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Research Article

Distribution of Optic Disc Parameters and Association of Axial Length in East Indian Myopic Population: A Correlational Study

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Abstract

Background: In the past, several investigations on myopia and the size of the optic disc were conducted. It has been proposed that the size of the optic disc varies with refractive error, growing larger with myopia and shrinking with hyperopia. Myopes have a probability of developing glaucomatous disc alterations, much as the population of myopia is growing in Asia's countries like India.

Purpose: The current study's goal was to assess the association between longer axial lengths, disc sizes, and disc volumes in the East Indian population's myopic population.

Methods: A cross-sectional study was performed in a Tertiary Eye Care centre. 276 eyes from 138 people between the ages of 18 and 40 were included, along with best corrected visual acuity of greater than 6/18, myopia (ranging from -0.25 to -8.00 DS), and astigmatism less than -3.00cyl. Subject with any cases with pathological myopia, retinal disease, or any eye surgery were excluded from the study. All subjects underwent for subjective refraction, slit-lamp examination, applanation tonometry, gonioscopy, A-scan ultrasonography, funduscopy, and color optic disk stereo photography, peripapillary RNFLT imaging were performed. Disk ovality was assessed using the ratio of minimum to maximum disk diameter (index of tilt). A ratio of ≥ 0.8 was considered as significant disk tilt.

Results: A total of 138 subjects were included. Among them 71 (51%) were female and 67 (49%) were male with mean age of 28.3 ± 6.99 years. The mean AXL was 23.90 ± 1.03 mm. In group-I, 167 eyes with refractive error ranging from (-0.25 to -1.00 Ds), followed by 62 eyes from Group-II with a refractive error ranging from (-1.25 to -3.75 Ds), 32 eyes from Group-III where the refractive error ranged from (-4.00 to -5.75 Ds), and lastly 15 eyes from Group-IV with refractive error ranged from (-6.00 to -8.00 Ds) respectively. It was found that with the increase in myopic error there was no significant increase in disc size and disc volume. Also, when eyes with AXL ranging from (22 -28 mm) were compared against disc area & disc volume, there was no significant glaucomatous changes noticed. The Pearson correlation test did not show any statistical significance. With mean axial length (AXL) 23.9 ± 1.03 mm, the results indicated that optic disc size is mostly independent of refractive error within the range of -0.25 to -8.00 D respectively.

Conclusion: The introduction of SD-OCT and IOL Master700, the relationship between longer axial length disc size and disc volume in the north Indian myopic population was shown to be insignificant.

Keywords: Scleral Buckling; Subretinal Fluid Drainage; Rhegmatogenous Retinal Detachment

Introduction

Myopia has become far more common, according to emerging research. High myopes are also more susceptible to developing primary open angle glaucoma than non-highly myopes. Particularly, the frequency of myopia is rising from an estimated 1.4 billion people globally in 2010 to an anticipated 5 billion people in 2050 [1]. A meta-analysis of seven studies also found that those with myopia had a 2.5-fold higher risk of glaucoma than people without myopia [2]. Myopia raises the risk of glaucoma for unknown reasons; however, it is most likely due to the optic nerve head's increased vulnerability to glaucoma damage due to a number of mechanisms. For fact, it has been suggested how the smaller lamina cribrosa in myopic eyes increases its susceptibility as a result of the pressure gradient being steeper [3], together with secondary myopia-related expansion of the optic nerve head, elongation and thinning of the peripapillary scleral flange, and other factors, these factors may raise someone's chance of getting glaucoma [3-6]. Moreover, diagnosing glaucoma in high myopes can be difficult due to the myopic optic nerve head's appearance, which sometimes mimics glaucomatous optic disc damage due to its higher degree of tilt and possible oval form and torsion.

A qualitative analysis of fundus images in relation to the clinical disc margin has been used in the majority of research to evaluate ovality index, disc tilt, and torsion measures. Regarding the relationship between these characteristics and axial length, recent research has produced mixed findings [7-9]. You, Xu and Jonas (2008) had reported in their study about the association of tilted discs with moderate myopia, astigmatism [10]. So early detection of tilted discs may prompt to prevent amblyopia. In non-glaucomatous myopes may be over diagnosed and overtreated if the myopic optic disc is wrongly thought to be glaucoma [11]. Hence, studying the structural characteristics of the myopic optic disc might help us better understand how myopia and glaucoma are related [12-18].

When measuring the ovality index, disc tilt, or torsion using a photographic method, markers like the clinical disc margin are used that are not based on the true three-dimensional anatomy of the optic disc [19-21].The Bruch's membrane opening (BMO) architecture is less likely to be reflected by the clinical disc border with increasing axial length, according to data, therefore a two-dimensional photography-based evaluation does not accurately reflect the genuine disc configuration in all respects [22]. The ability to objectively identify and assess ovality index, tilt, and torsion in relation to the BMO is one benefit of employing optical coherence tomography (OCT) imaging for this purpose [23].The aim of this study is to improve our knowledge of the morphological features of the glaucomatous optic disc in axial myopes.

Methods

A prospective, observational research was performed which included 138 individuals and for analysis both eyes were considered as separate data values. Hence 276 myopic eyes were analysed. All participants underwent comprehensive eye examinations, which included checks for axial length, peripapillary RNFLT imaging, visual acuity, refraction, applanation tonometry, slit lamp assessment, and dilated fundus evaluation. The inclusion criteria for the enrolment of subjects were set at subjects who aged between 18-40 years and having myopia ranging from -0.25DS to -8.00 DS with/without astigmatism ≤ -3.00D. Cup disc size ≥ 0.5 were included. A ratio of ≥ 0.8 was considered as significant disk tilt. Best corrected visual acuity better than 6/18 on Snellen chart and intra ocular pressure < 22mm Hg on applanation tonometer were included. Individuals and eyes having a history of any optic nerve problem or severe posterior segment pathology, such as multiple sclerosis, infiltrative nerve processes, tractional retinal detachments, ischemic optic neuropathy, or non-ischemic optic neuropathy, Individuals with tilted disc were excluded. By using simple and multiple regression analysis, the relationships between the axial length, optic disc size, and were analyzed.

Axial myopia categories

The optic disc and the fundus may undergo morphological alterations as a result of axial elongation [24]. The refractive error definition of myopia does not necessarily include axial elongation, which might result in the above-mentioned morphological alterations. Eyes that are axially long but no longer appear to be (very) myopic as defined by refractive error may have a refractive change as a result of cataract surgery or other refractive treatments. Due to the fact that this study evaluated the morphological alterations of the optic disc in relation to axial length, myopia was defined by axial length rather than refractive error.

The following axial myopia classes were defined based on population-based studies [25].

- No axial myopia: axial length≤24.0 mm
- Mild axial myopia: 24.0 mm< axial length≤26.0 mm
- High axial myopia: axial length>26.0 mm

Image acquisition and axial length measurement

The parameters such as axial length was analysed by instrument IOL master 700 and optic disc area, RNFLT and disc volume was assessed by Cirrus HD OCT5000.

Statistical analysis

The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected, then non-parametric test was used. Spearman rank correlation coefficient (as the data sets were not normally distributed) was used to assess the association of various parameters with axial length. A p value of 0.05 was considered statistically significant.

Results

A total of 138 subjects were included. Among them 71 (51%) were female and 67 (49%) were male with mean age of 28.3 ± 6.99 years. The mean AXL was 23.90 ± 1.03 mm. As this study was aimed to find the association only in Myopic population and hence Myopes were further classified into four groups as per the refractive error.

	Sample size	Mean ± SD	Median	Min-Max	Inter quartile Range
AXL (mm)	276	23.94 ± 1.03	23.86	22.06-27.44	23.080 - 24.735
DISC AREA (mm^2)	276	1.94 ± 0.37	1.92	1.1-3.45	1.670 - 2.130
DISC VOL (mm^3)	276	0.18 ± 0.19	0.14	0-1.76	1.700 - 0.247

Table 1: Mean values of AL, Disc area and Disc Volume.

ǂ Sourced by Author self.

Demographic Details					
Age Mean (± SD)	28.3 (± 6.99)				
Sex	Male (n = 67, 49%)	Female (n = 71, 51%)			
	Group-I (-0.25 to -1.0D)	Group-I (-1.25 to -3.75D)	Group-III (-4.00 to -5.75D)	Group-IV (-6.00 to -8.0D)	
No of eyes on range of myopia	167	62	32	15	
Descriptive Statistics					
	Sample size	Mean (± SD)	Median	Min-Max	Inter quartile Range
AXL (mm)	276	23.94 ± 1.03	23.86	22.06-27.44	23.080 - 24.735
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Table 2: Comparison of myopic group with AXL, Disc area and disc volume.

ǂ Sourced by Author self.

Inferential Statistics			
			AXL (mm)
Gr-1 (-0.25 to -1.00D) N = 167	Disc Area (mm^2)	Correlation Coefficient	-0.01012
		p-Value	0.8968
	Disc Volume (mm^3)	Correlation Coefficient	0.213
		p-Value	0.006
Gr-2 (-1.25 to -3.75D) N = 62	Disc Area (mm^2)	Correlation Coefficient	-0.327
		p-Value	0.0094
	Disc Volume (mm^3)	Correlation Coefficient	-0.063
		p-Value	0.626

Gr-3 (-4.00 to -5.75D) N = 32	Disc Area (mm^2)	Correlation Coefficient	-0.10288
		p-Value	0.5753
	Disc Volume (mm^3)	Correlation Coefficient	0.175
		p-Value	0.339
Gr-4 (-6.00 to -8.00D) N = 15	Disc Area (mm^2)	Correlation Coefficient	-0.36706
		p-Value	0.1784
	Disc Volume (mm^3)	Correlation Coefficient	0.082
		p-Value	0.771
Axial length (22-23.99 mm) N = 153	Disc Area (mm^2)	Correlation Coefficient	-0.02842
		p-Value	0.7273
	Disc Volume (mm^3)	Correlation Coefficient	0.072
		p-Value	0.376
Axial length (>24.00 mm) N = 123	Disc Area (mm^2)	Correlation Coefficient	-0.194
		p-Value	0.0314
	Disc Volume (mm^3)	Correlation Coefficient	-0.117
		p-Value	0.196

Table 3: Comparison of Variables AXL range with disc area and disc volume.

ǂ Sourced by Author self.

In group-I, 167 eyes with refractive error ranging from (-0.25 to -1.00 Ds), followed by 62 eyes from Group-II with a refractive error ranging from (-1.25 to -3.75 Ds), 32 eyes from Group-III where the refractive error ranged from (-4.00 to -5.75 Ds), and lastly 15 eyes from Group-IV with refractive error ranged from (-6.00 to -8.00 Ds) respectively.

It was found that with the increase in myopic error there was no significant increase in disc size and disc volume. Also, when eyes with AXL ranging from (22 - 28 mm) were compared against disc area & disc volume, there was no significant glaucomatous changes noticed. The Pearson correlation test did not show any statistical significance. With mean axial length (AXL) 23.9 ± 1.03 mm, the results indicated that optic disc size is mostly independent of refractive error within the range of -0.25 to -8.00 D respectively.

Discussion

We conducted this study among the subjects who came in the hospital for their comprehensive eye evaluation. Only those who are having minimal myopia to high myopia were included. Some recent studies have reported that, cup-to-disc area was shown to be statistically significant at the 5% level to be higher when the eyeball was long and myopic and lower when the eyeball was short and hypermetropic [26]. This would be consistent with the idea that the diameter and disc area itself fluctuate with eyeball size, just as the depth of AC in the cornea varies across individuals. The optic disc is bent in myopia due to the lengthening of the eye, and glaucoma is more common in myopic eyes. According to a research, people with long axial length should have their eyes thoroughly checked for glaucoma since it may be a risk factor for NTG and POAG [27]. Asians and Indians would be more affected by this because myopia is particularly prevalent among these people [28]. One might hypothesise that the degree of high axial myopia and indirectly the size of the enlarged optic disc are related to the susceptibility to glaucomatous optic nerve fibre loss. This is because myopic stretching of the globe and secondary enlargement of the optic nerve head increase with increasing axial myopia.

The lamina cribrosa's posteriorly exposed portion is situated near to the edge of the eye. Since the optic disc width increases with myopic stretching of the optic nerve head but does not significantly affect the diameter of the optic nerve inside the pia mater, the posterior surface of the lamina cribrosa is exposed to the pia mater and indirectly to the cerebrospinal fluid area [29]. Yet, red has been seen in eyes that are very myopic and have an axial length more than 26.5 mm.

High resolution spectral domain optical coherence tomography (SD-OCT), which makes it possible to see a conventional glaucoma indication known as the circum-papillary retinal nerve fibre layer (cp-RNFL) thinning, is a useful tool for detecting early glaucomatous alterations. Yet another clinical trait of high myopia's enlarged eyes and stretched retinas is a thin cp-RNFL. Assessment of macular measurements, such as ganglion cell complex and ganglion cell inner plexiform layer, which are unaffected by myopic thinning of the cp-RNFL, are proving to have superior diagnostic value for detecting glaucomatous changes in high myopic eyes because retinal thinning typically occurs in the peripheral but not the central areas. The goal of this study was to determine whether there may be a relationship between axial length, disc size, and disc volume. Sensitive impressions or predictions would need to be refined further based on variables such patient age, race, gender, etc.

Drawbacks

The research was conducted over a brief period of time, and the study population was quite small, which is the study's main weakness. Also, the results were restricted by the choice of subjects with myopia ranging from -0.25 to -8.00 Ds and AL 22 mm to 28 mm. Thus, it is crucial to apply our findings to people of varied ethnic backgrounds.

Conclusion

The study found no link between glaucoma susceptibility in myopia (from -0.25 to -8.00 D) with AXL from 22 mm to 28 mm in the East Indian population and longer axial length, disc area, or disc volume. Further analysis and refining that is sensitive may be required for study and research.

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