Original Research Article

Evaluation of Axial Length Variations and Fundus Changes in Patients with High Myopia Attending A Tertiary Care Hospital

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Abstract

Background: Myopia is defined as the refractive error in which the parallel rays of light coming from infinity are focused in front of the retina when accommodation is at rest. Myopia is the most common visually significant refractive error, with prevalence of nearly 25% for whites and 13% for blacks. **Objective:**To evaluate axial length and fundus changes among patients with high myopia presenting to a tertiary care hospital
Materials and Methods: The present Cross sectional study was conducted in the department of in Ophthalmology in in Sri Siddhartha Medical College from November 2017 to October 2019.A total of 92 study participants/ subjects consisted of patients presenting to the out-patient facility of all units of the Department of Ophthalmology, Sri Siddhartha Medical College Hospital &Research Centre, Tumkur were included in the study. **Results : The** maximum number of patients were between 21 to 25 yrs of age, followed by 26 to 30yrs.It was observed that severity of fundus changes is more in eyes with longer axial length. Crescent is seen in eyes with axial length range of 22.35-33.31mm and Posterior staphyloma in the range of 32.08-33.31mm. It can be seen that the peripheral retinal degenerations were seen in axial lengths ranging from 29.02 to 33.31mm.**Conlcusion:** All eyes with greater axial lengths should undergo a detailed fundus examination for retinal degenerations and their management. Thus, biometry of the eyes using A-scan ultrasonography is a clinically useful tool for assessing the severity of myopia.

Keywords: Axial length, myopia, Fundus changes, Refractive Error

Introduction

The term myopia is derived from Greek words - "Myein", which means close and "Ops", which means eye. It describes the ancient observation that affected individuals habitually approximate their eyelids to form a stenopic slit to improve image quality[1,2].
Myopia is defined as the refractive error in which the parallel rays of light coming from infinity are focused in front of the retina when accommodation is at rest.Myopia is the most common visually significant refractive error, with prevalence of nearly 25% for whites and 13% for blacks. The myopic eye brings the parallel rays of light into focus at a point anterior to the retina. The far point of a myopic eye is between infinity and the anterior surface of the cornea[3].
In myopic eye, second principal focus lies in front of retina because the eye is abnormally long[4].Myopia is the major threat for vision health across the world. It is responsible for around 75% of the refractive error related complications, with serious social and economic consequences[5,6].
Most commonly myopia begins between ages 7-10 yrs. and is bilateral and progressive until late adolescence[7].Myopia is the form of refractive error wherein parallel rays of light come to a focus in front of the sentinel layer of retina, when accommodation is at rest. In Simple myopia this is brought about by variation within normal limits of the optical system, an increased curvature of the cornea or the lens surfaces, shallow anterior chamber, a high refractive effectivity of the lens, or a great axial length of the globe[8].

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Pathological myopia is that type of myopia which is accompanied by degenerative changes occurring particularly in the posterior segment of the 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[9].
It is estimated that over 285 million people in the world have vision impairment and that 42% of this is due to uncorrected refractive errors[10].Published estimates based on epidemiological studies indicate that myopia affects 1.89 billion people worldwide, and, if the current prevalence rates do not change, projections show that it will affect 2.56 billion people by 2020[11].Children at risk for the development of myopia may have an excessively long axial length, but display a similar rate in increase compared with that in children who remain emmetropic. This study has been undertaken to establish a correlation between the axial length and the degree of myopia using A-scan USG, to establish a correlation between degree of myopia, axial length, the degenerative changes and complications of myopia in patients attending the ophthalmology OPD in Sri Siddhartha Medical College among all patients between 6 yrs.- 30 yrs.
Objective: To evaluate axial length and fundus changes among patients with high myopia presenting to a tertiary care hospital
Materials and Methods
The present Cross sectional study was conducted in the department of in Ophthalmology in in Sri Siddhartha Medical College from November 2017 to October 2019.
The study participants/ subjects consisted of patients presenting to the out-patient facility of all units of the Department of Ophthalmology, Sri Siddhartha Medical College Hospital &Research Centre, Tumkur, satisfying the inclusion and exclusion criteria and who willingly sign the informed consent form.

Using the following formula for calculation of sample size for prevalence studies using confidence level of 95% and precision of 5%

$n = [Z^2P(1-P)] / d^2$

Where

n is the sample size,

Z is the Z statistic for level of confidence (1.96),

P= expected prevalence (39.6%) according to a study in rural India[12]

d is the precision (0.09), $n = [1.96^2 \times 0.39 (1-0.39)] / 0.1^2$

we obtained a sample size of **92**.

We studied in a total **184** Myopic eyes of **92** patients.

Inclusion Criteria

All patients visiting to ophthalmology OPD at Sri Siddhartha Medical College and Hospital who are suspected with refractive errors of age group 6-30 yrs.

Exclusion Criteria

All patients attending the ophthalmology OPD at Siddhartha Medical College and Hospital, Tumkur**,** which are:

- With astigmatism
- With hypermetropia.
- With corneal lesions and lens defects.
- With uveitis and infections of the eye.
- Patients not willing to participate in the study.

The patients are screened in the OPD and are selected from 6 years onwards, of either sex and all castes and any occupation. Preliminary examination of visual acuity for distance is determined with snellen's chart. Any pinhole improvement is noted. Cycloplegic refraction &retinoscopy is performed in children. Refraction reading are determined with a retinoscopy in a dark room and subjective correction is given. Retinoscopy readings are done after using a cycloplegic like cyclopentolate (0.5 to 1%) and they are called on next day for post mydriatic refractive correction. All patients are screened for refractive errors. Those patients with myopia are segregated and detailed slit lamp bio-microscopic, and fundus examination with direct and indirect ophthalmoscopy is done.

Data collected is entered and tabulated in MS Excel spread sheet (version 2010). Statistical software Epi Info software version 3.5.3.is used for the same. Mean, standard deviation is calculated.

Results

A total of 184 eyes i.e. a total of 92 patients were studies and analyzed.

Table 1: Social Profile of the study subjects

		Frequency	Percentage
Age Group	6 to 10 Years	1	1.1
	11 to 15 Years	4	4.3
	16 to 20 Years	16	17.4
	21 to 25 Years	37	40.2
	26 to 30 Years	34	37.0
Gender	Male	48	52.2
	Female	44	47.8

From the above table we have found that maximum number of patients were between 21 to 25 yrs of age, followed by 26 to 30 yrs..It is found that Myopia is more common in Male (52.2%) than Female (47.8%) out of the total 92 cases.

Table 2: Distribution of Myopic Eye Examinations findings

		Frequency	Percentage
Degree of Myopia	-6 D to -9.5 D	129	70.1
	-10 D to -13.5 D	45	24.5
	-14 D to -17.5 D	8	4.3
	>= -18 D	2	1.1
Myopic Fundus Changes	Crescent	178	96.7
	Chorioretinal Atrophy	96	52.2
	Fuchs Spots	43	23.4
	Lacquer Cracks	20	10.9
	Peripheral Retinal Degeneration	12	6.5
	Posterior Staphyloma	3	1.6
Peripheral Retinal Degeneration	Lattice Degeneration	11	6
	Pigmentary Changes	9	4.9
	White with Pressure	4	2.2
	Retinal Detachment	7	3.8

The above table shows that -6 to -9.5D constituted the largest number of myopic eyes examined, that is 70.1% followed by -10 to -13.5 D (24.5%) out of the total 184 myopic eyes which were examined. The most common fundus changes seen in myopic eyes was myopic crescent (96.7%) followed by Chorioretinal atrophy which was observed in 52.2% of myopic eyes. 23.4% of myopic eyes showed Fuchs spots, 10.9% showed Lacquer cracks, 6.5% showed peripheral retinal degenerations and 1.6% showed Posterior staphyloma.

The most common peripheral retinal degeneration was lattice degeneration (6%) of the 184 myopic eyes followed by pigmentary degeneration (4.9%), Retinal detachment (3.8%) and white with pressure (2.2%).

Table 3: Correlation between axial lengths, VA & degrees of myopia

Degree	Axial Length	Range of Axial Length	Range of VA
-6 D to -9.5 D	24.98 +0.92	22.35-27.02	6/36 to CF at 0.5 meter
-10 D to -13.5 D	27.77+1.35	25.34-30.72	6/36 to PL Positive
-14 D to -17.5 D	29.99 + 2.01	27.62-33.31	CF at 0.5 meter to PL Positive
>= -18 D	31.31+ 1.09	30.53-32.08	CF to PL Positive

From the above table it was observed that mean axial length increases as the degree of myopia increases. It was least (24.98±0.92) in the patients who had myopia of -6 to -9.5D and highest (31.31 ±1.09) in patients having myopia of > -18 D. A wide range of axial lengths are seen ranging from 22.35mm to 32.08mm.

From the above table, it was observed that as the degree of myopia is increased, there is increase in the axial length and vision is reduced as done on snellen's chart readings. For myopia of -6 to -9.5D, range of visual acuity was found to be 6/36 to CF at ½ mtr, and when myopia was ≥-18D, vision was CF to PL +ve.

Table 4: Myopic Fundus Changes, Retinal Degeneration and AXL

	Myopic Fundus Changes	Mean axial Length	Range
Myopic Fundus Changes	Crescent	26.01 + 1.90	22.35-33.31
	Chorioretinal Atrophy	27.25 + 1.75	25.00-33.31
	Fuchs Spots	28.61 + 1.63	25.50-33.31
	Lacquer Cracks	29.98 + 1.34	28.24-33.31
	Peripheral Retinal Degeneration	30.57 + 1.34	29.02-33.31
	Posterior Staphyloma	32.58 + 0.64	32.08-33.31
Peripheral Retinal Degeneration	Lattice Degeneration	30.61 + 1.41	29.02-33.31
	Pigmentary Changes	30.49 + 1.11	29.02-32.36
	White with Pressure	31.23 + 1.86	29.03-33.31
	Retinal Detachment	30.42 + 1.35	29.02-32.36

It was observed that severity of fundus changes is more in eyes with longer axial length. Crescent is seen in eyes with axial length range of 22.35-33.31mm and Posterior staphyloma in the range of 32.08-33.31mm. It can be seen that the peripheral retinal degenerations were seen in axial lengths ranging from 29.02 to 33.31mm. Lattice degenerations in mean axial length of 30.61±1.41mm, Pigmentary degenerations in 30.49±1.11mm, White with pressure was seen in 31.23±1.86 mm of mean axial length and retinal detachment was seen in mean axial length of 30.42±1.35mm.

Discussion

Myopia is a common refractive error affecting all age groups either sex. Axial myopia is seen in majority of cases that is due to increase in the antero-posterior diameter of the eye.We found that the myopia is more common in male (52.2%) than female (47.8%). Prema R et.al in their study reported that Women have shorter axial length than men,which could explain the increased prevalence of hyperopia among women and myopia in males[12].In our study, the majority of patients (70.1%) had myopia of -6 to -9.5D. This was followed by patients with myopia of -10 to -13.5D in 24.5% patients and myopia of -14 to -17.5D in remaining (4.3%) patients. Very few patients (1.1%) had myopia ≥ -18 D.We found that mean axial length increases as the degree of myopia increases. It was least (24.98±0.92) in the patients who had myopia of -6 to -9.5D and highest (31.31±1.09) in patients having myopia of ≥-18D. Keller JT in his study published that axial length is the largest determinant of refractive error[13].Lik T L et.al in their study concluded that, the longer the axial length, severe the myopia[14].Pathological myopia usually refers to a condition where there is greater than six diopters of myopia or an axial length greater than 26-27 mm[15]. It is a progressive disorder where serious ocular complications can develop such as chorioretinal degeneration, posterior staphyloma, retinal detachment, primary open angle glaucoma and posterior sub capsular and nuclear cataract[16].In our study, myopic Crescent was seen in 96.7% eyes with mean axial length of 26.01±1.90mm (22.35–33.31mm). A high prevalence crescents were reported in myopic adolescents by Samarawickrama et al., who found crescent in 92% of eyes with myopia[17].CarylSiu-Yin Lam study, the incidence of crescent formation was significantly associated with increasing axial length and myopia[18].Peripheral retinal degenerations in 6.5% eyes with mean axial length of 30.57±1.34mm (29.02-33.31mm). L. Pierro in his study have shown an association between increased axial length and the severity of myopia with peripheral retinal degeneration[19]. Epidemiological studies done by Jamali P have demonstrated increased prevalence of peripheral retinal degenerations in association with high myopia and increased axial length [20]. In our study we found Chorioretinal atrophy in 52.2% eyes with mean axial length of 27.25±1.75mm (25.00-33.31mm); Lacquer cracks in 10.9% eyes with mean axial length of 29.98±1.34mm (28.24-33.31mm); White with pressure (WWP) is seen in 2.2% of eyes with mean axial length of 31.23±1.86mm (29.03-33.31mm) Posterior Staphyloma in 1.6% eyes with mean axial length of 32.58±0.64mm (32.08-33.31mm). Hyams SW and Neumann E in their study reported that individuals with high myopia have increased risks of retinal complications such as WWP, retinal tears, retinal detachment, posterior staphyloma, chorioretinal atrophy, retinal pigment epithelial atrophy, lacquer cracks[21].The major threat to vision in the myopic eye is retinal detachment, especially as posterior vitreous detachment (PVD) and predisposing retinal degenerations, such as lattice degeneration, are more common in these eyes.In our study, among peripheral retinal degenerations, lattice degeneration (LD) was seen in 6.0% of participants with mean axial length of 30.61±1.41mm (29.02 - 33.31mm). Karlin and Curtin study showed an increased prevalence of lattice degeneration with increased axial length in adult myopic eyes with an overall incidence of 6.1%[22].Pierro et al and Lai et alin their study also found lattice degeneration in 13.2% and 13.6% of eyes respectively in eyes with an axial length greater than 24 mm[19].Pigmentary degeneration, consisting of extensive pigment deposition in the extreme retinal periphery, and the non-predisposing paving stone degeneration (yellow white areas of chorioretinal thinning) are also more common in myopic eyes. The pigment proliferation and RPE migration of pigmentary degeneration may be due to retinal traction, while the chorioretinal thinning in paving stone degeneration may be due to localized occlusion of the choroidal circulation[23].In our study we found Pigmentary degeneration (PD) in 4.9% of eyes with a mean axial length of 30.49±1.11 mm (29.02-32.36mm). Jamali P et.al., in their study, reported retinal pigmentary degenerative changes due to excessive axial elongation of the globe in high myopia causing mechanical stretching and thinning of the choroid and retinal pigment epithelium layers[20].It has been estimated that potentially up to 80% of eyes suffering retinal detachment have some degree of myopia. Also, a person with five diopters of myopia is at a 15 times greater risk of developing retinal detachment than an emmetrope. With 20 dioptres of myopia, the risk increases to 110 times.There are also reports of retinal detachments in myopes following clear lens extraction procedures used to retroactively correct the myopia [25].Myopic degeneration is a significant cause of visual impairment worldwide. In the Rotterdam study of 6775 subjects aged 55 years and above, myopic degeneration was the predominant cause of impaired vision (accounting for 23.0% in adults younger than 75 years)[26,27].In our study Retinal Detachment is seen in 3.8% of eyes with a mean axial length of 30.42±1.35mm (29.02-32.36mm). Lewis H in his study reported that among the different types of PRD in high myopia, lattice degeneration is the most important which can predispose to rhegmatogenous retinal detachment (RRD)[28].This is because retinal tears can develop at posterior and lateral margins of

the lattice degeneration caused by strong vitreoretinal adhesions following posterior vitreous detachment.

Conclusion

Excessive axial elongation of eye ball in high myopia can cause mechanical stretching and thinning of the choroid and retinal pigment epithelium layers, resulting in various retinal degenerative changes. It is well known that individuals with high myopia have increased risks of retinal complications such as peripheral retinal degenerations, retinal tears, retinal detachment, posterior staphyloma, chorioretinal atrophy, retinal pigment epithelial atrophy, lacquer cracks and other changes. Some of these retinal lesions may be associated with severe irreversible visual loss and therefore it is important for clinicians to be aware of the retinal pathologies in high myopia. The findings of our study are in the line with published literature.Ultrasonography replaced the traditional methods like computational methods and radiologic methods because accurate measurement of axial lengths without any harmful effects on the ocular structure. As the radiologic method had a drawback of harmful effects on the ocular tissue. Thus the A-scan biometry is the method of choice in the measurement of axial lengths.All eyes with greater axial lengths should undergo a detailed fundus examination for retinal degenerations and their management. Thus, biometry of the eyes using A-scan ultrasonography is a clinically useful tool for assessing the severity of myopia.

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