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Original Research Article

Clinical Study on Retinal Nerve Fiber Layer Thickness Assessed on OCT in Relation to Myopia

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Abstract: Myopia is the commonest refractive error prevalent among all age group. Present study was conducted among 100 myopic patients to evaluate the co-relation of retinal nerve fiber layer (RNFL) with different degrees of myopia. Patients were enrolled in the study after obtaining written informed consent and fulfilling the inclusion criteria. Selected patients were subjected to general ocular examination which includes visual acuity test, slit lamp biomicroscopy, intraocular pressure assessment and fundus examination .For recording axial lengths, A-scan biometry was performed. Thereafter stratus optical coherence tomography with fast RNFL scan protocol was used to measure the RNFL thickness. The print out scan reports were recorded and analysed in relation to myopia. Demographic pattern of myopia was also studied. Myopia was noted to be prevalent in maximum in the age group between 21-25 years with equal gender distribution. As the degree of myopia increased, the axial length of eyes was also found to be increased. Average RNFL thickness was noted to be decreased with increase in the dioptric power of the eyes. Superior and Inferior RNFL thickness also showed decreased thickness with increase in the degree of myopia. OCT imaging is an excellent, effective and sensitive device to assess the RNFL thickness in relation to myopia and guides in early detection of retinal degenerative changes and glaucoma associated with myopia. The newer ongoing studies world wide would provide us more information in this aspect in future.
Keywords: Retinal nerve fiber layer thickness, degree of myopia, A scan biometry, optical coherence tomography, axial lengths, retinal degenerative changes, glaucoma

INTRODUCTION:-

Myopia is a common cause of vision loss, with uncorrected myopia being the leading cause of distance vision impairment globally. It was estimated that there was 1406 million people with myopia (22.9% of world population) and 163 million people with high myopia (27% of the world population) in 2000. It is predicted that by 2050, there will be 4758 million people with myopia (49.8% of the world population) and 938 million people with high myopia (9.8% of world population) [1]. Prevalence of myopia has been reported to be as high as 70-90% in Asian population. In India, uncorrected refractive errors are the most common cause of visual impairment and second major cause of avoidable blindness. Due to this, the public health and economic impact of myopia is enormous [2].

The introduction of OCT in Ophthalmology represents a definitive change in the ways doctors understand and treat several diseases of retina [3]. Using OCT imaging, myopia has been found to be associated with temporal displacement and thinning of superior and inferior nerve fiber layer bundles [4]. As such OCT is an excellent and very sensitive device for measurement and analysis of retinal never fiber layer (RNFL) thickness and studying its morphology in relation to different degrees of myopia.

Moreover, myopic eyes with increased axial length appear to have higher cup disc ratios (CDRs), increased optic nerve fiber layer defects and possibly greater deformability of lamina cribrosa, leading to higher susceptibility to glaucomatous optic disc changes [5]. Since optic disc is quite variable in appearance with normal population, RNFL analysis, using stratus OCT has been proposed as a new way to evaluate for glaucoma [6]. Considering the enormous and increasing myopic population with other refractive errors, and

glaucoma often leading to blindness, vision 2020 in India has primarily targeted these eye diseases to reduce the visual impairment and blindness by 2020 along with five other ocular disorders [7]. To achieve this goal, OCT imaging along with other devices would work as a vital tool in the days to come.

AIM OF STUDY:-

The present work was undertaken to evaluate the co-relation of retinal nerve fiber layer (RNFL) thickness with different degrees of myopia. It was also aimed to evaluate the pattern of RNFL changes in different sectors of retina among myopes. Besides, the demography of myopia was also observed.

MATERIALS AND METHOD:-

This prospective cross sectional study was conducted at Regional Institute of Ophthalmology, Gauhati Medical College, Assam among 100 myopic patients. The patients were selected from out patient department and informed consent was obtained from each patient after explaining the purpose of the study design. It comprised both male and female patients and their age ranged from 10 to 30 years. Myopia was diagnosed on routine retinoscopy and auto refractometer. Patients with myopia less than 2 dioptre, those with media opacity, diabetic and hypertensive retinopathy, intraocular inflammation, glaucoma, ocular trauma and with ocular surgery were excluded from the study.

All enrolled patients were subjected to general ocular examination which included visual acuity test with Snellen chart, Slit lamp biomicroscopy, intraocular pressure assessment and fundus examination. A-scan biometry of each patient was performed to record the axial length. Finally, stratus optical coherence tomography (OCT) with fast RNFL scan protocol was used. The patient details were entered. The height of OCT desktop and chin rest were adjusted and patient was asked to look at the green light. Retinal nerve fiber layer (RNFL) thickness was measured in peripapillary region with circular scans of 3-4 mm diameter around the optic nerve head. The RNFL scans are printed by printer and printed result sheets were recorded and datas were analysed .Besides, demographic pattern of myopia relating to age, gender, degree of myopia were also recorded.

PHOTOGRAPHS SHOWING DIFFERENT PROCEDURES PERFORMED DURING OUR STUDY:

PHOTO -1: Autorefractometry

PHOTO -2: A-Scan Biometry

PHOTO -3: Optical Coherence Tomography (OCT)

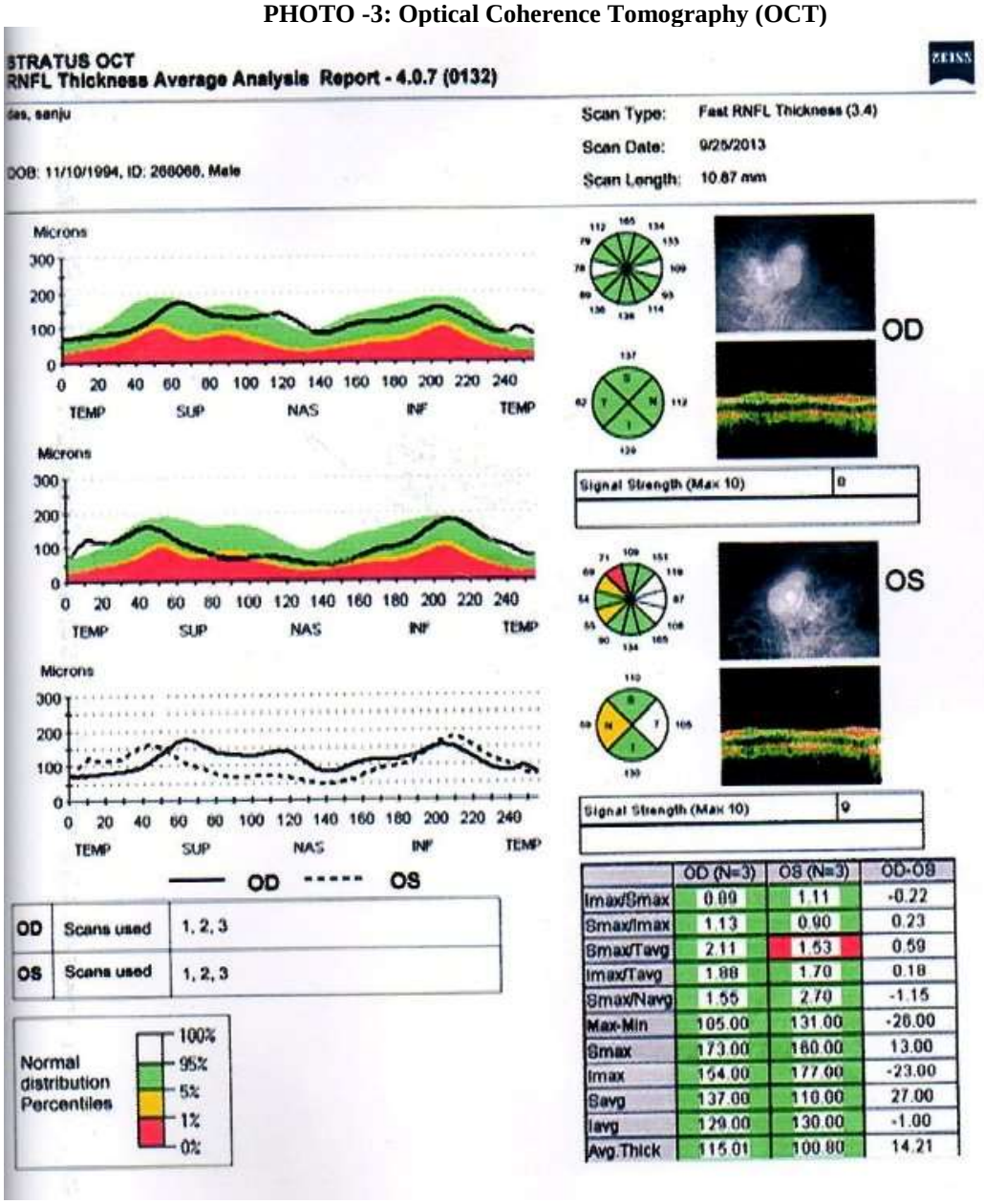

PHOTO -4: Stratus OCT showing RNFL thickness analysis

RESULTS

The study population consisted of 100 myopic patients between 10-30 years of age. The result obtained and calculated is shown in tables and figures below:-

AGE DISTRIBUTION: - 35% of the myopic patient was in the age group of 21-25 years followed by 25%, 23% and 17% in age group of 10-15 years, 16-20years and 26-30 years respectively (Table-1) and (figure-1).

Table-1: Age distribution

Age (in Year)	Number of patients	Percentage
10-15	**25**	**25%**
16-20	**23**	**23%**
21-25	**35**	**35%**
26-30	**17**	**17%**
Total	**100**	**100%**

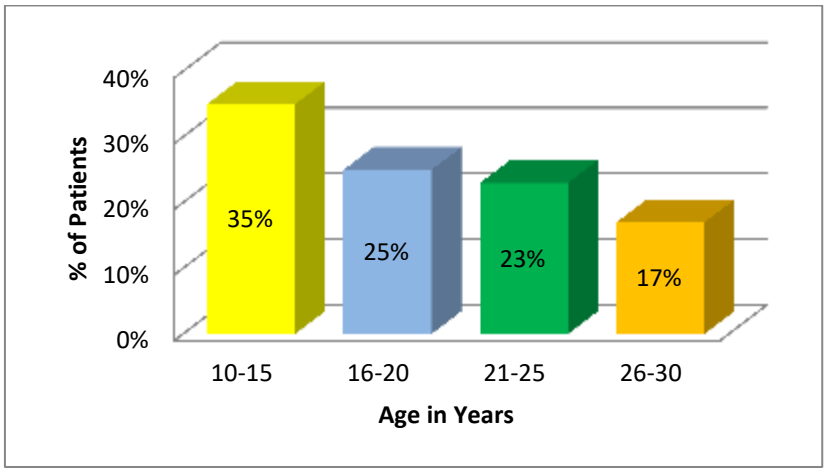

Fig-1: Age Distribution of Patient

GENDER DISTRIBUTION: - 50% of patients were males and 50% were females among 100 patients (Table-2) and (Figure-2).

Table-2: Gender Distribution

Gender	Number of patient	Percentage
Male	**50**	**50%**
Female	**50**	**50%**
Total	**100**	**100%**

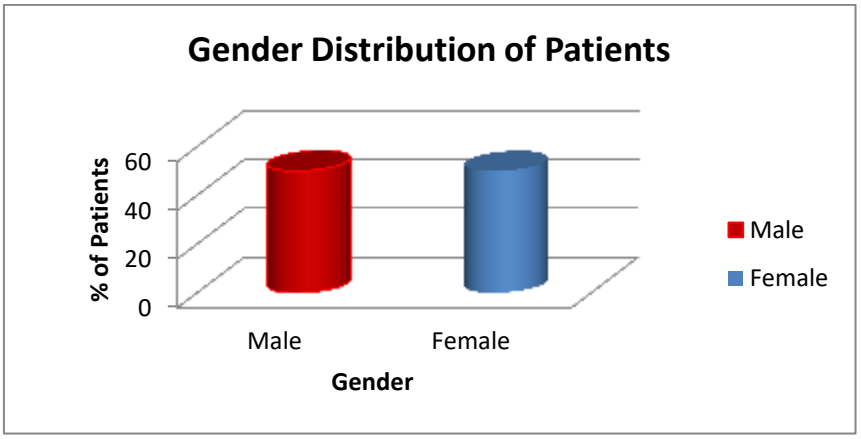

Fig-2: Gender Distribution of Patients

Table-3: Distribution of Different Degrees of Myopia

Degree of Myopia	Myopia in Dioptre	No. of cases	Percentage
Low myopia	2.00-3.00	18	18%
Moderate Myopia	3.25-6.00	37	37%
High Myopia	>6.00	45	45%
	Total	**100**	**100%**

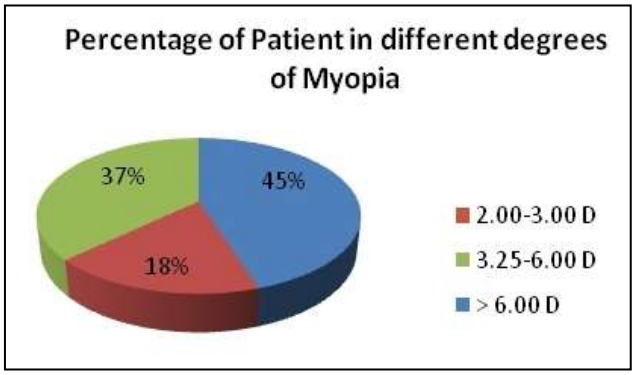

Fig-3: Percentage of patient in different degrees of Myopia

RELATION OF DIFFERENT DEGREES OF MYOPIA WITH AXIAL LENGTH

The present study showed different axial lengths in different degree of myopia (Table -4).

Table-4 : Relation of Different Degrees of Myopia with Axial Length

Degree of myopia	Axial length (average)
Low degree (< 3D)	22.2mm
Moderate degree (-3D to -6D)	24.0mm
High degree (> 6D)	25.62mm

MEASUREMENT OF AVERAGE RETINAL NERVE FIBER LAYER (RNFL) THICKNESS OF MYOPIC EYES

In our study in the right eye, the minimum and maximum value of RNFL thickness was found as 60 µm and 119 µm respectively. The average is 99.69 µm, 16% of total eyes had RNFL thickness below average and 84% had above average. This showed significant difference in average RNFL thickness among different degrees of myopia in right eye. In left eye, the minimum and maximum value of average RNFL thickness was observed as 70.6 µm and 115.15 µm respectively with average value as 101.5 µm in which 22% of total eye had RNFL thickness below average and 78% had above average. This showed significant difference in average RNFL thickness in different grades of myopia in right eye (Table-5) and in left eye (Table-6)

Table 5: Average RNLF thickness of right eye

Degree of myopia(in Dioptre)	Average RNFL (in µm)	No. of eyes
2.00-3	119.00	18
3.25-4	115.90	14
4.25-5	110.53	15
5.25-6	107.55	8
6.25-7	104.62	12
7.25-8	103.87	3
8.25-9	101.48	6
9.25-10	99.90	5
10.25-11	97.56	3
11.25-12	99.35	3
12.25-13	96.23	2
13.25-14	95.92	4
14.25-15	94.30	4
15.25-16	67.87	1
16.25-17	60.00	2

Table 6: Average RNFL thickness of left eye

Degree of myopia (in Dioptre)	Average RNFL(in µm)	No. of Eyes
2.00-3	115.15	21
3.25-4	113.40	16
4.25-5	112.82	10
5.25-6	109.00	8
6.25-7	108.50	10
7.25-8	108.00	10
8.25-9	107.39	3
9.25-10	102.60	4
10.25-11	101.11	4
11.25-12	97.17	5
12.25-13	96.35	3
13.25-14	93.68	3
14.25-15	71.95	2
15.25-16	70.60	1

MEASUREMENT OF SUPERIOR, INFERIOR, NASAL AND TEMPORAL RNFL THICKNESS OF MYOPIC EYES

In right eye, the minimum and maximum average superior RNLF thickness was found to be 50.03 µm and 105.74 µm respectively and in left eye these values were 63.30µm and 115.89 µm respectively which showed significant difference in RNFL thickness in different grades of myopia. Similar pictures were found in inferior RNFL thickness in both right and left eye and also showed significant differences in different degree of myopia. But on the contrary nasal and temporal RNLF thickness did not show any significant differences in various grades of myopia both in right eye and left eye.

DISCUSSION

Measurement and analysis of RNFL thickness in myopic population with optical coherence tomography (OCT) and co-relating the findings with change of axial length and with different grades of myopia is of great importance. In the present study, myopia was found to be prevalent in maximum in the age group between 21-25 years (35%). Awasthi *et al.;* [8] reported that the incidence of myopia was highest between 15-40 years where as Harman et al [9] from a study of school children reported maximum myopia in the age group between 8-12 years.

Our study found the incidence myopia in males and females to be equal in ratio (1:1). Malik SRK *et al.;* [10] also did not notice any gender variation in myopia. Contrary to this Young *et al.;* [11] reported the incidence to be more in females where Awasthi *et al.;* [8] found the incidence to be more in males. Co-relating the degree of myopia with axial length in this study we recorded the average axial length to be 22.2 mm, 24mm and 25.62mm in low degree, moderate degree and high degree myopia respectively. Puspendu Das *et al.;* in 2016 [12] noticed in their findings as tabulated below:-

Table-7: Degree of myopia noticed by Puspendu Das *et al.* [12]

Degree of myopia (in Dioptre)	Axial length (in mm)
Low degree (≤ 3D)	23.16 + 1.14
Moderate degree (-3D to -6D)	23.77+ 0.88
High Degree (≥ 6 D)	26.40 + 1.70

These findings are comparable with our observations. As myopia increases in dioptre (D), the axial length also increases proportionately. In our study, average RNFL thickness in right eye and left eye were found to be 99.69 µm and 101.5 µm respectively. In a study conducted by Mohammad Saleh P.A. in 2012 [13] found that mean RNFL thickness was thinner in highly and moderately myopic eyes with thickness to be 93+7.9 µm and 92.6+7.7 µm respectively which is comparable to our above mentioned results. Besides, Jacky W.Y. Lee *et al.;* in their study [14] observed that in myopic group average RNFL thickness was 95.7+10.3 µm which was thinner than hypermetropic and emmetropic group. Similar results were noticed by Mousumi Malakar *et al.;* in 2015 [15]. Dennis L. Del Rosario *et al.;* [16] also remarked that there was decrease in the average RNFL thickness as refractive error becomes more myopic which is similar to our observations.

In our present study, superior RNFL thickness ranged between 50.03µm and 105.74 µm in right eye while in left eye it ranged between 63.30µm and 115.89µm showing decrease thickness of RNFL with increase of myopic dioptre (D). Similar decrease in thickness was noticed in inferior RNFL thickness. Mohammad Saleh P.A. in his study [13] recorded superior RNFL thickness and inferior RNFL thickness to be 119.2 +16.8 µm and 117.1+16.8 µm respectively which are slightly higher than our study. Frederick M. Rauscher *et al.;* [17] in 2009 found that RNFL was thin at inferior and superior poles of optic disc while S.H. Kang *et al.;* in 2010 [18] observed that myopic eyes had thinner superior and inferior RNFL. Besides, Veysi oner *et al.;* in 2012 [19] noted that in myopes the RNFLs were thinner in superior, inferior and temporal sectors. It was also observed that there were negative co-relation between axial length and RNFL thickness in myopic patients which supports our findings that as axial length and myopia increases, RNFL thickness decreases.

CONCLUSION

Myopia which is one of the leading causes of curable blindness is prevalent in all age group with no gender variation. Different degrees of myopia show different axial lengths with the conclusion that as myopia increases in dioptric power (D), axial length also increases proportionately. There is a definite co-relation between RNFL thickness and the degree of myopia as assessed and analysed on OCT. Average RNFL thickness and also superior and inferior RNFL thickness decreases with increase in the dioptric power of myopes and their axial length. As high myopia is often accompanied by chorioretinal degeneration and associates with glaucoma, measures are to be taken for prevention, early detection and timely management of these situations. For achieving the above goal, accurate assessment of RNFL thickness and morphology and its subsequent analysis plays the pivotal role. For this, optical coherence tomography (OCT) is an excellent device. There is much to learn with forthcoming data from numerous ongoing studies worldwide. A huge leap forward in improving OCT imaging performance is also expected to occur with next few years.

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