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PHYSIOLOGY

A Comparative Study of Visual Field in Emmetropic and Myopic Subjects by Automated Perimetry.

Dr. Ankita Juyal	Assistant Proffesor ,Physiology, Govt. Doon. Medical College, Dehradun.
Dr. Punam Verma	Professor, Physiology, Shri Guru Ram Rai Medical College, Dehradun.
Dr. Sanjeev Mittal	Professor, AIIMS, Rishikesh. AIIMS Rishikesh Campus, Near IDPL, Rishikesh.

ABSTRACT Field of vision reflects status of retinal functioning. Factor affecting the integrity of retina may also alter normal field of vision. Myopia, being one of such condition estigates us to design this study. This study was carried out on thirty emmetropic and thirty myopic subjects of equal number of both sexes of 22-30 years of age. After routine ophthalmic examination, automated perimetry was done with the help of " Humphrey Visual Field Analyzer" and results were evaluated in terms of three global indices namely Foveal Intensity (FI), Mean Deviation (MD) and Pattern Standard Deviation (PSD) representing the retinal sensitivity. FI and MD were statistically significantly lower in myopes than emmetropes and PSD was statistically significantly higher in myopes than emmetropes. In view of these findings, early detection of visual field loss due to myopic refractive error helps for better diagnostics and prompt management.

KEYWORDS : field of vision, myopia, automated perimetry

Introduction

Visual field, an island or hill of vision, depicts a three-dimensional spatial model where the contour of the island represents various levels of retinal sensitivity. The narrowest peak represents the fovea (greatest sensitivity) and the whole outer border corresponds to the least sensitive areas of the peripheral field. Outside these edges, even a very large and bright object cannot be seen (1). The dimensions of visual field can be affected by age, size of nose & orbital structures, factors related to stimuli, refractive error, fixation and eye movement (2).

The surface of the hill of vision, or sensitivity of given point, is measured in modern automated perimetry by varying the brightness of stimulus to find the dimmest stimulus known as threshold stimulus. Visual field testing is required to determine whether the visual field is affected by disease that cause reduction in sensitivity(threshold), local scotoma as a more extensive loss of vision (3).

Myopia is a defect of eye that causes light to focus in front of retina instead of directly on it, resulting in inability to see distant objects clearly. It is a common refractive error that limits occupational choices. It is also a risk for various vision threatening conditions like glaucoma, retinal detachment, acute macular degeneration etc. It has been estimated that potentially up to 80% people suffering from retinal detachment have some degree of myopia (4). It is one of the most common ocular abnormalities reported worldwide (5).

Change in axial length, power of cornea and lens are responsible for myopia development but axial length being the primary determinant of myopia(6-9). Henceforth any factor affecting the integrity of retina like shape of the eye particularly, its axial length may also alter normal field of vision (10).

Present study was planned to see if any correlation exists between refractive error, field of vision and there by retinal sensitivity even in young adults. In presence of a positive finding, even at an early age myopia related field changes detection can be recommended to check the progression of disease.

Materials and Method

The study was conducted in the departments of Physiology and Ophthalmology of Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun over a period of twelve months on sixty subjects of equal number of both the sexes. Half of the subjects were grouped as Emmetropes and other half as Myopes. All the subjects were of similar educational status and socio-economic status. The study was approved by institutional research and ethical committee.

Detailed history regarding personal habits, family history especially of myopia, history of diabetes mellitus, hypertension, drug history were obtained from all the subjects. In all the subjects, history of any ocular diseases like diabetic retinopathy, cataract, optic neuropathy, pathological myopia (> -6 diopters), migraine, vasospastic disorders, ocular surgery, use of photosensitizing agents were ruled out.

Informed consent for doing ophthalmic examination was sought. All subjects underwent a complete ophthalmic examination, which was done in three steps:

Step I-Refractometry: Refractometry was performed in both the eyes and was converted to spherical equivalents. Also visual acuity testing unaided and with glasses was done. Myopic subjects with refractive error between -0.5 to -6 diopters (mild to moderate myopia) were selected for the study.

Step II- Fundus Examination: Fundus examination in all the subjects was done with the help of slit lamp to see any abnormality.

Step III- Automated Perimetry: Visual field testing was performed with the help of Automated Perimeter-"**Humphrey visual field analyzer II – i series**"(HFA) using 'Central 30 - 2' test where the stimulus is varied in intensity from 0.8 to 10000 apostilbs(asb), a range of about 5 log units. The differential threshold is inversely related to the intensity of the stimulus and is recorded in decibels. The background luminance is 31.5asb and the testing distance is 33 cm (11).

Before doing Perimetry, subject was explained and exposed to the test procedure to relieve him/her of any apprehension. In half of the subjects, test was started with the left eye and in another half of the subjects with the right eye to reduce any possible differences between the two eyes as a result of learning or fatigue.

The Humphrey visual field analyzer's (HFA) statistical software, STATPAC, provides immediate expert analysis of visual field test results based on concept of 'hill of vision' of normal visual field and the fovea is being the highest retinal sensitivity point. The peak of hill of vision is represented by fovea and on moving away from the centre (fovea) to the periphery, retinal sensitivity decreases. This drop of sensitivity from centre to periphery gives characteristic shape and contour to the hill of vision. In hill of vision the most important points to be focused are the height of hill of vision and smooth contour of hill of vision. **Alteration in retinal sensitivity will affect either the**

height of hill of vision or the smooth contour of hill of vision or both. These are expressed in terms of global indices, namely Foveal Intensity, Mean Deviation and Pattern Standard Deviation: (12,13).

1.Foveal Intensity(FI): It is measured by retinal threshold that is the ability to detect a stimulus under defined testing conditions. The normal threshold is taken as the mean threshold in normal people of a given age group, at a given location in the visual field. FI of a patient is compared with these normal standard thresholds by the help of machine. This is measured in decibels, in a range of 0-50 dB. 50 dB is the dimmest target the perimeter can project. It is unlikely that any normal person can detect this much dim a stimulus.

2.Mean Deviation(MD): The mean deviation expresses the change in the 'height' of hill of vision. It indicates deviation of patient's overall functions from the age matched normals. The positive value indicates that the patient's overall sensitivity is better than normal observer where as negative value indicates that the patients's overall sensitivity is worse than the average normal individual.

3.Pattern Standard Deviation(PSD): PSD expresses the change in the smoothness of the contour of the hill of vision. It is a measurement of the degree to which the shape of the patient's measured field deviates from the normal, age-corrected reference field. A low PSD indicates a smooth hill of vision, a high PSD indicates an irregular hill. PSD characterizes localized changes in the visual field.

Statistical Analysis was carried out by using SPSS version 17.0 software.

Multivariate test was used for comparing the global indices of the emmetropic and myopic subjects. Pearson Correlation was used to find correlation of the global indices with the refractive error of the subjects.

Results

Study was conducted on total of 60 subjects, 30 emmetropics and 30 myopics of equal number male and female subjects.

1) The mean ± s.d. of refractive error in male myopic subjects was -2.18 ± 0.91 diopters and in female myopic subjects was -2.43 ± 1.41 diopters i.e. Refractive error was higher in females, although the difference was statistically insignificant (Table1).

2) In emmetropes, mean ± sd of FI, MD and PSD were 37.86 ± 1.15 dB, -1.21 ± 0.49 dB and 1.59 ± 0.46 dB respectively. In myopes, mean ± sd of FI, MD and PSD were 35.43 ± 2.53 dB, -3.18 ± 1.66 dB and 2.51 ± 0.81 dB respectively (Table2). Thus the mean of FI & MD were lower and PSD was higher in myopic than in emmetropic subjects.

3) Multivariate analysis showed statistically significant relation of global indices namely FI, MD and PSD to refractive errors and no statistical significant relation was observed with gender. FI and MD were statistically significantly lower in myopic subjects in comparison to emmetropic subjects while PSD was statistically significantly higher in myopic subjects in comparison to emmetropic subjects (Table3). These values reflect reduced retinal sensitivity.

4) Negative correlation of refractive errors with FI (r=-0.40) and MD (r=-0.51) while positive correlation with PSD (r=0.43) was found. As refractive error increases, dimensions of visual field decreases.

Discussion

In present study, refractive error in female subjects were more as compared to that in male subjects, reason being spending more time in indoor activities like studying and household chores by females in comparison to their male counterparts who spend more time in outdoor sport activities (14,15). However some studies reported no significant relationship of near work in adulthood due to stabilization of the refractive status with the progression of age (16).

In this study, FI and MD were statistically significantly lower in myopic subjects as compared to emmetropic subjects while PSD was statistically significantly higher in myopic subjects as compared to emmetropes reflecting reduced retinal sensitivity in myopes. Similar observations of decline in retinal sensitivity in moderate or high myopic patients regardless of the method of correction and with increase of axial length of the eye is also reported in previous studies (17,18,19). The reason could be linked to the involvement of retina, thinning of width of the ganglion cell complex and peripapillary retinal nerve fiber layers in all quadrants except nasal quadrant, the visual field changed occurred (20).

Present study also observed negative correlation of refractive error with FI and MD while positive correlation with PSD. Similar findings in a Chinese study explained that the central visual field defects are present in high myopia that was related to the degree of myopia, the axial length of the eyeball, age of the patients and severity of the posterior polar lesions (21). Ito A et al examined the effect of myopia associated with glaucoma and found negative correlation of increasing refractive error with Foveal Intensity and Mean Deviation but found no significant change in Pattern Standard Deviation (22).

Raynon J et al reported that degree of visual field defects in subjects with mild, moderate and severe myopia, were increased approximately 2-fold, 3-fold and 14-fold respectively as compared to that in emmetropic subjects. This pattern suggested an exponential rather than a linear relationship between myopia and visual field defects. They gave the reason that the individuals with axial myopia have weaker scleral support at the optic nerve which contributes to a greater susceptibility of the optic nerve to get damaged and thereby visual field defects (23).

In the present study, there was no statistical significant gender variation in FI, MD and PSD in both emmetropic and myopic subjects. This was in accordance to the finding of Christopher Bowd et al who also observed the relationship of visual field with age, optic disc area, refraction, gender, optic disc topography and retinal nerve fiber layer measurements. They reported that refractive error and gender were not associated with any optic disc or retinal nerve fiber layer thickness abnormality (24).

Conclusion

In myopia, generalized reduction in retinal sensitivity may occur at an early age that is reflected by visual field changes in the form of decreased Foveal Intensity, Mean Deviation and increased Pattern Standard Deviation. There is positive correlation of the refractive error with the changes in visual field showing enhanced visual field defects with the progression of degree of myopia.

In view of these findings, visual field mapping should be recommended on the regular basis since the beginning of the myopia to check progression of visual field defects as early as possible.

TABLE 1

Comparison of refractive powers between male and female myopic subjects

Myopic Subjects	Refractive error (diopters) Mean ± sd
Male	-2.18 ± 0.91
Female	-2.43 ± 1.41
p value	0.54

TABLE 2

Global indices in emmetropic and myopic subjects

Subjects	Fovial Intensity (Mean±SD)		Mean Deviation (Mean±SD)		Pattern Standard Deviation (Mean±SD)	
	Emmetropes	Myopes	Emmetropes	Myopes	Emmetropes	Myopes
Male	37.8±1.16	34.96±3.03	-1.21±0.41	-3.56±2.15	1.49±0.37	2.49±0.91
Female	37.93±1.14	35.90±2.10	-1.20±0.58	-2.81±0.83	1.69±0.52	2.54±0.70

Total	37.86±1.15	35.43±2.63	-1.21±0.49	-3.18±1.66	1.59±0.46	2.51±0.81

TABLE 3

Multivariate analysis of variance Comparison of visual field in emmetropic and myopic male and female subjects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Refractive status	FI	177.633	1	177.633	43.625	p<0.05
	MD	117.434	1	117.434	80.420	p<0.05
	PSD	25.456	1	25.456	57.930	p<0.05
Gender	FI	8.533	1	8.533	2.096	p>0.05
	MD	4.170	1	4.170	2.856	p>0.05
	PSD	.455	1	.455	1.036	p>0.05
Refractive status *Gender	FI	4.800	1	4.800	1.179	p>0.05
	MD	4.126	1	4.126	2.825	p>0.05
	PSD	.180	1	.180	.410	p>0.05

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