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Evaluation of Fundus Changes in High Myopia and their Correlation with the Axial Length of the Globe

Ramya Krishna T G[1], Purva Agarwal[2], Aravind. J[3]

3rd Year Postgraduate in Department of Ophthalmology

Abstract: ***Myopia is prevalent in 15%-33% of general population. The varying degrees of human disability and suffering caused by myopia exact a very real economic cost not only in terms of support required by the blind and visually handicapped, but also in the cost of optical corrections and other medical or surgical corrections. To evaluate the fundus changes in high myopia in correlation with the axial length of globe. Methods: 100 eyes of the 50 patients with myopia more than -6D attending the outpatient department of Ophthalmology at santhiram medical college and general hospital,nandyal. Keratometry was done to measure corneal curvature using Bausch and Lomb keratometer. Ultrasound biometry was 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. A) 12 patients had unilateral high myopia. B) 1 patient had unilateral functioning eye. C) 38 patients had bilateral myopia. Interpretation and conclusion: 1) A steady rise from 75% in the range of average axial length <23.5mm to 100% in all eyes of average axial length of 23.5mm and above was seen in eyes with crescent in this study. 2) Chorioretinal atrophy was observed in 32 eyes of axial length >26.5mm and was found more frequently with increasing axial length. 3) Fuchs spots was seen in 13 eyes out of 39 eyes of axial length >26.5mm and was seen more frequently with higher axial lengths. 4) Lacquer cracks was seen in 7 patients of axial length >28.5mm. 5) Posterior Staphyloma was seen in 2 patients of axial length >25.5mm and was less common than Fuchs spots and Lacquer cracks in this study group. 6) A steady rise from 33% in the range of average axial length of 29.5mm to 100% in all eyes of average axial length of >33.5m. A substantial proportion of asymptomatic highly myopic subjects in this community-based study were found to have peripheral retinal degenerative as well as posterior pole chorioretinal lesions. As previous studies in highly myopic eyes have demonstrated these degenerative lesions might be associated with serious vision threatening complications, highly myopic patients should be educated about the symptoms of retinal complications such as retinal detachment and choroidal neovascularisation, and advised to seek ophthalmic care promptly should such symptoms arise.***

Keywords: myopic crescent, chorioretinal atrophy, fuchs spots, lacquer cracks, posterior staphyloma

1. Introduction

The term myopia is derived from two Greek roots - “Myein” , which means close and “Ops”, which means eye. 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 be have high myopia.

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

In myopic eye, the second principal focus lies infront of the retina because the eye is abnormally long.[1]

Most commonly myopia begins between ages 7-10 and is bilateral and progressive until late adolescence.[2]

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.[3]

The pathological changes can be grouped as follows:

A) Changes in the vitreous
B) Changes in the optic nerve head
C) Disseminated changes in the fundus
D) Changes at the macula
E) Changes at the periphery
F) 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.

2. Objectives of the Study

1) To evaluate the fundus changes in high axial myopia
2) To correlate these fundus changes with the axial length of the globe
3) To interrelate these fundus changes with each other out of all cases examine

3. Methodology

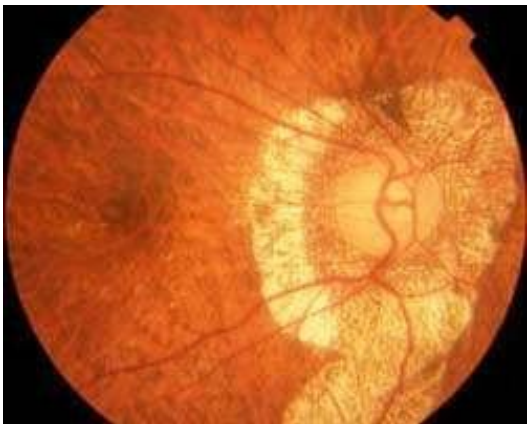
The materials for the present study were taken from patients attending the out patient department of Ophthalmology santhiram medical college and general hospital, nandyal during a study period of August 2018-July 2019. All cases were subjected to a detailed history such as age of onset, progression, duration of use of refractive correction and any other ocular complaints.

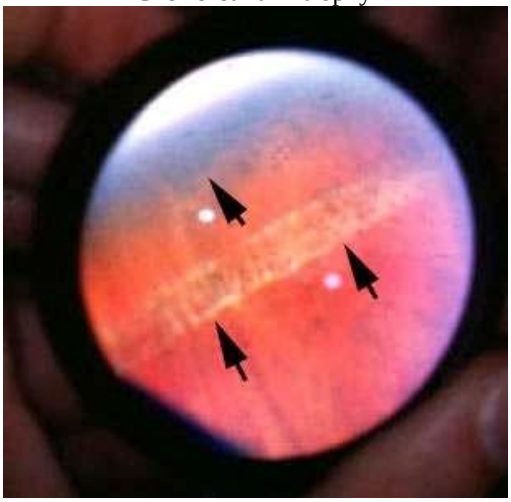
Ocular examination included:
- Vision (unaided)
- Improvement with pinhole
- Best corrected vision (Retinoscopy + subjective correction)
- Anterior segment examination
- Axial length measurements
- Keratometry
- Fundus examination
- Direct ophthalmoscope
- Indirect ophthalmoscope
- Slit Lamp biomicroscope

The findings documented using
- Fundus Camera Photography
- IOP

Inclusion Criteria
- All OPD patients having myopia which is confirmed by visual acuity and refraction were included.
- Any similar condition prevalent amongst parents and siblings of the patients were enquired.

Exclusion Criteria
- Patients having media opacities that prevented direct ophthalmoscopic examination were excluded.
- Patients having curvature myopia were excluded.
- Patients who are not available for follow up for a required period of time


Chorioretinal Atrophy


Lattice Degeneration


Keratometer – Bausch and Lomb


Biomedix A-scan

4. Results

There were 100 eyes examined in this manner.
- 12 patients had unilateral high myopia.
- 1 patient had unilateral functioning eye.
- 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) Chorio-retinal atrophy
3) Forster- Fuchs Spot
4) Lacquer cracks
5) Posterior staphyloma
6) Peripheral Retinal Degeneration

The results have been arranged into 2 parts
Part 1: Incidence and characteristics of myopic fundus changes
Part 2: Interrelationship of myopic fundus changes.

Part 1: Incidence and Characteristics of Myopic Fundus Changes

Table 1: Number of Eyes with Chorio Retinal Atrophy at each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Chorio Retinal Atrophy	Percentage (%)
<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

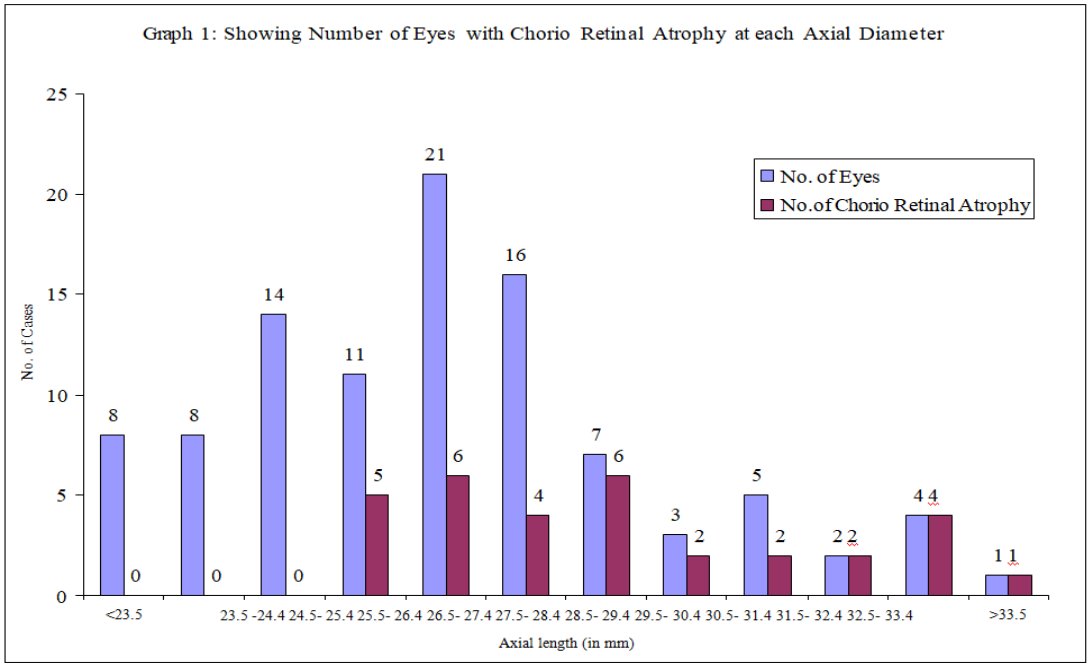


Table 2: Number of eyes with Crescents at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Crescents	Percentage (%)
<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

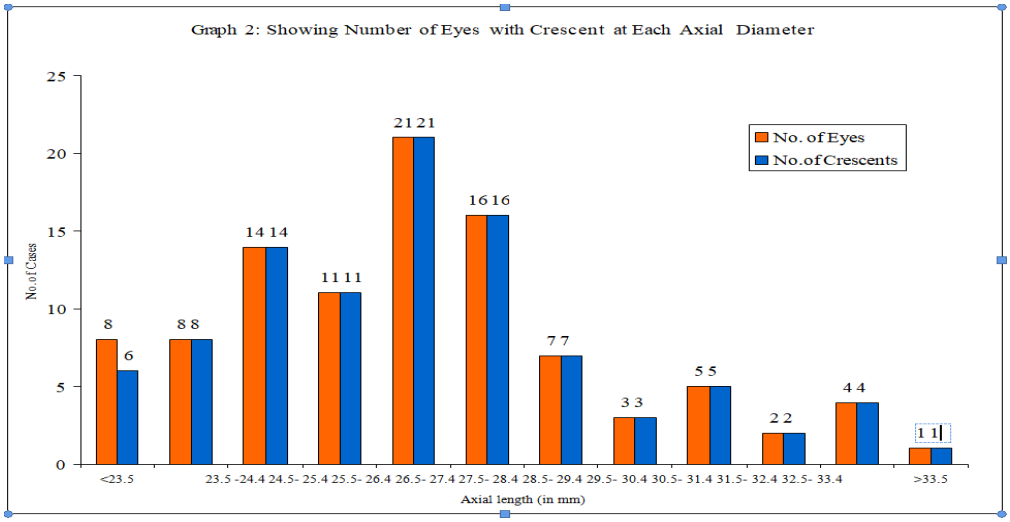


Table 3: Number of eyes with Fuch's Spot at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Fuch's Spot	Percentage (%)
<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

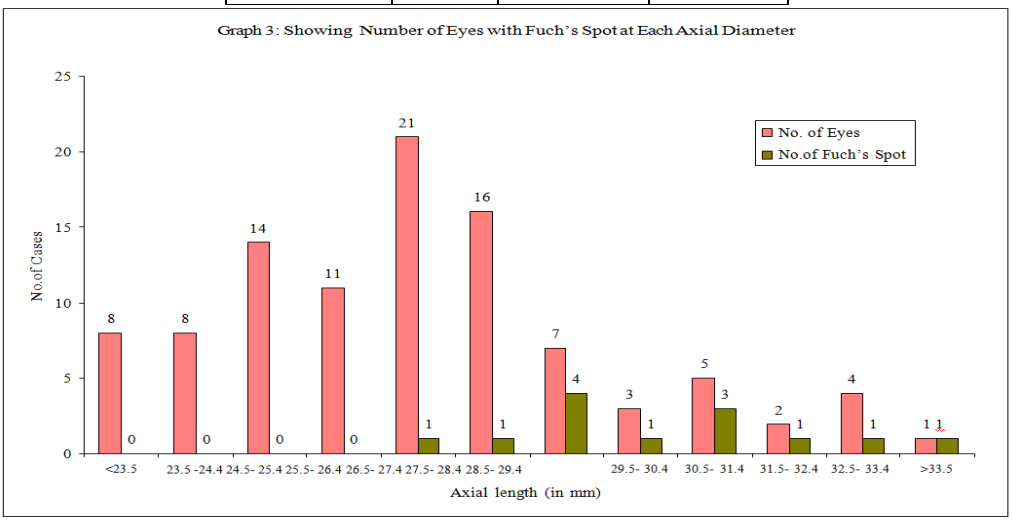


Table 4: Number of eyes with Lacquer cracks at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Lacquer cracks	Percentage (%)
<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

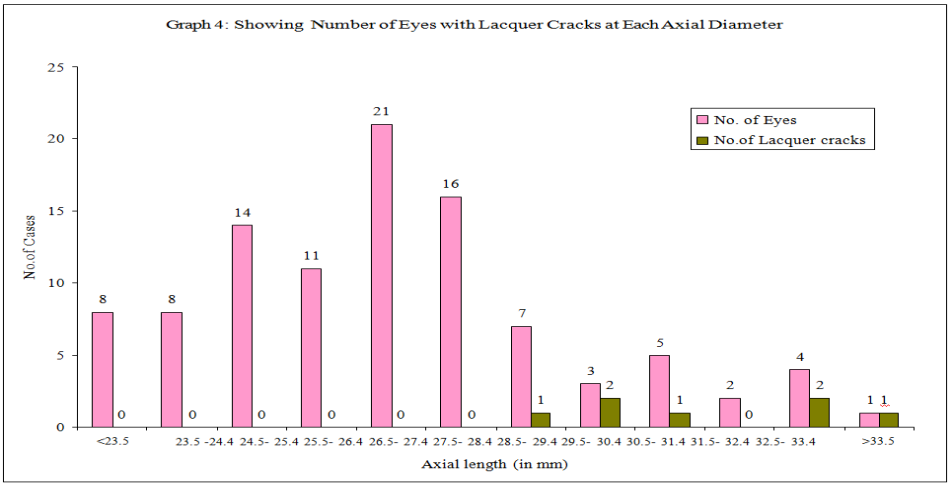


Table 5: Number of eyes with Peripheral Retinal Degeneration at Each Axial Diameter

Axial Length Range (mm)	Number of Eyes	Number of Peripheral Retinal Degeneration	Percentage (%)
<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

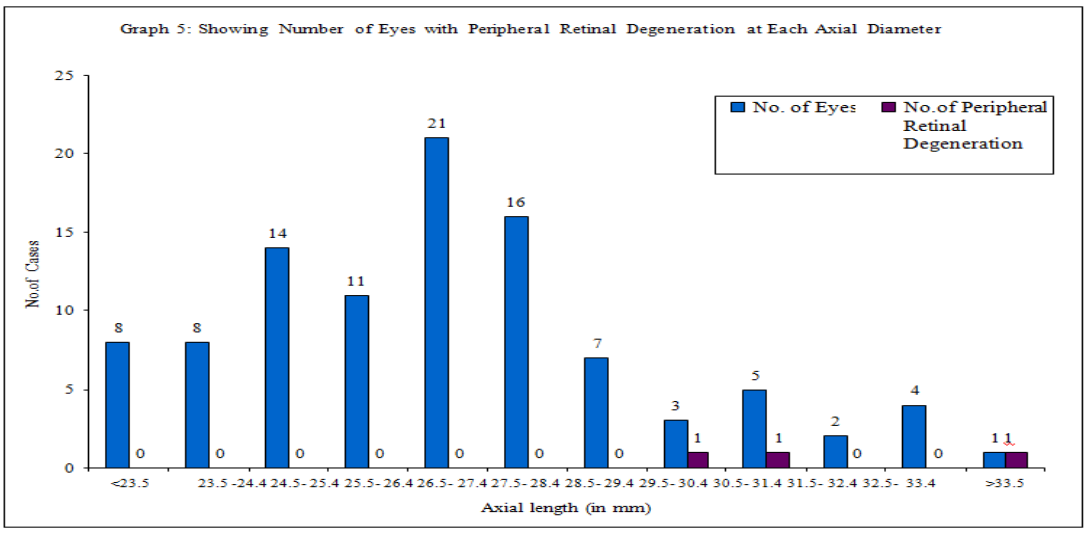
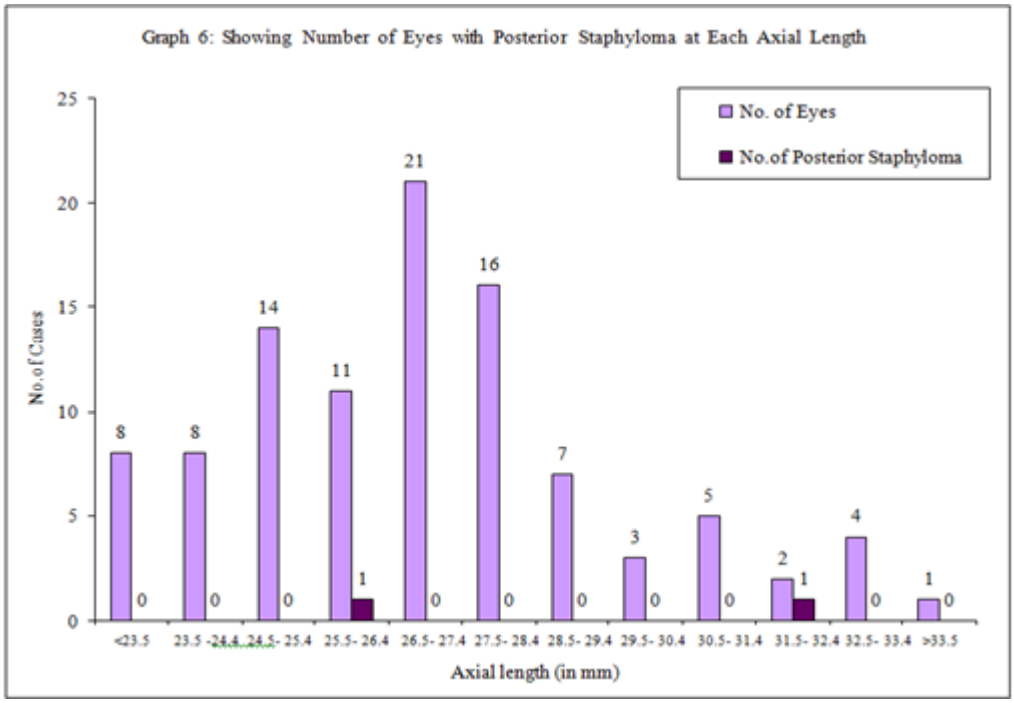


Table 6: Number of eyes with Posterior Staphyloma at Each Axial Length

Axial Length Range (mm)	Number of Eyes	Number of Posterior Staphyloma	Percentage (%)
<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



Part 2: Interrelationship of Myopic Fundus Changes

Table 7: Inter Relationship of Myopic Fundus Changes

		Crescents	Chorio Retinal Atrophy	Fuch's 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%
Chorio Retinal Atrophy	32	32/32=100%	13/13=100%	13/32=40%	7/32=21%	2/32=21%	3/32=9%
Fuch's Spot	13	13/13=100%	7/7=100%	-	7/13=53%	1/13=7%	2/13=23%
Lacquer Cracks	7	7/7=100%	2/2=100%	7/7=100%	-	0/7=0%	3/7=42%
Posterior Staphyloma	2	2/2=100%	3/3=100%	1/2=100%	0/2=0%	-	0/2=0%
Peripheral Retinal Degeneration	3	3/3=100%		3/3=100%	3/3=100%	0/3=0%	-

5. Discussion

Although this study demonstrates a strong correlation between increasing axial length of the eye and at least three myopic changes of the fundus, it does not rule out the possibility of another common correlating factor. Such a factor could be a derangement of the retinal pigment epithelium. An abnormal retina may induce the formation of a sclera deficient in quantity, quality, or both with resultant ectasia under the stress of normal intraocular pressure. In this way abiotrophic degeneration of the retina could ensue 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 and 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 the lamina vitrea complex on the other.

The association of atrophy and crescent is further remarkable in that the incidence and severity of the chorioretinal degenerative changes are related to crescent type and size. In addition, the occurrence of myopic degeneration in a connective-tissue disease such as Marfan's syndrome must also be noted.

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. By studying a community-based sample of subjects, we aimed to estimate the prevalence of retinal abnormalities in association with high myopia as well as determining the association between retinal lesions with axial length and high myopia. This will minimise the bias associated with some of the previous clinic-based studies. Despite our study having included a homogeneous population of NANDYAL Indians, 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 of >29.5mm had lacquer crack

on fundus examination, compared with only 1% of eyes with axial length of <29.5mm. Higher magnitude of refractive error was also found to be independently associated with the presence of posterior pole chorioretinal lesions after adjustment of axial length findings. Posterior staphyloma and lacquer cracks are known to be associated with the development of macular hole retinal detachment and choroidal neovascularisation, respectively, it is therefore important to inform older patients with these posterior pole lesions to seek ophthalmic care as soon as new symptoms arise.

Our results also demonstrated there were strong associations between axial length and various peripheral retinal lesion and posterior pole chorioretinal lesions. 33% of eyes with axial length of <30.4mm compared to 100% of eyes with axial length of >33.5mm were found to have peripheral retinal lesions. This was consistent with previous study by Pierroet al[4] 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,[5,6,7] close follow-up of highly myopic patients with lattice degeneration in these patients might be warranted.

6. Conclusion

1) A steady rise from 75% in the range of average axial length <23.5mm to 100% in all eyes of average axial length of 23.5mm and above was seen in eyes with crescent in this study.
2) Chorioretinal atrophy was observed in 32 eyes of axial length >26.5mm and was found more frequently with increasing axial length.
3) Fuchs spots was seen in 13 eyes out of 39 eyes of axial length >26.5mm and was seen more frequently with higher axial lengths.
4) Lacquer cracks was seen in 7 patients of axial length >28.5mm.
5) Posterior Staphyloma was seen in 2 patients of axial length >25.5mm and was less common than Fuchs spots and Lacquer cracks in this study group.
6) A steady rise from 33% in the range of average axial length of 29.5mm to 100% in all eyes of average axial length of >33.5mm.

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Author Profile

Dr. T G Ramya Krishna, 3rd year postgraduate Ophthalmology, Santiram Medical College and General Hospital, Nandyal. Born and brought up in Tirupathi

Dr. Purva Agarwal, 3rd year postgraduate, Ophthalmology, Santiram Medical College and General Hospital, Nandyal. Born and brought up in Hyderabad

Dr. Jonnadulu Aravind, 3rd year postgraduate ophthalmology, Santhiram Medical College and General Hospital, Nandyal. Born and brought up in Rajampeta