International Journal of Medical Ophthalmology 2021; 3(2): 30-33

International Journal of Medical Ophthalmology

E-ISSN: 2663-8274
P-ISSN: 2663-8266
www.ophthalmoljournal.com
IJMO 2021; 3(2): 30-33
Received: 14-05-2021
Accepted: 29-06-2021

Dr. Rohit M Shirodkar
Post graduate junior Resident, Department of ophthalmology, Goa University, Goa Medical College and Hospital, Goa, India

Dr. Ugam PS Usgaonkar
Professor and Head, Department of Ophthalmology, Goa Medical College., Goa, India

Corresponding Author:
Dr. Rohit M Shirodkar
Post graduate junior Resident, Department of ophthalmology, Goa University, Goa Medical College and Hospital, Goa, India

Correlation of axial length and peripapillary retinal nerve fibre layerthickness by optical coherence tomographyin myopes

Dr. Rohit M Shirodkar and Dr. Ugam PS Usgaonkar

DOI: https://doi.org/10.33545/26638266.2021.v3.i2a.85

Abstract
Background: Myopia is considered a risk factor for open-angle glaucoma. This study aimed to assess the association of axial length and degree of myopia on RNFL thickness.
Material and Method: This cross-sectional study is conducted among 50 myopic patients aged between 18 to 60yrs attending ophthalmology OPD at a tertiary care hospital. The study was conducted after getting approval from institutional ethics committee and patients recruited after obtaining informed consent. The ocular examination of all the included patients was done using an auto refractometer, retinoscopy, ONH OCT for RNFL thickness measurement, fundus with IDO and 90D. The average RNFL thickness was recorded globally and separately for the superior, inferior, nasal, and temporal quadrants.
Results: A total of 100 eyes were evaluated, mean age of the study population was 35.02±9.07 years with range of 21-54years. The mean of refraction errors in all the patients was -3.41±2.04D with a range of -1 to -20D and mean axial length was 24.11±1.10 with a range of 22.18 to 26.8mm. There is a significant decrease in the RNFL thickness in patients with increase in refractive error and the axial length. ($p<0.001$) We found a significant strong linear association of axial length and myopia with the RNFL thickness. ($p<0.001$)
Conclusion: The people with higher degrees of myopia and increased axial length had thinner RNFLs. A significant linear relation of the decrease in RNFL thickness with the severity of myopia and the axial length was found.

Keywords: Myopia, Refractory Error, Axial Length, Optical Coherence Tomography (OCT), Retinal Nerve Fibre Layer Thickness (RNFL)

Introduction

Myopia is considered a risk factor for open-angle glaucoma [1, 2]. The prevalence of myopia in adults aged over 30 years was 17% in Central India[3] and 19.4% in Indians with diabetes aged over 40 years [4]. Disc changes in myopia makes it difficult to distinguish glaucomatous optic neuropathy from myopia related optic nerve and retinal abnormalities that may complicate the diagnosis and treatment of glaucomatous disease [5]. Therefore, it is critical to comprehend the impact of various grades of myopia on RNFL thickness. The elongation of axial length (AL) arises as a result of increased negative refractive power and specific optic disk properties of myopic eyes affecting the precision of OCT performance [6, 7]. Compared with conventional red-free photography, optical coherence tomography (OCT), which measures RNFL thickness based on reflectivity changes between adjacent tissues, provides instant and quantitative information on RNFL thickness. However, the performance of OCT could be compromised by several factors such as image quality [8], accuracy of the centring of the scan circle [9], and the influence of myopia [10].

The reported correlations between AL and RNFL varies with various sample demographics, OCT instruments, and modified magnification [11]. Some studies have shown that the average RNFL thickness is inversely associated with AL or negative refractive power [12, 14]. On the other hand, several studies have documented a positive association between AL and RNFL thickness [1, 2].

This study aimed to assess the association of axial length and degree of myopia on RNFL thickness.

Material and Method

This cross-sectional study was conducted among 50 myopic patients attending ophthalmology OPD at a tertiary care hospital using convenient sampling.

All the patients aged between 18 yrs. to 60 yrs. with bilateral myopia were recruited after obtaining informed consent. The study excluded patients with pre-existing glaucomatous optic nerve head changes, patients who have undergone any refractive surgery and intraocular surgery, patients with lenticular opacities and patients with a history of any ocular trauma. 2 unilateral myopes found during the study were excluded as one patient had associated primary angle glaucoma and second patient had undergone retinal detachment surgery. The ocular examination of all the included patients was done using an auto refractometer (Grand Seiko GR-3300K) Heine streak retinoscopy, ONH OCT (ZEISS PRIMUS 200) for RNFL thickness measurement. The average RNFL thickness was recorded globally and separately for the superior, inferior, nasal, and temporal quadrants. Patient was dilated using tropicamide and phenylephrine eye drop and fundus examination was performed using IDO (appasamy) AND 90D slit lamp examination. The biometry and OCTs were done by the same person.

For the purpose of analysis, the patients were divided into three groups based on the degree of myopic refraction as follows: low myopia (<−3D), moderate myopia (−3D to −6D), and high myopia (>−6D). Based on the axial length measured, the patients were assigned to two groups; group A with an axial length of ≤24 mm and group B with axial length >24 mm.

All the data were entered in excel sheet and analysed using IBM SPSS v23 operating on windows 10. The continuous variables are presented as mean, standard deviation and the categorical data are presented as frequency and percentage. The differences between the two continuous variables are analysed using student independent t-test and one way ANOVA with post hoc analysis was done for data more than two groups a p-value <0.05 was considered statistically significant. Pearson's Correlation test was used to correlate between RNFL thickness and the degree of myopia and axial length.

Results

This study included 50 patients with myopia ranging from -1 to -10 D. The mean age and SD of the study population was 35.02±9.07 years with a range of 21-54years. (Table 1)

The mean of refraction errors in all the patients was -3.41±2.04D with a range of -1 to-20D. The low myopia group (<-3D) had 65 eyes, moderate myopia (-3to -6D) had 23 eyes and high myopia (>-6D) had 12 eyes in present study. The mean axial length of the subjects was 24.11±1.10 with a range of 22.18 to 26.8mm. Group with AL<24mm included 54 eyes and group with AI >24mm was with 46 eyes. (Table 2). Mean refractive error, Axial length and RNFL thickness were compared with age and gender, however it was not found to be statistically significant.

Table 1: The mean age of the participants

	N	Minimum	Maximum	Mean	SD
Age in Years	50	21.00	54.00	35.02	9.07

Table 2: Mean axial length compared to age and gender

Age Group (in years)	Male	Female
18-32	23.61	24.685
33-46	24.92	24.15
47-60	23.945	23.59

Table 3: Mean Refractive Error Compared To Age and Gender

Age Group (in years)	Male	Female
18-32	-2.415	-4.31
33-46	-4.87	-3.46
47-60	-2.78	-2.905

Table 4: Mean RNFL Compared To Age and Gender

Age Group (in years)	Male	Female
18-32	91.75	89.33
33-46	85.06	90.535
47-60	94.25	91.625

Table 5: Distribution of eyes according to the axial length and refraction group

		Frequency	Percent
Axial Length Group	<24mm	54	54.0
	>24mm	46	46.0
	Total	100	100.0
Refraction Group	<-3D	65	65.0
	-3 to -6D	23	23.0
	>-6D	12	12.0
	Total	100	100.0

Table 6: Comparison of the RNFL thickness with the axial length using student t-test.

RNFL	Axial Length Group				
	<24mm		>24mm		Unpaired t-test
	Mean	SD	Mean	SD	p-value
Average	92.33	5.02	87.87	5.85	0.001**
Superior	121.15	6.13	113.00	9.53	0.001**
Inferior	118.63	5.93	110.85	9.57	0.001**
Nasal	66.33	3.79	61.37	5.68	0.001**
Temporal	62.91	3.55	62.72	3.64	0.793

*p<0.05 is statistically significant;
**p<0.001 is statistically highly significant

There is a significant decrease in the RNFL thickness in patients with increase in the axial length. This finding was found to be significant in all the quadrant and average RNFL. However, this decrease in the RNFL thickness was not statistically different with the axial length in the temporal quadrant. (Table 3).

Table 7: Comparison of the RNFL thickness with the myopia using ANOVA test

RNFL	Refraction Group						
	<-3D (a)		-3 to -6D (b)		>-6D (c)		
	Mean	SD	Mean	SD	Mean	SD	Anova study
Average	92.86	4.71*b,c	87.39	4.21*a,c	81.83	2.79*a,b	0.001**
Superior	120.15	6.33*c	117.74	4.73*c	101.83	10.77*a,b	0.001**
Inferior	119.00	5.51*b,c	111.74	5.23*a,c	100.00	9.34*a,b	0.001**
Nasal	66.69	3.61*b,c	60.78	3.20*a,c	56.00	5.12*a,c	0.001**
Temporal	63.29	3.46	62.22	2.49	61.42	5.37	0.163

*p<0.05 is statistically significant;
**p<0.001 is statistically highly significant; Post-hoc analysis was performed using Bonferroni.

There is a significant decrease in the RNFL thickness in patients with increase in the Refractive error. This finding was found to be significant in all the quadrant and average RNFL. However, this decrease in the RNFL thickness was not statistically significant in the temporal quadrant with respect to refractive error (Table 4)

Table 8: Pearson's correlation between the RNFL thickness with myopia and the axial length

RNFL		Refraction	Axial Length
Average	r	.678**	-.594**
	p-value	.000	.000
Superior	r	.722**	-.579**
	p-value	.000	.000
Inferior	r	.792**	-.670**
	p-value	.000	.000
Nasal	r	.768**	-.678**
	p-value	.000	.000
Temporal	r	.309**	-.239*
	p-value	.002	.017

*p<0.05 is statistically significant;
**p<0.001 is statistically highly significant

There is a significant linear association of axial length and myopia with the RNFL thickness. There is a significant decrease in the RNFL thickness with increase in the degree of myopia and the axial length of the eye in the patients. The association is strong with the inferior quadrant measurement and least with the temporal quadrant of RNFL thickness with myopia and AL. (Table 5)

Discussion

The relationship between the RNFL thickness and myopia has been extensively investigated [10, 13, 15]. However, whether the RNFL thickness could vary with the degree of refractive error of the eye remains unclear. The effect of myopia on the average RNFL thickness is debatable. Hoh *et al.*, reported no correlation between these parameters, whereas many other researchers reported that the average RNFL thickness decreased with myopia and with an increase in the axial length [15].

We found a significant decrease in average RNFL thickness with increase in myopia and axial length. Similar findings are showed by Porwal S *et al.*, that there is a significant decrease in the RNFL thickness among the various grades of the refraction error and the axial length [16]. In similar context, Sachow D *et al.* documented that refraction had a negative effect on the RNFL thickness among the children in his study [17]. In the Kim *et al.*'s study, of the48 myopic patients, they reported thinner RNFL's in the higher myopia group than those in both lower and moderate myopia groups in the non-temporal quadrants; however, while in the temporal quadrant, thicker RNFL's are associated with the higher myopia group [18]. However, similar to present study, the Peng P *et al.*, documented no significant difference in the temporal RNFL thickness with the axial length and the degree of myopia. However there was decrease in the RNFL thickness with the increase in axial length and the severity myopia in both temporal and non-temporal quadrant.[19] Elongation and thinning of the sclera and the retina, which spread the nerve fibers over a larger surface area, could be the reason for thin RNFL in myopes. It could also represent a decrease in nerve fiber number, although there is no histological basis for it yet. Thus, thin RNFL measurements in moderate to high Myopes appeared to be related to axial lengthening [16].

Our study showed a significant strength of linear correlation between the RNFL thickness and myopia the increasing axial length. Similar to present study, Leung C *et al.*, documented a significant strength of association of decrease in RNFL thickness with the refraction error and axial length among the adults [10]. Ozdek *et al.*, showed that with gradual decrease in the superior and inferior RNFL there was simultaneous increase in myopia. For each diopter decrease in spherical equivalent, there was 0.122 and 0.092µm reduction in superior and inferior RNFL thickness [20]. Kremmer S *et al.* also reported a linear correlation between average RNFL thickness and spherical equivalent (average RNFL thickness= -2.848*SE+78.529) in 75 myopic eyes of healthy volunteers (age range, 21–40 years; mean spherical equivalent= -4.6 D; range 0.75 to8.5 D) [21].

The study has a number of limitations, therefore more detailed research is needed. First, because small subjects were recruited from OPD, selection bias cannot be ruled. Secondly, follow up of patients could have been helpful for better analysis and findings but in this study follow of patients was not done. Our findings may be imprecise in assessing RNFL longitudinal changes to generalise to the larger population.

Conclusion

There is a significant linear relation of the decrease in RNFL thickness with the severity of myopia and the axial length. The strength of association between the degree of myopia and the increase axial length was stronger in the inferior quadrant RNFL thickness compared to other quadrants.

Reference

1. Kang SH, Hong SW, Im SK, Lee SH, Ahn MD. Effect of Myopia on the Thickness of the Retinal Nerve Fiber Layer Measured by Cirrus HD Optical Coherence Tomography. Invest Ophthalmol Vis Sci 2010;51(8):4075-4083. doi:10.1167/iovs.09-4737
2. Hsu SY, Chang MS, Ko ML, Harnod T. Retinal nerve fibre layer thickness and optic nerve head size measured in high myopes by optical coherence tomography. Clin Exp Optom 2013;96(4):373-378. doi:10.1111/cxo.12052
3. Nangia V, Jonas JB, Sinha A, Matin A, Kulkarni M. Refractive Error in Central India. Ophthalmology 2010;117(4):693-699. doi:10.1016/j.ophtha.2009.09.037
4. Rani PK, Raman R, Rachapalli SR, Kulothungan V, Kumaramanickavel G, Sharma T. Prevalence of Refractive Errors and Associated Risk Factors in Subjects with Type 2 Diabetes Mellitus. Ophthalmology 2010;117(6):1155-1162. doi:10.1016/j.ophtha.2009.10.025
5. Chen SJ, Lu P, Zhang WF, Lu JH. High myopia as a risk factor in primary open angle glaucoma. Int J Ophthalmol 2012;5(6):750-753. doi:10.3980/j.issn.2222-3959.2012.06.18
6. Vongphanit J, Mitchell P, Wang JJ. Population prevalence of tilted optic disks and the relationship of this sign to refractive error. Am J Ophthalmol 2002;133(5):679-685. doi:10.1016/s00029394(02)01339-9
7. Hwang YH, Yoo C, Kim YY. Characteristics of peripapillary retinal nerve fiber layer thickness in eyes with myopic optic disc tilt and rotation. J Glaucoma. 2012;21(6):394-400. doi:10.1097/IJG.0b013e3182182567
8. Sung KR, Wollstein G, Schuman JS, *et al.* Scan quality effect on glaucoma discrimination by glaucoma imaging devices. Br J Ophthalmol 2009;93(12):1580-1584. doi:10.1136/bjo.2008.152223
9. Gabriele ML, Ishikawa H, Wollstein G, *et al.* Optical

coherence tomography scan circle location and mean retinal nerve fiber layer measurement variability. Invest Ophthalmol Vis Sci 2008;49(6):2315-2321. doi:10.1167/iovs.07-0873

10. Leung CKS, Mohamed S, Leung KS, *et al*. Retinal nerve fiber layer measurements in myopia: An optical coherence tomography study. Invest Ophthalmol Vis Sci 2006;47(12):5171-5176. doi:10.1167/iovs.06-0545
11. Lan YW, Henson DB, Kwartz AJ. The correlation between optic nerve head topographic measurements, peripapillary nerve fibre layer thickness, and visual field indices in glaucoma. Br J Ophthalmol 2003;87(9):1135 LP - 1141. doi:10.1136/bjo.87.9.1135
12. Bendschneider D, Tornow RP, Horn FK, *et al.* Retinal nerve fiber layer thickness in normals measured by spectral domain OCT. J Glaucoma 2010;19(7):475-482. doi:10.1097/IJG.0b013e3181c4b0c7
13. Budenz DL, Anderson DR, Varma R, *et al*. Determinants of normal retinal nerve fiber layer thickness measured by Stratus OCT. Ophthalmology. 2007;114(6):1046-1052. doi:10.1016/j.ophtha.2006.08.046
14. Cheung CY, Li H, Lamoureux EL, *et al.* Validity of a new computer-aided diagnosis imaging program to quantify nuclear cataract from slit-lamp photographs. Invest Ophthalmol Vis Sci 2011;52(3):1314-1319. doi:10.1167/iovs.10-5427
15. Hoh ST, Lim MCC, Seah SKL, *et al.* Peripapillary Retinal Nerve Fiber Layer Thickness Variations with Myopia. Ophthalmology 2006;113(5):773-777. doi:10.1016/j.ophtha.2006.01.058
16. Porwal S, Nithyanandam S, Joseph M, Vasnaik A. Correlation of axial length and peripapillary retinal nerve fiber layer thickness measured by Cirrus HD optical coherence tomography in myopes. Indian J Ophthalmol 2020;68(8):1584-1588. doi:10.4103/ijo.IJO_1778_19
17. Salchow DJ, Oleynikov YS, Chiang MF, *et al.* Retinal nerve fiber layer thickness in normal children measured with optical coherence tomography. Ophthalmology 2006;113(5):786-791. doi:10.1016/j.ophtha.2006.01.036
18. Kim MJ, Lee EJ, Kim TW. Peripapillary retinal nerve fibre layer thickness profile in subjects with myopia measured using the Stratus optical coherence tomography. Br J Ophthalmol 2010;94(1):115LP-120. doi:10.1136/bjo.2009.162206
19. Peng PH, Hsu SY, Wang WS, Ko ML. Age and axial length on peripapillary retinal nerve fiber layer thickness measured by optical coherence tomography in nonglaucomatous Taiwanese participants. Bhattacharya S, ed. PLoS One 2017;12(6):e0179320. doi:10.1371/journal.pone.0179320
20. Ozdek SC, Onol M, Gürelik G, Hasanreisoglu B. Scanning laser polarimetry in normal subjects and patients with myopia. Br J Ophthalmol. 2000;84(3):264-267. doi:10.1136/bjo.84.3.264
21. Kremmer S, Zadow T, Steuhl KP, Selbach JM. Scanning laser polarimetry in myopic and hyperopic subjects. Graefes Arch Clin Exp Ophthalmol 2004;242(6):489-494. doi:10.1007/s00417-004-0859-1