36 dB) compared to lower dilatations of 3 (MD = -0.1509 dB) and 4 (MD = -0.3053 dB) pupil sizes (Table 4). This shows that with the increase in dilation of the pupil the MD worsened progressively with variation of mean from -0.159 dB to – 0.36 dB.

Table 4: Comparison of variation of SITA parameters with variation of pupil size

Variation in pupil size (mm)	Sample size, n	Percentage	FT (dB)	MD (dB)	PSD (dB)
Δ3	11	31.42%	0.72	-0.1509	-0.09
Δ4	13	37.14%	-0.76	-0.3053	0.065
Δ5	11	31.42%	-0.09	-0.36	-0.312
Total	**35**	**100%**	**-0.14**	**-0.274**	**-0.10**

dB, decibels; SITA, Swedish interactive threshold algorithm; FT, foveal threshold; MD, mean deviation; PSD, pattern standard deviation.

Inconsistent with the increase in dilation of the pupil the MD worsened in 90.9% eyes of Δ5 mm of pupil size (Table 5). Hence the maximum dilatation of the pupil worsened the MD in significant number of eyes (p = 0.0038). The parameters altered least with Δ3 mm of pupil size. However, the improvement in the PSD was noted in 72.2 % eyes with a 5 mm dilation of pupil from the baseline pupil size.

Table 5: Subject-specific comparison of variation of parameters

Variation in pupil size in mm		FT (dB) n (%)	MD (dB) n (%)	PSD n (%)
Δ3	Worsening	1 (9.0%)	5 (45.5%)	5 (45.5%)
	Improvement	5 (45.5%)	6 (54.5%)	6 (54.5%)
	Unaffected	5 (45.5%)	0 (0%)	0 (0%)
Δ4	Worsening	8 (61.5%)	8 (61.5%)	5 (38.5%)
	Improvement	3 (23.1%)	5 (38.5%)	7 (53.9%)
	Unaffected	2 (15.4%)	0 (0%)	1 (7.6%)
Δ5	Worsening	6 (54.5%)	10 (90.9%)	1 (9.1%)
	Improvement	5 (45.5%)	1 (9.10%)	8 (72.7%)
	Unaffected	0 (0%)	0 (0%)	2 (18.2%)

dB, decibels; FT, foveal threshold; MD, mean deviation; PSD, pattern standard deviation.

DISCUSSION

Despite the documented deterioration in the visual field of glaucoma subjects following mydriasis, little is known of the effect on the normal subjects.[12] Mydriasis is thought to have a minimal influence on perimetric performance in healthy subjects while pharmacologically induced miosis can cause constriction of visual field with automated perimetry.[13] Using the Humphrey Field Analyzer, miotics worsened the mean deviation in normal subjects compared to baseline perimetry. Although the effects of miotics agents on visual field performance are well documented, the effects of pupillary dilation are not. Very few studies have reported the effect of pupillary dilation on the visual field performance by automated perimetry.[14] Our study compared the perimetric performance between the baseline and dilated eyes using SITA – Standard global indices. Fixation losses, false positive responses and false negative responses were similar between baselines and dilated automated visual fields. The mean deviation (MD) worsened with a mean decrease of 0.27 dB (p = 0.001). The pattern standard deviation (PSD) improved by a mean of 0.10 (p = 0.199). There was worsening in foveal threshold with a mean decrease of 0.14 dB (p = 0.661). Subject specific information showed that dilation worsened the mean deviation in 23 eyes (65.71%) and improved in 12 eyes (34.29 %) as compared to the mean deviation of baseline field. 90.9 % (n = 10/11) eyes with 5 mm dilation of pupil size from baseline showed worsening of mean deviation while only 9.1% showed improvement. The MD worsened maximally with a mean decrease of 0.36 dB and the PSD improved by a mean of 0.312 in the above eyes**.** Among the various studies done to determine the effects of pupillary dilation on visual fields by automated perimetry worsening of the mean deviation was the most consistent conclusion. The present study of ours also showed the similar result.[15-18] Kim *et al*, W.K. Kellogg eye center, Michigan reported worsening of MD by 0.83 dB in dilated fields as compared with baseline visual fields. In this study MD worsened by 0.27 dB and the FT worsened by 0.14 dB which was less in the present study as compared to Kim *et al* where worsening was 0.55 dB.[19] When compared to Kim *et al* variation in MD was similar where as variation of PSD was against their observation.[19] The mean difference in the pupil size was 4 mm in diameter in the present study where as Kim *et al* study calculated the pupillary area with a mean difference of 30 mm² between baseline and dilated pupils. Subject specific information showed that dilation worsened the mean deviation in 66% of eyes in the present study as compared to 78 % of eyes in Kim *et al*.[19] In the study by Kim *et al* the author explains the worsening of the parameters on the basis of altered retinal illumination.[19] Increased retinal illumination occurs with mydriasis under mesopic perimetric conditions and thus threshold sensitivity values would be expected to improve. This expected improvement may be reduced by the Stiles – Crawford effect, spherical and chromatic aberrations. PSD is an index of localized defects and is thus not significantly altered. Kudrna *et al* compared the results in both eyes of all subjects and reported worsening of Mean deviation with a range of 1.15 dB to 1.43 dB and decrease in foveal threshold in a range of 1.95 dB to 2.56 dB.[20]

LIMITATIONS

Most of the studies used cycloplegics like tropicamide whereas in the our study mydriatic agent, 10 % phenylephrine eye drops were used.[21] One limitation of the present study is that testing was done on normal subjects. If it was done on patients with glaucoma there is a possibility that the results could have been altered.

CONCLUSIONS

The present study shows that there was statistically significant worsening of the Mean Deviation (MD) (p <0.01) after pupillary dilation. There was no statistically significant change in the Pattern Standard Deviation (PSD) and foveal threshold after pupillary dilation. Thus this study emphasizes the importance of consistent pupil diameter in serial visual field testing.

REFERENCES

1. DAY, R. M. and H. G. SCHEIE. Simulated progression of visual field defects of glaucoma. Arch. Ophthal. 50: 418–433 (1953).
2. Forbes, M.: Influence of miotics on visual fields in glaucoma. Invest. Ophth. 5:139, 1966
3. Youn DH, Kee CW. The Influence of Miotics on Visual Field in Glaucoma. J Korean Ophthalmol Soc 1986 Dec 27(6):1065-1071.
4. McCluskey DJ, Douglas JP, O'Connor PS, Story K, Ivy LM, Harvey J.S. The effect of pilocarpine on the visual field in normals. Ophthalmology. 1986 Jun; 93(6):843-6.
5. Webster AR, Luff AJ, Canning CR, Elkington AR. The effect of pilocarpine on the glaucomatous visual field. Br J Ophthalmol. 1993 Nov; 77(11):721-5.)
6. (Engel S. Influence of a constricted pupil on the field in glaucoma. Arch Ophthalmol 1942; 27: 1184-7.
7. Lindenmuth KA, Skuta GL, Rabbani R, Musch DC. Effects of pupillary constriction on automated perimetry in normal patients. Ophthalmology 1989; 96: 1298-301.)
8. Forbes M. Influence of miotics on visual fields in glaucoma. Invest Ophthalmol 1966; 5: 139-45.
9. Rebolleda G, Munoz FJ, Fernandez VJM, Pellicer T, del Castilla JM. Effects of pupillary dilation on automated perimetry in glaucoma patients rceiving pilocarpine. Ophthalmology 1992; 99: 418-23.
10. Lindenmuth KA, Skuta GL, Rabbani R, Musch DC, Bergstrom TJ. Effects of pupillary dilation on automated

perimetry in normal patients. Ophthalmology 1990; 97: 367-70.
11. Park HJ, Youn DH. Quantitative analysis of changes of automated perimetric thresholds after pupillary dilation and induced myopia in normal subjects. Korean J Ophthalmol. 1994 Dec; 8920:53-60.
12. Mendivil A. Influence of a dilated pupil on the visual field in glaucoma. J Glaucoma 1997; 6: 217-220.
13. Lindenmuth KA, MD,Gregory L. Skuta, MD,Roya Rabbani,BS, Terry J.Bergsrom,MD. Effects of Pupillary Constriction on Automated Perimetry in normal patients. Ophthalmology 1989; 96(3):1298-1301.
14. Heijl A, Bengtsson B. The effect of perimetric experience in patients with glaucoma. Arch Ophthnlmol1996; 114: 19-22.
15. Dunbar Hoskins H. Does computerised perimetry offer practical advances in choice of therapy in the glaucoma patient? Eye 1992; 6: 43-6.
16. Mikelberg FS. Do computerised visual fields and automated optic disc analysis assist in the choice of therapy in glaucoma? Eye 1992; 6: 47-9.
17. Tate GW Jr, Lynn JR. Principles of quantitative perimetry: testing and interpreting the visualfield. New York: Grune and Stratton, 1977: 69.
18. McCluskey, DJ, Douglas, JP, O'Connor, PS et al, The effect of pilocarpine on the visual fields in normals. Ophthalmology. 1986; 93:843–846.
19. Kim A. Lindenmuth, MD,Gregory L. Skuta, MD,Roya Rabbani, BS, Terry J.Bergsrom, MD. Effects of Pupillary Dilation on Automated Perimetry in Normal Patients. Ophthalmology 1990 Mar; 97(3):367-70.
20. Kudrna GR, Stanley MA, Remington LA. Pupillary dilation and its effects on automated perimetry results. J Am Optom Assoc. 1995 Nov; 66(11):675-80.
21. McCluskey, DJ, Douglas, JP, O'Connor, PS et al, The effect of pilocarpine on the visual fields in normals. Ophthalmology. 1986; 93:843–846.

Source of Support: None Declared
Conflict of Interest: None Declared