FUNDUS CHANGES IN HIGH AXIAL MYOPIA AND THEIR CORRELATION WITH THE AXIAL LENGTH OF GLOBE

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ABSTRACT

BACKGROUND

Myopia is a common optical aberration. Physiological myopia, by far the most prevalent, is less than -6D in magnitude and is considered a normal biological variation. Eyes that have errors greater than -6D are said to have high myopia. Pathological myopia is that type of myopia, which is accompanied by degenerative changes occurring particularly in posterior segment of globe. It is usually, but not invariably associated with lengthening of the anterior-posterior axis of eyeball and is usually, but by no means always progressive. It is probable that to some extent at any rate the two - the myopia and degenerative changes are independent, but are usually closely related.

MATERIALS AND METHODS

100 eyes of the 50 patients with myopia more than -6D attending the Outpatient Department of Ophthalmology at Santosh Medical College and Hospital, Ghaziabad, were examined. Keratometry was done to measure corneal curvature using keratometer. Ultrasound biometry was done using contact probe Biomedix A-Scan with digital display to assess axial length in all subjects in both eyes.

RESULTS

There were 100 eyes examined in this manner. 12 patients had unilateral high myopia, one patient had unilateral functioning eye and 38 patients had bilateral myopia.

CONCLUSION

A steady rise from 75% in the range of average axial length <23.5 mm to 100% in all eyes of average axial length of 23.5 mm and above was seen in eyes with crescent in this study. Chorioretinal atrophy was observed in 32 eyes of axial length >26.5 mm and was found more frequently with increasing axial length. Fuchs spots was seen in 13 eyes out of 39 eyes of axial length >26.5 mm and was seen more frequently with higher axial lengths. Lacquer cracks was seen in seven patients of axial length >28.5 mm. Posterior staphyloma was seen in two patients of axial length >25.5 mm and was less common than Fuchs spots and Lacquer cracks in a steady rise from 33% in the range of average axial length of 29.5 mm to 100% in all eyes of average axial length of >33.5 m. A proportion of asymptomatic high myopic subjects were found to have peripheral retinal degenerative and posterior pole chorioretinal lesions. As these degenerative changes may be associated with serious vision threatening complications, so these patients should be advised to seek ophthalmic care promptly should such symptoms arise.

KEYWORDS

Myopia, Axial Length, Chorioretinal Atrophy, Peripheral Retinal Degeneration.

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BACKGROUND

The term myopia is derived from two Greek roots - "Myein", which means close and "Ops", which means eye. It describes the ancient observation that affected individuals habitually approximated their eyelids to form a stenopeic slit to improve image quality.[1,2]

Myopia is a common optical aberration. Physiological myopia, by far the most prevalent, is less than -6D in magnitude and is considered a normal biological variation. Eyes that have errors greater than -6D are said to have high myopia.[3]

Myopia is the most common visually significant refractive error with a prevalence of nearly 25% for whites and 13% for blacks. The myopic eye brings a pencil of parallel rays of light into focus at a point anterior to the retina. The far point

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of a myopic eye is between infinity and the anterior surface of the cornea.[4]

In myopic eye, the second principal focus lies in front of the retina because the eye is abnormally long.[5] Most commonly myopia begins between ages 7-10 and is bilateral and progressive until late adolescence.

Myopia is that form of refractive error wherein parallel rays of light come to a focus in front of the sentinel layer of retina when eye is at rest. In simple myopia, this is brought about by variation within normal limits of the optical system- an increased curvature of the corneal or the lens surfaces, a shallow anterior chamber, a high refractive effectivity of the lens or a great axial length of the globe.[6]

Pathological myopia is that type of myopia, which is accompanied by degenerative changes occurring particularly in posterior segment of globe, it is usually, but not invariably associated with lengthening of the anterior-posterior axis of eyeball and is usually, but by no means always progressive. It is probable that to some extent at any rate the two- the myopia and degenerative changes are independent, but are usually closely related.[7]

Although, there is a fairly close association between the higher degrees of myopia and the complications to be referred to in this study, the nature of the connection is yet to be fully understood as there is no definite parallelism between the severity of these changes and the degree of myopia and it is not unusual for these complications to appear at a long interval after the onset of the refractive error and to advance long after the myopia has come to a halt.

The pathological changes can be grouped as follows-

1. Changes in the vitreous.
2. Changes in the optic nerve head.
3. Disseminated changes in the fundus.
4. Changes at the macula.
5. Changes at the periphery.
6. Changes in the lens.

Interpretation of these findings, however, depends on an accurate and detailed knowledge of the retinal topography, anatomical variations and degenerations that commonly affect the posterior pole and peripheral retina.

In the present study that I have undertaken, an attempt has been made to study the changes in the fundus of the high myopic eye and correlate these changes with axial length of the globe.

Purpose- To evaluate the fundus changes in high myopia in correlation with the axial length of globe.

MATERIALS AND METHODS

A minimum of hundred eyes of 50 patients of myopia (>6D), which is confirmed by visual acuity and refraction attending the Outpatient Department of Ophthalmology, Santosh Medical College and Hospital, Ghaziabad, were examined during a period from July 2015 to June 2016. Any similar condition prevalent amongst parents and siblings of the patients were enquired. Patients having media opacities that prevented direct ophthalmoscopic examination and patients having curvature myopia were excluded.

All cases were subjected to detailed history such as age of onset, progression, duration of use of refractive correction and other complaints.

Ocular examination included- Vision (unaided), best corrected vision (retinoscopy and subjective correction), anterior segment examination, axial length measurements, keratometry, fundus examination, direct ophthalmoscopy, indirect ophthalmoscopy, slit lamp biomicroscope and IOP.

The patients were screened in OPD and preliminary examination was done. Visual acuity for distance was determined with Snellen's chart and pinhole improvement was noted. Patient's refraction readings were determined with a retinoscope in dark room after using a cycloplegic and subjective correction was given the next day.

The patients with myopia were separated and detailed slit lamp biomicroscopy and fundus examination with direct and indirect ophthalmoscopy with sclera indentation was done. Keratometry reading were taken and noted in millimeter. Axial lengths were measured using A-scan.

The results obtained were statistically analysed.

RESULTS

There were 100 eyes examined in this manner. 12 patients had unilateral high myopia.[1] Patient had unilateral functioning eye and 38 patients had bilateral myopia. All cases in which a complete examination could be performed were included in this study with no attempt made to obtain a balanced sample of eyes. Five fundus changes were found to be associated with increased axial length of the eye. These were-

1. Crescents.
2. Chorioretinal atrophy.
3. Forster-Fuchs spot.
4. Lacquer cracks.
5. Posterior staphyloma.
6. Peripheral retinal degeneration.

The results have been arranged into two parts.

Part 1- Incidence and characteristics of myopic fundus changes.

Part 2- Interrelationship of myopic fundus changes.

Axial Length Range (mm)	Number of Eyes	Number of Chorioretinal Atrophy	% Age
<23.5	8	0	0
23.5-24.4	8	0	0
24.5-25.4	14	0	0
25.5-26.4	11	5	45
26.5-27.4	21	6	28
27.5-28.4	16	4	25
28.5-29.4	7	6	85
29.5-30.4	3	2	66
30.5-31.4	5	2	40
31.5-32.4	2	2	100
32.5-33.4	4	4	100
>33.5	1	1	100

Table 1. Number of Eyes with Chorioretinal Atrophy at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Crescents	% Age
<23.5	8	6	75
23.5-24.4	8	8	100
24.5-25.4	14	14	100
25.5-26.4	11	11	100
26.5-27.4	21	21	100
27.5-28.4	16	16	100
28.5-29.4	7	7	100
29.5-30.4	3	3	100
30.5-31.4	5	5	100
31.5-32.4	2	2	100
32.5-33.4	4	4	100
>33.5	1	1	100

Table 2. Number of Eyes with Crescent at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Fuchs Spot	% Age
<23.5	8	0	0
23.5-24.4	8	0	0
24.5-25.4	14	0	0
25.5-26.4	11	0	0
26.5-27.4	21	1	4
27.5-28.4	16	1	6
28.5-29.4	7	4	57
29.5-30.4	3	1	33
30.5-31.4	5	3	60
31.5-32.4	2	1	50
32.5-33.4	4	1	25
>33.5	1	1	100

Table 3. Number of Eyes with Fuchs Spot at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Lacquer Cracks	% Age
<23.5	8	0	0
23.5-24.4	8	0	0
24.5-25.4	14	0	0
25.5-26.4	11	0	0
26.5-27.4	21	0	0
27.5-28.4	16	0	0
28.5-29.4	7	1	14
29.5-30.4	3	2	66
30.5-31.4	5	1	20
31.5-32.4	2	0	0
32.5-33.4	4	2	50
>33.5	1	1	100

Table 4. Number of Eyes with Lacquer Cracks at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Peripheral Retinal Degeneration	% Age
<23.5	8	0	0
23.5-24.4	8	0	0
24.5-25.4	14	0	0
25.5-26.4	11	0	0
26.5-27.4	21	0	0
27.5-28.4	16	0	0
28.5-29.4	7	0	0
29.5-30.4	3	1	33
30.5-31.4	5	1	20
31.5-32.4	2	0	0
32.5-33.4	4	0	0
>33.5	1	1	100

Table 5. Number of Eyes with Peripheral Retinal Degeneration at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Posterior Staphyloma	% Age
<23.5	8	0	0
23.5-24.4	8	0	0
24.5-25.4	14	0	0
25.5-26.4	11	1	9
26.5-27.4	21	0	0
27.5-28.4	16	0	0
28.5-29.4	7	0	0
29.5-30.4	3	0	0
30.5-31.4	5	0	0
31.5-32.4	2	1	50
32.5-33.4	4	0	0
>33.5	1	0	0

Table 6. Number of Eyes with Posterior Staphyloma at Each Axial Diameter

		Crescents	Chorioretinal Atrophy	Fuchs Spot	Lacquer Cracks	Posterior Staphyloma	Peripheral Retinal Degeneration
Crescents	98	-	32/98=32%	13/98=13%	7/98=7%	2/98=2%	3/98=3%
Chorioretinal atrophy	32	32/32=100%	-	13/32=40%	7/32=21%	2/32=6%	3/32=9%
Fuchs spot	13	13/13=100%	13/13=100%	-	7/13=53%	1/13=7%	3/13=23%
Lacquer cracks	7	7/7=100%	7/7=100%	7/7=100%	-	0/7=0%	3/7=42%
Posterior staphyloma	2	2/2=100%	2/2=100%	2/2=100%	0/2=0%	-	0/2=0%

Peripheral retinal degeneration	3	3/3=100%	3/3=100%	3/3=100%	3/3=100%	0/3=0%	-

Table 7. Interrelationship of Myopic Fundus Changes

DISCUSSION

This study demonstrates a strong correlation between increasing axial length of the eye and myopic changes of the fundus. During embryologic development, the formation of both the choroid and sclera is induced by the pigment epithelium. The formation of a sclera deficient in quantity and quality with resultant ectasia may be induced by an abnormal retina. In this way, abiotrophic degeneration of the retina would be independent of the enlargement of the scleral shell. However, there are aspects of this study, which indicate that biomechanical factors are operative to some degree in these fundus changes. The crescent, which is so strongly associated with myopia of itself cannot be considered an abiotrophic entity. It can be seen in emmetropic and even hyperopic eyes. It is usually found in the absence of ocular disease. The crescent being closely associated with increased axial length must be considered the result of a disparity in area between the scleral shell on one hand and lamina vitrea complex on the other.

The frequent onset of atrophy at the edge of the crescent and the high correlation of chorioretinal atrophy with increased axial length, crescent and staphyloma would suggest that at least some element of biomechanics is involved in this disease process. The association of atrophy and crescent is further remarkable. The severity of the chorioretinal degenerative changes are related to crescent type and size. The occurrence of myopic degeneration in a connective-tissue disease such as Marfan's syndrome must also be noted. Although, atrophic changes in myopia must continue to be considered possibly abiotrophic in nature, this study strongly suggests at least some element of biomechanical effect. No conclusion as to the origin of Fuchs' spots or lacquer cracks can be deduced from this material. Although, strongly associated with crescent, these changes could be abiotrophic in nature.

Posterior staphyloma could be the result of a congenitally defective sclera or maybe an abiotrophic effect.

In this cross-sectional study of asymptomatic community-based individuals, we found that more than 3% of subjects had one or more peripheral retinal lesion and 32% of subjects had posterior pole chorioretinal lesion. The commonest retinal lesion noted was pigmentary degeneration followed by white without pressure. Moreover, the prevalence of myopia is dependent on the subjects, ethnic background and therefore results from other studies might not be generalisable to various populations. Our aim is to estimate the prevalence of fundus changes in high axial myopia and their correlation with the axial length of the globe. Despite our study having included a homogeneous community-based population, our study sample might still have some bias due to self-selection of the population.

Our study evaluated the association of posterior pole chorioretinal lesions with axial length. Eyes with chorioretinal lesions at the posterior pole had significantly longer axial length and higher magnitude of myopia compared with those without posterior pole lesions. Around 6% of eyes with axial length >29.5 mm had lacquer crack on fundus examination compared with only 1% of eyes with axial length of <29.5 mm. Higher magnitude of refractive error were also found to be independently associated with presence of posterior pole chorioretinal lesion after adjustment of axial length findings. Posterior staphyloma is known to be associated with development of macular hole retinal detachment and lacquer cracks with choroidal neovascularisation. It is therefore important to educate older highly myopic patients with these lesions to seek ophthalmic care.

Our results also demonstrated strong associations between axial length and various peripheral retinal lesion and posterior pole chorioretinal lesions. 33% of eyes with axial length <30.4 mm compared to 100% of eyes with axial length >33.5 mm were found to have peripheral retinal lesions. This was consistent with previous study by Pierro et al[8] in which eyes with white without pressure, paving stone degeneration and lattice degeneration had significantly greater axial length. As myopia and lattice degeneration were demonstrated to be important risk factors for retinal detachment,[9,10,11] close follow-up of highly myopic patients with lattice degeneration in these patients might be warranted.

In a study done to describe the types and severity of high myopic maculopathy in 604 eyes of 337 Chinese patients, the most common subtype of high myopic maculopathy was lacquer cracks (prevalence 29.1%).[12]

In comparison with the above study, our study showed that the predominant type of high myopic maculopathy was lacquer crack (prevalence 53%).

In a study done to evaluate the prevalence and factors associated with posterior pole and peripheral retinal lesions in Chinese subjects with high myopia, eyes with axial length of >29 mm were more likely to have posterior pole chorioretinal lesion including chorioretinal atrophy and lacquer cracks compared with eyes with axial length of <29 mm.[13] According to our study, eyes with axial length >26.5 mm were more likely to have posterior pole chorioretinal lesions including chorioretinal atrophy (>26.5 mm) and lacquer crack (>28.5 mm) compared with eyes of axial length of <26.5 mm.

Eyes with axial length of >29 mm were more likely to have peripheral retinal lesion compared with those with axial length of <29 mm. According to our study, eyes with axial length >29.5 mm were more likely to have peripheral retinal degeneration compared with those of axial length <29.5 mm.

CONCLUSION

From this study, we have concluded that a steady rise from 75% in the range of average axial length <23.5 mm to 100% in all eyes of average axial length of 23.5 mm and above was seen in eyes with crescent in this study. Chorioretinal atrophy was observed in 32 eyes of axial length >26.5 mm and was found more frequently with increasing axial length. Fuchs spots was seen in 13 eyes out of 39 eyes of axial length >26.5 mm and was seen more frequently with higher axial lengths. Lacquer cracks was seen in seven patients of axial length >28.5 mm. Posterior staphyloma was seen in two patients of axial length >25.5 mm and was less common than Fuchs spots and Lacquer cracks in this study group. A steady rise from 33% in the range of average axial length of 29.5 mm to 100% in all eyes of average axial length of >33.5 mm.

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