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Research Article

Co-relation Between Myopia and Age, Sex, Axial Length, Pachymetry and Anterior Chamber Depth in Young Adults

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Abstract

To find the correlation between myopia and age, sex, axial length, pachymetry and anterior chamber depth in young adults.

Keywords: Myopia; Axial Length; Pachymetry

Introduction

Myopia or short-sightedness is a refractory state of the eye in which parallel rays coming from infinity tend to fall in front of retina with accommodation at rest. It is a complex trait including both genetic and environmental factors as well as gene-environment interactions [1,2]. High myopia is associated with an increased risk of pathological ocular complications and may lead to blinding disorders such as premature cataracts, glaucoma, retinal detachment, and macular degeneration [3]. Thus, high myopia is a major cause of legal blindness in many developed countries [4].

Prevalence of myopia varies across populations of different regions and ethnicities. Prevalence of myopia is significantly higher in Asian populations than in populations of European descent, especially in the younger generations in recent decades [5,6].

The aim of this paper is to evaluate and determine if there is any co relation between myopia and age, sex, axial length (AL), pachymetry and anterior chamber depth (ACD) in young Indians between age group 18 to 30 years.

Materials and Methods

This was an observational, prospective, relational study conducted at Army Hospital Research and Referral. Patients between age group of 18 to 30 years who were referred to the Dept of ophthalmology for refraction were included in the study and were subjected to comprehensive ophthalmological examination including best corrected visual acuity of 6/6, AL, pachymetry and ACD. Inclusion criteria included age between 18 – 30 years, no history of any refractive surgery or trauma to the eye, no associated maculopathy and no history of any other coexisting ocular pathology or any neurological disorder. On the basis of spherical equivalent (SE) of refractory error measured in spherical diopters (DS), subjects were divided in 3 groups:

- Low Myopia (1 - 3 DS)
- Moderate Myopia (3 - 6 DS)
- High Myopia (> 6 DS)

Data acquisition

Best corrected visual acuity of 6/6 was checked with Snellen's Chart and SE to achieve that was noted. Pachymetry was measured with Ultrasound pachymeter and AL and ACD were measured with IOL Master (Carl Zeiss Meditec, Dublin, CA, USA).

For calculation of pachymetry, the subject was comfortably seated with the head upright and eyes in the primary position of gaze. The probe was sterilized with 70% alcohol and allowed to air-dry. A drop of topical anaesthetic (Proparacaine 0.1%) was instilled in subject's eyes. The probe was carefully aligned perpendicularly to and cornea was lightly applanated. At least twenty five readings were continually taken and the average calculated as the measured pachymetry (expressed in microns).

For calculation of AL and ACD, the subject was asked to place his chin on the chin rest, and press his forehead against the forehead strap of the IOL Master. The subject's eye was aligned to the visual axis by a central fixation light or target. Minimum of 5 readings were taken and their average calculated for both AL and ACD. A single trained operator performed all of the examinations using both devices to avoid inter-observer bias.

Statistical analysis

SPSS ver., 16.0 was used for data analyses and preparation of figures. The measured variables were tested for correlation with the Pearson co-relation factor (r). Gender-related differences in measured variables were tested with Student's *t*-test (unpaired). The relationship between variables was tested with regression analysis. Statistical significance was declared when *p*-value was ≤0.05. Statistical analysis was done separately for all the 3 groups i.e. Low, Moderate and High myopia.

Results

176 eyes of 88 patients were included in the study. 47 of them were females and 41 were males. Various parameters varied as shown in table 1.

Parameters	Min value	Max value
Age (yrs)	18	30
SE (DS)	-1.5	-24.5
Pachymetry (microns)	419	570
A L (mm)	23.09	32.12
A.C.D (mm)	3.06	4.36

Table 1

Low myopia

Refractory error considered in this group was 1 - 3 DS. There were 46 eyes which comprised this group. In this group, axial length showed an insignificant positive co-relation with refractory error, anterior chamber depth showed a significant positive co-relation whereas pachymetry showed an insignificant negative co-relation with refractory error. Pearson co-relation factor with p values are shown in table 2.

Low myopia, n = 46				
		AL	ACD	PACHY
SE (1- 3 DS)	r	0.106	0.387**	-0.124
	p value	0.482	0.008	0.412
*. Correlation is significant at the 0.05 level (p value).				
**. Correlation is significant at the 0.01 level (p value).				

Table 2

Moderate myopia

Refractory error considered in this group ranged from 3 - 6 DS. There were 92 eyes which were included in this group. In this group, both axial length and anterior chamber depth showed an insignificant positive co-relation with refractory error whereas pachymetry showed an insignificant negative co-relation with refractory error. Pearson co-relation factor with p values are shown in table 3.

Moderate myopia, n = 92				
		AL	ACD	PACHY
SE (3 - 6 DS)	r	0.122	0.141	-0.194
	p value	0.245	0.207	0.064
*. Correlation is significant at the 0.05 level (p value).				
**. Correlation is significant at the 0.01 level (p value).				

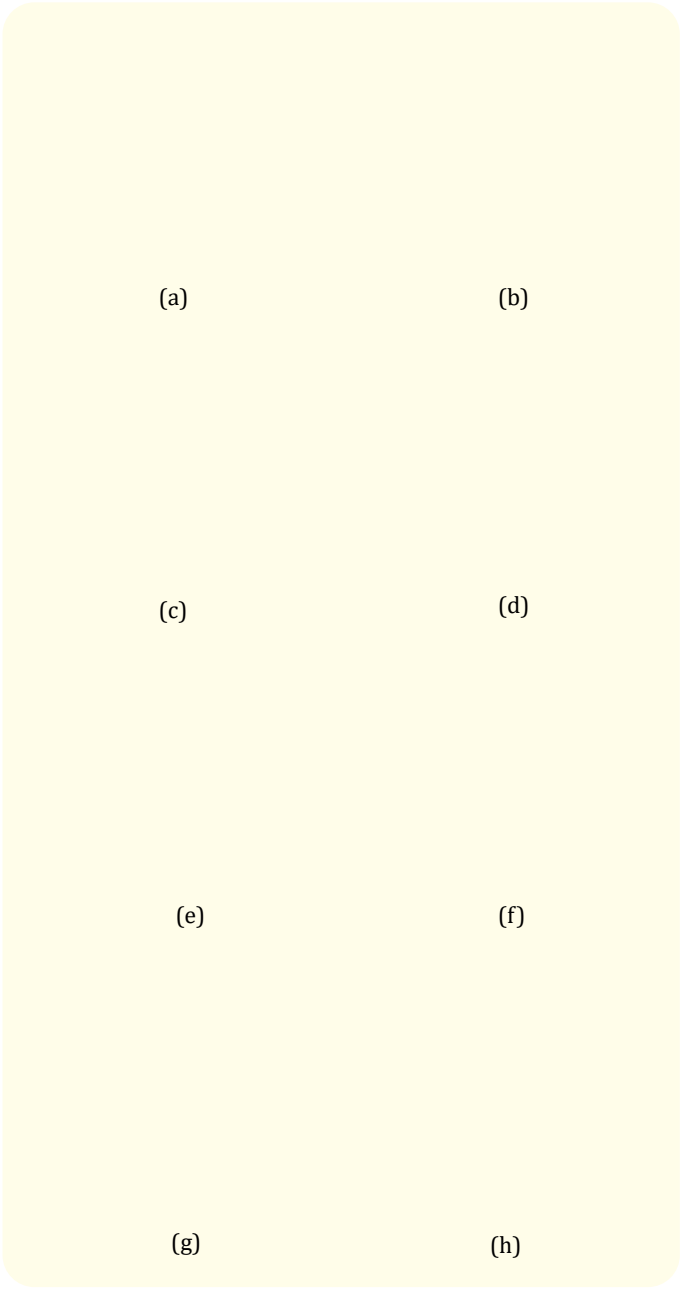
Table 3

High myopia

Refractory error considered in this group was above 6 DS. There were 38 eyes which were included in this group. In this group, axial length showed a significant positive co-relation with refractory error whereas anterior chamber depth and pachymetry showed an insignificant negative co-relation with refractory error. Pearson co-relation factor with p values are shown in table 4.

High myopia, n = 38				
		AL	ACD	PACHY
SE (> 6 DS)	r	.764**	-0.273	-0.182
	p value	<0.001	0.102	0.275
*. Correlation is significant at the 0.05 level (p value).				
**. Correlation is significant at the 0.01 level (p value).				

Table 4



(a) (b) (c) (d) (e) (f) (g) (h) (i)

Figure 1: Scatter plots of AL, ACD and pachymetry against myopia (SE of refractory error) in different groups; (a, b, c) Low myopia group; (d, e, f) Moderate myopia group; (g, h, i) High myopia group.

Overall co-relation

Myopia vs axial length

There was a statistically significant positive correlation between myopia and AL with Pearson correlation factor (r) being 0.757 ($p < 0.001$). Although AL was found to have statistically insignificant positive co-relation with myopia in low and moderate myopia but when all the 3 groups were analyzed altogether the result came out to be statistically significant.

Myopia vs pachymetry

There was a statistically significant negative correlation between myopia and pachymetry with Pearson correlation factor being 0.155 ($p < 0.039$). Although pachymetry was found to have insignificant negative co-relation in all the three groups but when all the 3 groups were analyzed together the result is statistically significant and negatively co-related.

Myopia vs anterior chamber depth

There was negative correlation between myopia and anterior chamber depth with Pearson correlation factor being 0.131 but it was statistically insignificant as $p = 0.094$. Since ACD was positively correlated in low as well as moderate myopia but negatively correlated with high myopia, this finding seems to have been influenced by the extreme readings seen in high myopia group.

Myopia vs age

No significant correlation of myopia could be found with the age of the patient (Pearson correlation factor was 0.028 and p value was 0.708).

Myopia vs sex

82 eyes were of male patients as compared to 94 eyes of females. Mean SE of refractory error in males was 5.53 DS ± 4.02 DS and in females it was 4.94 ± 3.44 DS. There was no significant correlation of myopia with sex (p = 0.296) as shown in table 5.

Sex	N	Mean SE	Std. Deviation	t-value	p-value
Male	82	5.53	4.02	1.048	0.296
Female	94	4.94	3.44		

Table 5

Discussion

The introduction of laser refractive procedures (photorefractive keratectomy [PRK] and laser in situ keratomileusis [LASIK]) brought about increasing interest in the determination and evaluation of differences in normal central corneal thickness (CCT). Axial length (AL) of the eyeball is the distance from the posterior corneal surface to an interference peak corresponding to retinal pigment epithelium/Bruch's membranes [7,8]. Chen., *et al*. [9] found no statistically significant correlation between CCT and AL. They claimed that the eye elongates with sclera thinning but CCT may not be affected by the sclera thinning that occurs during eye elongation in myopia. However, Chang., *et al*. [10] hypothesized that there might be a stretching-related increase in corneal area associated with axial elongation and scleral thinning but could find no statistically significant relationship between AL and CCT in a Taiwan based clinical study. A previous study that examined the general population found that greater AL was significantly associated with a thicker cornea using univariate analysis; however the association was not found to be significant using multivariate analysis [11].

In our study, AL showed a statistically significant positive correlation with SE of refractory error and pachymetry showed a statistically significant negative correlation with increasing myopia. When subjects were divided in 3 groups on the basis of SE i.e. Low, Moderate and High myopia, AL was positively correlated with myopia in all the 3 groups and pachymetry was found to be negatively correlated with the refractory error. This implies that as the eyeball elongates, there is an increase in refractory error and an associated decrease in the pachymetry.

To implant phakic intraocular lenses, ACD must be measured to avoid complications such as an attack of acute angle-closure and also associated endothelial cell loss [12,13]. Previous population-based studies have shown that ACD is associated with age, gender, body stature, AL, and lens thickness [14-18]. These studies examined the general population and focused on factors associated with reduced ACD. Jivrajka., *et al*. reported a significant positive correlation between AL and ACD in cataractous eyes [19]. In the Jivrajka study, greater than 99% of participants had an AL < 27 mm. In a previous study, Hoffmann., *et al*. showed that in eyes with an AL of 21.63–25.84 mm, AL was positively correlated with ACD and in eyes with an AL ≥ 25.84 mm, AL was negatively correlated with ACD [20]. They included 23,239 eyes with cataracts in the study with a mean subject age of 74 years. Hye Jin Chung and Chan Kee Park conducted a study on ocular biometers and found that ACD increased as AL increased in the moderate-myopia group (>−6 D). However, in the high-myopia group, ACD showed no association with AL, and showed a tendency to decrease with decreasing SE [21].

In our study, ACD showed a positive correlation with refractory error in Low as well as Moderate myopia but showed a negative correlation with refractory error in High myopes (> 6 DS). This implies that up to a certain point in the AL increase, both the anterior and posterior segments of the eyeball contributed to the overall increase in the AL. After this point was reached, axial elongation was due to the elongation of the posterior part, so overall ACD seemed not to increase. This posterior elongation could aggravate the pathological myopia in the posterior segment of the eyeball leading to vitreous and retinal changes.

Age and sex do not seem to have a significant correlation with myopia.

Conclusion

Surgical treatment of myopia is either keratorefractive where pachymetry plays an important role in determining the type of

surgery keeping the residual stromal bed within safe limits or phakic IOL's where anterior chamber depth plays a crucial role in laying down the criterias for declaring a patient fit for phakic IOL's. Positive correlation of axial length with myopia proves that as the axial length increases refractory error also increases. Positive correlation of ACD with myopia in low to moderate myopes only indicates that phakic IOL's can be a good option in low to moderate myopes but may not be that good an option in high myopes. Negative correlation of pachymetry with myopia indicates that pachymetry can be a restricting factor in keratorefractive surgeries as the refractory error of the patient increases.

The ocular biometric parameters we examined are closely interrelated. Understanding the changes in ocular biometric parameters as myopia increases is very important in not only interpreting the ocular data but also modeling the pathology of ocular disease and also deciding in the approach for the management of the patient.

Because the present study was performed using normal eyes, further studies on pathologic eyes would be valuable. In addition, since all the participants were Indian, the effect of race should be examined.

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Author has no financial disclosures.

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