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A Clinical Study of Myopia for Evaluation of Retinal Nerve Fibre Layer Thickness Using Spectral Domain Oct

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ABSTRACT
BACKGROUND:- *Myopia is one of the most common ocular abnormalities reported worldwide, mainly in Asia. Eyeball is enlarged with increased axial length & stretching occurs beyond normal dimensions, leading to thinning of retina. The RNFL is a sensitive indicator for predicting early glaucomatous changes & extent of RNFL damage correlates with severity of functional deficit in visual field. These field defects result from loss of ganglion cells, which is manifested as thinning of the RNFL and RNFL defects. RNFL thickness (RNFLT), therefore, is a very important parameter in evaluation and monitoring of glaucoma.*
AIM:- *To measure & evaluate the effect of severity of myopia on RNFL thickness in different quadrants of optic nerve head using spectral domain OCT.*
MATERIAL & METHODS:- *Study subjects were classified into 4 groups- Group A (Emmetropic group) with SE of + 0.50D, Group B (Low myopia group with SE between <-0.50D to -3.00D), Group C (Moderate myopia group with SE between <-3.00D to -6.00D) ,Group D (High myopia group with SE<-6.00D to -12.0D) with study duration of 12 months. Patients with age group 18-35 years with SE<+0.50D to -12.0D were consecutively recruited & a cross-sectional study was conducted. After pharmacological dilatation of pupil, Subjects were scanned with Spectral Domain Optical Coherence Tomography (SDOCT, Zeiss-CIRRUS HD OCT) and peripapillary SD-OCT RNFL thickness measurements were performed on all subjects.*
RESULTS & CONCLUSION*:-The globe elongation in axial myopia is associated with thinning of globe wall and results in a thin RNFL. The mean superior, inferior, nasal and average peripapillary RNFL thickness was significantly thinner in all 3 myopia groups (P=0.0001) as compared to emmetropia. The superior and inferior RNFL thickness was also significantly comparable in low, moderate and high myopia group (p value <0.05). But there was no significant (p = 0.304) difference found in mean temporal peripapillary RNFL thickness among various study groups.*
Keywords*:- Myopia, Spherical equivalent (SE), axial length, RNFL Thickness, OCT*

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I. Introduction

Myopia is one of the most common ocular abnormalities reported worldwide, mainly in Asia. It is also known as near sightedness. Myopia is a condition in which spherical equivalent (SE) objective refractive error is <-0.50D in either eye.[1]Curtin states that myopia is the state of refraction in which parallel rays of light are brought to a focus in front of retina of resting eye .It is measured by spherical power in diopters of diverging lens needed to focus light onto retina , which can be expressed as spherical equivalent (SE) i.e. sphere + ½ negative cylinder.[2] Optical system of myopic eye is too strong for it's axial length. Nodal point in myopic eye is away from retina, so the image formed will be larger. Far point of myopic eye is a finite point in front of eye.[3]Based on magnitude and causes of myopia, it is classified into- Primary myopia (due to elongation of visual axis) & secondary myopia (due to too strong refractive ocular media).[1]Simple or developmental myopia is physiological myopia. It is commonest variety. Usually onset occurs at school going age between 8-12 years of age, so it is also known as school myopia. It includes low myopia (2D OR <2D) & moderate myopia (2-6D).[3] Axial myopia results from increase in antero-posterior length of the eyeball, is the commonest form. In axial myopia, the increased axial elongation of globe leads to fundus changes. These fundus changes have been assumed to be the consequence of mechanical tissue strain and vascular changes that occur secondary to a process of stretching.[4]High/pathological/degenerative/progressive myopia starts in childhood at 5-10 years of age and results in high myopia (7-8D) during early adult life.[3]The risk of developing glaucoma is 2-3 times higher in myopic individuals.[5] Myopic individuals often have enlarged optic disc with a more oval configuration & larger areas of peripapillary atrophy.[6,7]That's why glaucomatous changes can't be easily interpreted in myopic discs leading to misdiagnosis of glaucoma. The RNFL is a sensitive indicator for predicting early

glaucomatous changes[8-10] & extent of RNFL damage correlates with severity of functional deficit in visual field.[11-13] So RNFL assessment may be more valuable than optic disc assessment in case of myopia subjects. RNFL can be quantitatively assessed by means of OCT.[14] Nerve fiber layer loss occur even before defects in the visual field are detected clinically.[15] OCT is used for evaluation of various posterior segment parameters i.e.macular and ONH changes in various retinal diseases which can be confounded by retinal changes induced by moderate to high axial myopia.[3]

II. Material And Methods:-

A 1 year cross- sectional study was conducted on 145 eyes of 80 patients (age between 18-35 year) attending ophthalmology outpatient department, Govt. Medical College, Kota from may 2019 to may 2020.

Inclusion criteria:-Physically & mentally fit Outdoor patients with spherical equivalent (S.E.) <+0.50D to -12.0D with age between 18-35 year

Exclusion criteria:-Patients with SE >+0.50D & <-12.0 D, Age < 18 year or >35 year, Glaucoma, Definite incyclotorsion or excyclotorsion of eye on fundus examination, any fundus abnormality other than myopic changes, patients with history of any ocular surgery or trauma.

Informed consent was taken from all subjects. A detailed clinical examination was done including proper medical history, visual acuity assessment, subjective refraction and spherical equivalent calculation, axial length measurement using A-scan biometer and dilated fundus examination.

The selected study subjects were divided into four groups according to their spherical equivalent-

1) Group A- Emmetropic group (control) with SE of + 0.50D
2) Group B- Low myopia group with SE between <-0.50D to -3.00D
3) Group C- Moderate myopia group with SE between <-3.00D to -6.00D
4) Group D- High myopia group with SE<-6.00D to -12.0D

(more the negative value of SE, more will be the myopia)

After pharmacological dilatation of pupil, Subjects were scanned with Spectral Domain Optical Coherence Tomography (SDOCT, Zeiss-CIRRUS HD OCT) and peripapillary SD-OCT RNFL thickness measurements were performed on all subjects. Scan of optic disc cube 200x200 was used for measurement of 6mm square grid by acquiring a series of 200 horizontal scan lines each composed of 200 A Scan. The scan pattern overlay consists of concentric rings to assist in the alignment of the optic disc. Three 200 x 200 cube optic disc scans were obtained per eye. The scan with highest signal strength with least eye movement was selected. The RNFL thickness at 256 points (0-255) of RNFL thickness profile, the mean RNFL thickness in each clock hour & average RNFL thickness were recorded. The ONH and RNFL OU Analysis were derived. On RNFL OU analysis, peripapillary SD-OCT RNFL thickness values were divided into 4 quadrants- superior(S), inferior(I), nasal(N) and temporal(T).

III. Observations And Results:-

One hundred and forty five eyes of 80 subjects were included in this study. Study subjects between 18 to 35 years of age were included.

(Table 1 & graph 1) shows sex distribution of study subjects among different groups. In present study among 80 subjects, 33 were males and 47 of them were females with M:F ratio of 0.7:1. In this study, the effect of age and gender was not studied.

(Table2 & graph 2) shows the mean spherical equivalent in different study groups which were -0.09+0.25D, -2.33±0.57 D,-4.13±0.70 D,-8.61±1.94 D in emmetropia, low myopia, moderate myopia, and high myopia group respectively. In the present study mean spherical equivalent was -3.84±3.39 D.

(Table 3 & graph 3) depicts the mean axial lengths in different study groups which were 22.49+0.48 mm, 24.03±0.75 mm, 24.64±0.64 mm, 26.26±0.85 mm in emmetropia, low myopia, moderate myopia, and high myopia group respectively. The mean axial lengths were found to increase significantly (p value =0.0001) with the severity of axial myopia which indicates the more stretching and lengthening in high myopic eyeballs. Axial length was significantly more in the 3 myopic groups (low, moderate & severe) as compared to emmetropia group ($p<0.01$). Also all the 3 myopic groups (low, moderate & severe) were significantly different from each other (p value <0.01) in terms of axial length. In the present study, mean axial length was 24.37±1.54 mm.

(Table 4 & graph 4) In present study we found that no significant difference was there in temporal quadrant peripapillary RNFL thickness among various study groups ($p=0.307$). Rather an increased temporal RNFL thickness was seen in moderate myopia group as compared to low myopia. All 3 myopia groups were also not significantly comparable to each other in this regard ($p>0.05$). There was also thinner Superior & nasal RNFL observed in all 3 myopia groups as compared to emmetropia (p value=0.0001). Also there was statistically significant superior RNFL thinning in moderate & high myopia group in comparison to low myopia ($p<0.01$). In present study we found that the mean peripapillary inferior ($p=0.0001$) and average ($p=0.0001$) RNFL thickness

was significantly thinner with increase in grades of axial myopia, which was statistically significant (all $p<0.05$). All 4 groups were significantly comparable to each other ($p<0.05$) in this regard.

Table 1 Demographic profile of study subjects among different groups

GROUPS	GENDER		NUMBER OF STUDY SUBJECTS	PERCENTAGE (%)
	MALE	FEMALE		
Emmetropia	10	8	18	22.5%
Low myopia	9	13	22	27.5%
Moderate myopia	5	13	18	22.5%
High myopia	9	13	22	27.5%
TOTAL	33	47	80	100%

Graph-1 : Sex distribution of study subjects among different groups

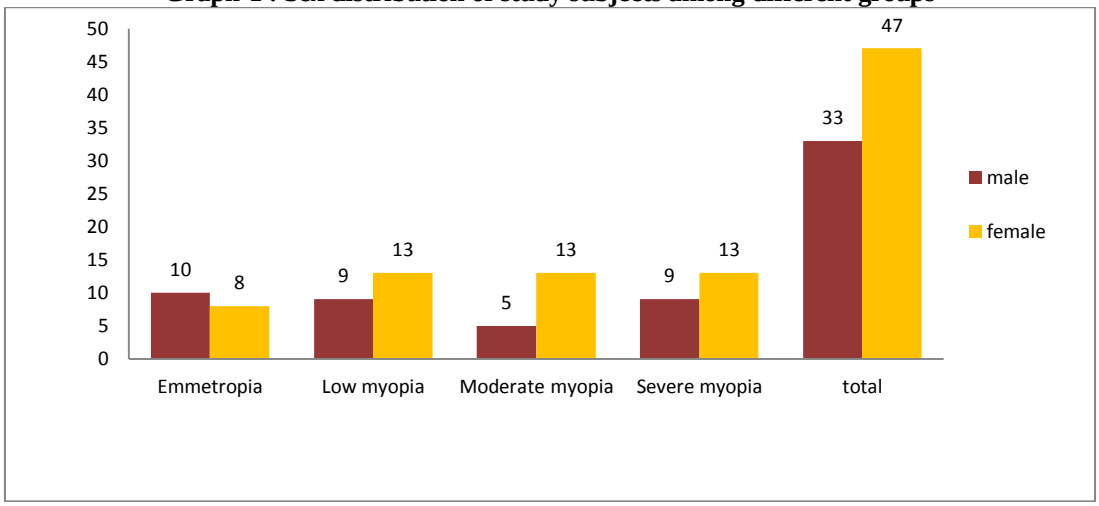


Table 2 Mean spherical equivalent in different study groups

	EMMETROPIA (+0.50 D) GROUP-A	LOW MYOPIA (<-0.50D TO -3D)GROUP-B	MODERATE MYOPIA(<-3D TO -6 D) GROUP-C	HIGH MYOPIA(<-6 D TO -12 D)GROUP-D
MEAN SPHERICAL EQUIVALENT (DIOPTER)	-0.09+0.25	-2.33+0.57	-4.13±0.70	-8.61+1.94

Graph 2: Mean spherical equivalent in different study groups

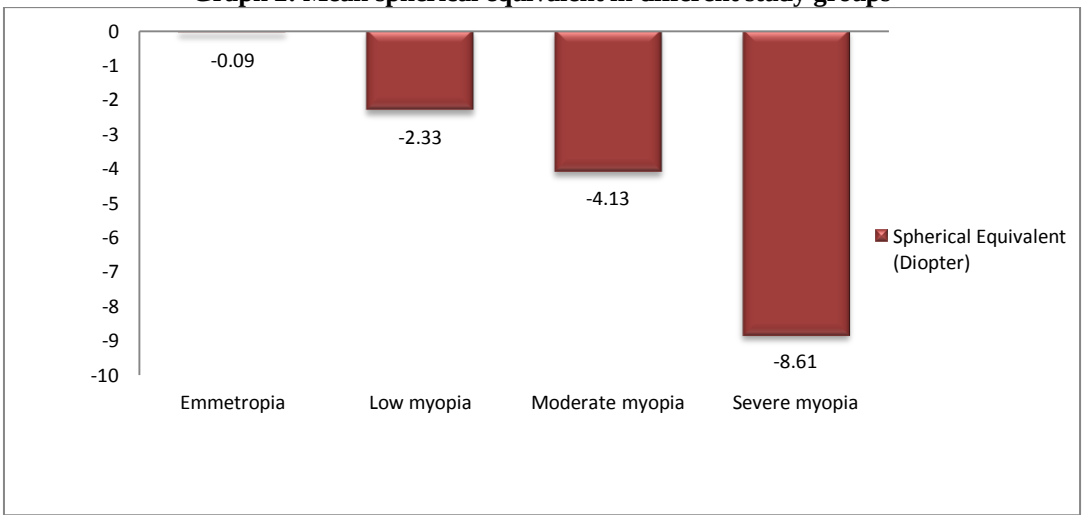


Table 3 Mean axial length in different study groups

	EMMETROPIA (+0.50 D) GROUP-A	LOW MYOPIA (<-0.50D TO -3 D) GROUP-B	MODERATE MYOPIA (<-3D TO -6 D) GROUP-C	HIGH MYOPIA (<-6 D to -12 D) GROUP-D	p VALUE (ANOVA)	p VALUE (COMPARISON BETWEEN GROUPS)
MEAN AXIAL LENGTH (mm)	22.49+0.48	24.03± 0.75	24.64± 0.64	26.26±0.85	0.0001	A vs B <0.01 A vs C <0.01 A vs D <0.01 B vs C <0.01 B vs D <0.01 C vs D <0.01

Graph 3: Mean axial length in different study groups

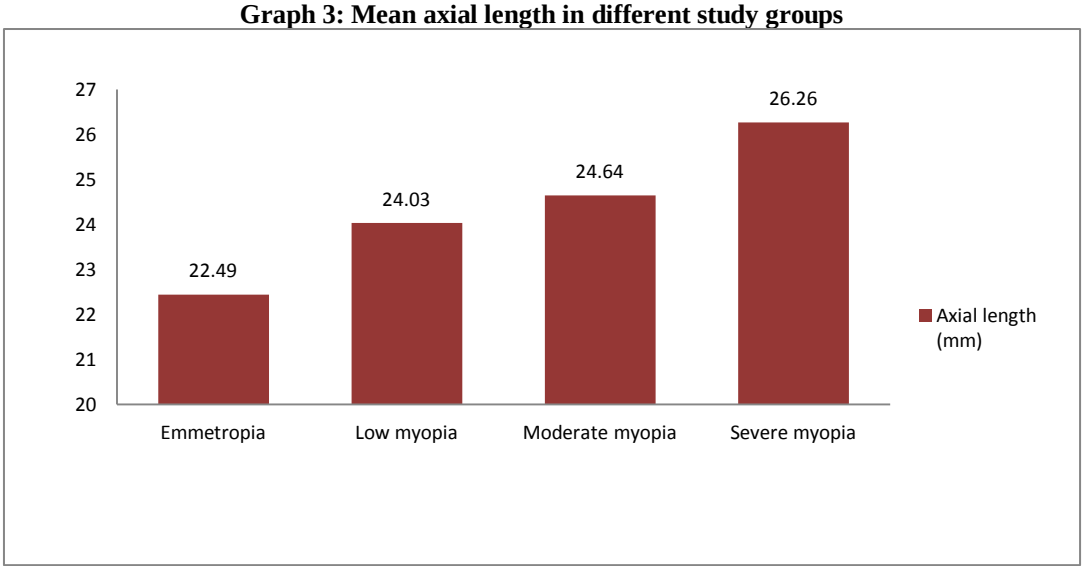
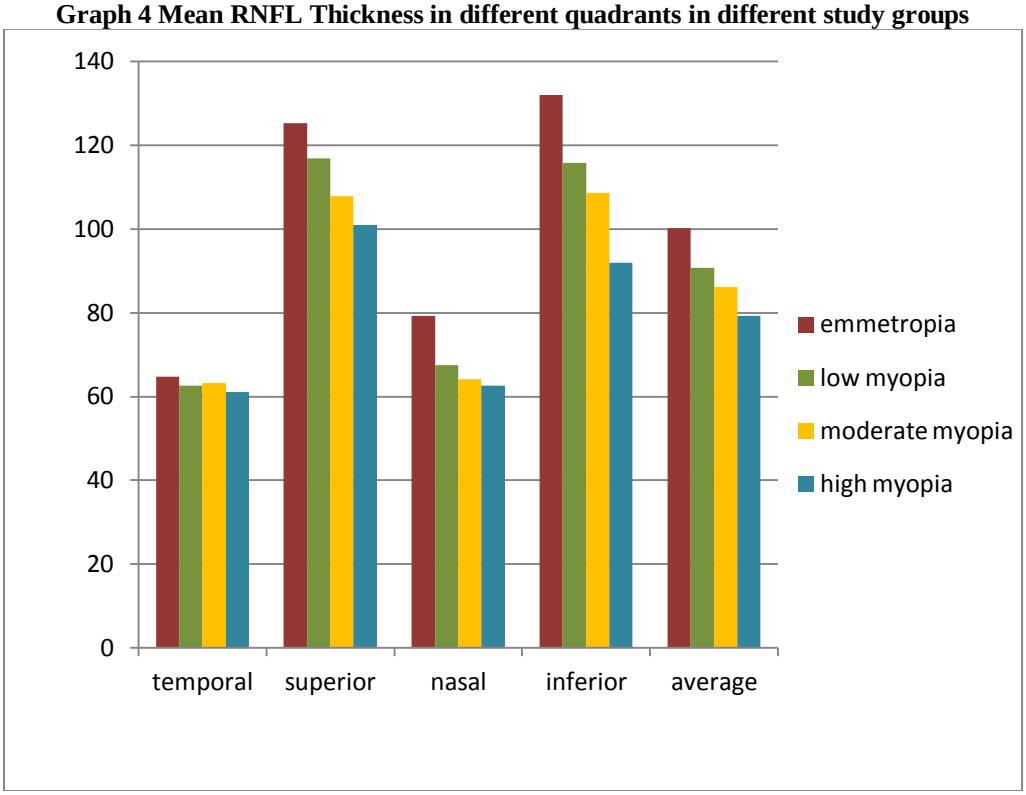


Table 4: Mean RNFL Thickness in different study groups

RNFL THICKNESS (µm) (MEAN±SD)	EMMETROPIA (+0.50 D) n=36 GROUP-A	LOW MYOPIA (-1D TO -3 D) n = 40 GROUP-B	MODERATE MYOPIA(-3D TO -6 D) n = 30 GROUP-C	HIGH MYOPIA(>-6 D TO -12D) n = 39 GROUP-D	p VALUE (ANOVA)	p VALUE (COMPARISON BETWEEN GROUPS)
TEMPORAL	64.72+7.95	62.55+5.19	63.17+9.32	61.17+9.70	0.307	they were not calculated as p>0.05
SUPERIOR	125.33+18.47	116.85+9.86	107.9+11.35	101.07+17.69	0.0001	A vs B <0.01 A vs C <0.01 A vs D <0.01 B vs C <0.01 B vs D <0.01 C vs D = 0.07
NASAL	79.25+11.04	67.5+10.17	64.2+8.72	62.58+14.61	0.0001	A vs B <0.01 A vs C <0.01 A vs D <0.01 B vs C =0.15 B vs D =0.08 C vs D = 0.59
INFERIOR	131.97+18.26	115.78+11.81	108.6+12.77	91.94+18.97	0.0001	A vs B <0.01 A vs C <0.01 B vs D <0.01 B vs C <0.01 B vs D <0.01 C vs D <0.01
AVERAGE	100.3+9.37	90.78+5.68	86.23+6.82	79.31+9.46	0.0001	A vs B <0.01 A vs C <0.01 B vs D <0.01 B vs C <0.01 B vs D <0.01 C vs D <0.01

Graph 4 Mean RNFL Thickness in different quadrants in different study groups



IV. Discussion:-

Our study is consistent with earlier studies e.g. Choi et al.[16], Leung et al.[17], Rauscher et al.18,Salih PA.[19] and Seo et al.[20]which reported that as the level of myopia and axial length increased, the thickness of peripapillary RNFL decreased ($p<0.05$). They all found that each quadrant RNFL thicknesses and their overall average were significantly thinner in high myopia as compared to low and moderate myopia. However, there were no significant differences found in temporal RNFL($P>0.05$) thickness. Budenz et al.[21] noted significant decrease in RNFL thickness with increasing axial length. Similarly, Kang SH et al.[22], Kim MJ et al.[23]and Salchow DJ et al.[24]all found decreasing RNFL thickness ($p<0.005$) with increase in myopia. They explained above results by the observation that the elongation of globe leads to mechanical stretching and thinning of sclera and the retina in myopia[25] which were associated with thinning of globe wall and resulted in RNFL thinning. To confirm the above results precisely Lee et al.[26]adjusted data for age and compared it again to determine whether the RNFL changes was due to physiological ganglion cell loss that came with aging or due to stretching of the RNFL that comes from axial myopic shift. They found thinning was significantly attributed to axial myopic shift. So in present study we confirmed that peripapillary RNFL thickness in average and in quadrants viz. superior, inferior and nasal significantly differs amongst different study groups, whereas in temporal quadrant it does not differ significantly.

CONCLUSION:- from this study, we concluded that-

1. The mean axial lengths were found to increase significantly (p value =0.0001) with the severity of axial myopia which indicates the more stretching and lengthening in high myopic eyeballs.
2. The mean superior, inferior, nasal and average peripapillary RNFL thickness was significantly thinner in all 3 myopia groups (P=0.0001) as compared to emmetropia.
3. The average and inferior RNFL thickness was also significantly comparable in low, moderate and high myopia group (p value <0.05).
4. There was no significant (p=0.304) difference found in mean temporal peripapillary RNFL thickness among various study groups.

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