Original article

A Clinical Study to Evaluate the Correlation between the Axial Length of Eye and degenerative fundus changes

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ABSTRACT

Introduction: Refractive errors are a common cause of visual disorders, of which myopia is the second most common. Myopia is also known as short sightedness. It is a condition occurring as a result of increased global axial length or increased refractive power of anterior segment, with the former being more important[1]. Its importance arises from the fact that it can affect almost all age groups, ethnic groups either sex and can even cause blindness [1]. As per 2001-02 national survey on blindness in India, refractive errors account for 19.7 % of total blindness [2]

Material and Methods: The present study is randomized prospective study carried out at tertiary eye care hospital at Bareilly to find out a correlation between axial length of eye and degenerative fundus changes in myopic patients.To establish a correlation between the axial length of eye and the degree of myopia using A-scan.

Results:There is a direct co-relation between the axial length and degenerative fundus changes. Dioptric power when correlated with the mean fundus changes also showed a very strong association in our study.

Conclusion: The range of axial length in our study was from 22.98 to 31.04mm. It showed an increase with advancing age and degree of myopia. The myopic fundus changes strongly correlated with increase in the axial length. The dioptric power is therefore a better indicator for predicting fundus degenerative changes, rather than axial length, though both are significant.

Keywords: Axial length, pathological myopia, degenerative fundus changes, slit lamp examination retinoscopy

INTRODUCTION

The average worldwide frequency of myopia is approximately 30 % and is traditionally subdivided into school myopia and pathological myopia[3].Prevalence of simple myopia is estimated at 36%[4]and prevalence of pathological myopia is estimated at 2-3 % in population based studies. Based on etiology myopia can be axial myopia due to increase in anterio-posteror diameter of eye. Curvature myopia due to increase in curvature of cornea or lens.Index myopia due to change of refractive index of lens nucleus, aqueous or vitreous. Peoplewith myopia (referred to as simple myopia 0 diopters to -6 diopters) and those with high or pathological myopia (greater than -6 diopters)

Prevalence of myopia varies among different ethnic group being least in blacks and greater in Asians. Among mixed population of USA, 25% were myopic, while in a subset of African- Americans, the percentage was 12.6%. When 120, 000 Chinese individuals were studied, 70% were myopic [5]. Myopia was seen more often in women (48%) than men (41%) [6]. Pathological myopia is also influenced by ethnicity but is observed less frequently over all.Higher degrees of myopia are known to be associated with higher incidence of chorioretinal degeneration (tessellated fundus, myopic crescent, Forster Fuchs fleck) and severity of complications like posterior staphyloma, lattice degeneration, retinal detachment, vitreous changes and retinal tears. High myopia can have a profound effect on the visual acuity of the patient and can cause blindness.[1]

It was generally held that the changes in fundus were due to the stretching of sclera. A high correlation was found between

progression of myopia and greater axial length. [7] But changes may be extensive in eyes which have a shorter axial length. Another study concluded that eyes with retinal detachment had increased axial length [8]. Axial length is measured with A-scan ultrasonography and this is a method of choice with high degree of accuracy. Ultrasonic frequencies in the range of 10NHz are used. All these factors make it necessary to study the axial length of eye, familial factors and degenerative fundus changes that can be associated with high myopia.

MATERIALS AND METHODS

This study was planned for 1 year in 100 patients above the age group of 6 years, of either sex attending the ophthalmology OPD at Rohilkhand Medical College and hospital with a complaint of diminution of vision due to a myopic status. The inclusion and exclusion criteria were as follows

INCLUSION CRITERIA

1. Patients above 6years of age, with complaint of diminution of distant vision.
2. Patient who signed the informed consent.

EXCLUSION CRITERIA

1. Patients less than 6 years of age
2. Corneal curvature outside normal range
3. Patients with pre-existing organic disease causing diminution of distant vision.

In this study patients with complains of diminution of distant vision were subjected to following protocol of examination-

Detailed history regarding complaints, onset, duration, and past history of wearing spectacles.Preliminary examination of uncorrected and best corrected visual acuity by SNELLENS CHART. Detailed slit lamp examination and fundus examination with direct and indirect ophthalmoscopy was done to rule out any other organic cause of blurred vision. Keratometry readings were taken to assess whether corneal curvature was within normal range. Measurement of IOP done. Retinoscopy was performed in all patients (cycloplegicretinoscopy in those under 20 years according to following chart.

AGE	CYCLOPLEGIC DRUG	DOSAGE	PMT
6-10 YEARS	Homatropine 2%	1 drop/10 min for 6 times	After 3 days
10-20 YEARS	Cyclopentolate 1%	1 drop/15 min for 3 times	After 1 day

After taking written consent from selected patients they were subjected to A-scan: procedure explained to the patient. Axial length of each eye was measured. A mean of 5 readings was taken. Detailed fundus examination to look out any degenerative changes using indirect ophthalmoscope. Patients subjected to questionnaire to determine any refractive error.

OBSERVATIONS AND RESULTS

Numerical distribution of eyes based on degree of myopia and grade of fundus changes.

TABLE -1

Degree of myopia(Dioptres)	No: of eyes (%)	Physiological Grade 1	Intermediate Grade 2	Pathological Grade 3
<-3.0	70(35%)	50	20	0
-3.0 to-6.0	72(36%)	21	49	2
-6.0 to -9.0	29(14.5%)	0	1	28
-9.0 to -12.0	12(6%)	0	0	12
-12.0 to -15.0	11(5.5%)	0	0	11
-15.0 to -18.0	6(3%)	0	0	6

Patients were assorted into 3 categories based upon grade of myopic retinal degeneration and 4 groups on the basis of axial length measurement .

The bulk of cases (71%) fell under the category of simple myopia (<6 dioptres).Out of these the majority presented with grade 1 (physiological) fundus changes.

TABLE-2

S.NO	Myopic Fundus changes	No of eyes	Percentage(%)
1.	Myopic crescent	105	52.5
2.	Tessellated fundus	48	24
3.	Vitreous changes	17	8.5
4.	Chorio-retinal degenrations	16	8
5.	Lattice degenration	13	6.5
6.	Paving stone degeneration	2	1
7.	Retinal break	1	0.5

The most ubiquitous feature of myopic fundus noted in our study was a myopic crescent, which was seen in 52.5% cases. On a graded scale employing Duke Elder's classification of myopic fundus, the pattern of mean fundus changes consistently matched with the degree of myopia. The mean grade of fundus changes for myopes below 3 diopters was 1.33 as against 2.89 for myopes between -6D and -9D. The observations also revealed that, all the eyes with myopic status above -9D have some degree of chorio-retinal degeneration.

TABLE -3

Groups	Axial Length(mm)	Total no of eyes	Grade 1 Physiological		Grade 2 Intermediate		Grade 3 Pathological	
			n	%	n	%	N	%
Group A	24-26	105	31	29.5	60	57.14	14	13.33
Group B	26-28	28	2	7.4	6	21.43	20	71.43
Group C	28-30	16	0	0	0	0	16	100
Group D	>30	7	0	0	0	0	7	100

Correlating the fundus changes with axial length, we noted that a near linear correspondence was present for grade of fundus when matched with the axial length .Grade 3 (pathological fundus) changes were seen in only 13.33% patients with axial length between 24-26 mm , while 100% pathological fundus changes were evident in eye having axial length above 28mm. While measuring, the association between these two indices through Pearson correlation coefficient , a high strength of correspondence was noted with an r-vaue of 0.7545 ($p<0.001$). Such a positive linear dependence is also evident on the scatter plot correlating fundus grade with dioptric power of eye. The r-value as calculated through Pearson correlation coefficient of 0.791 cites a higher degree of association for dioptric power compared to axial length. Hence a routine refractive check may in fact be a better indicator for predicting the degenerativechanges in fundus.

When correlating the dioptric power with axial length an extremely strong association is deciphered through the Pearson's correlation criteria , with a r- value of 0.9125 ($p< 0.001$). This statistical information corroborates the often mentioned fact that axial length is the primary determinant of the myopia status of eye with other ocular components playing a much secondary role.

DISCUSSION

Association of myopia with retinal co-morbidity has long been recognized. The ocular co-morbidities encountered in high myopia include optic nerve crescent, vitreous degeneration, myopic macular degeneration and chorio-retinal changes[8]. Various retinal degenerations found in myopia may cause irreversible blindness. Peripheral retina is prone for multifarious degenerations like lattice degeneration, pigmentary changes and retinal breaks. The peripheral degenrations are secondary to its anatomical dehiscence like thinning, presence of poorly developed retinal cells, excessive stretching and increased vascularity.[9] Its less resistance to traction make it vulnerable to serious complications like retinal detachment.

The degree of retinal changes, generally correlate with the axial length and extent of myopia. Choroidal tessellation are frequently reported even in mild myopia.Venkatesan et al, in their clinical analysis of fundus changes in myopia, reported 41% tessellation in retinal background.[9] Our own study , noticed 24% tessellations in studied subjects.

Bansal et al when commenting on the peripheral retinal status of 54 eyes of highly myopic children below 10 years of age reported that, nearly one third of them had peripheral retinal degeneration[10]. The commonest degenerative change noted was lattice degeneration (20%), white without pressure (11%) and retinal hole with sub retinal fluid (4%). A Cross – sectional study by Foster et al [11] reported peripheral retinal changes in 61.7% highly myopic eyes. The most common pathology observed included white without pressure (51.7%), lattice degeneration (5.8%), microcystoid degeneration (5%) and pigmentary degeneration (4.2%)

CONCLUSION

Correlation of axial length and degenerative fundus changes were evaluated in 100 patients. The bulk of cases (71%) fell under the category of simple myopia (<6 diopters).Out of these, the majority presented with grade 1 (physiological) fundus changes.(Table -1)

The pathological myopic fundus changes (grade 3) were near universal (98.3%) among higher myopes of diopter power above 6D. Myriad of myopic fundus changes include (table-2) myopic crescent (52.5%), tessellated fundus (24%), vitreous degeneration (8.5%), chorio-retinal degeneration (8%), lattice degeneration(6.5), paving stone degeneration (1%) and retinal break (0.5%) cases. Intermediate changes (grade2) highlighted by myopic crescent or peripapillary atrophy without any peripheral retinal changes were pronounced in moderate degree of myopia (-3 to -6D) (Table 2). The range of axial length in our study was 22.98 to 31.04 mm. it showed an increase with advancing age and degree of myopia. Mean axial length was marginally decreased in age group 51 to 60 years. The myopic fundus changes strongly correlate with increase in axial length (Table-3) They depicted a strong linear association as per Pearson's correlation coefficient ($r=0.754$ and $p<0.0001$). Retinal degeneration as evidenced in grade 3 fundus changes was high (71.43%), in the axial length category of 26-28mm. it was universal (100%) with axial length above 28mm.Axial length calculation can be of immense predictive value in determining vision threatening degenerative fundus changes in myopia.

RECOMMENDATIONS AND LIMITATIONS

Myopia has currently assumed a status of enormous threat to vision .Not only is it affecting increasing number of people, there is also a reported shift towards younger affections .Our study emphasized the close relationship that governs axial length change and fundus degeneration. It also correlated simple dioptric status of eye with degenerative changes in fundus. It highlighted the need for detailed assessment in all eyes with myopia above 6 dioptres.

The study did face certain limitations that influenced the validity of some of its findings. Firstly information derived through the study of a limited number of 100 cases could not be extrapolated for generalization, considering large subject of myopic population. Secondly, the subjective grading of fundus changes influenced the numerical objective analysis when correlating different parameters of myopia.

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