

High Myopia: A Hospital-Based Study of The Clinical Profile and Visual Impairment

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Introduction: High axial myopia is an increasingly common refractive error leading to retinal degeneration and visual impairment.

Objective: To study the clinical profile and visual impairment in high myopia presenting to a teaching hospital.

Material and methods: This study was a descriptive observational study of high myopia and included unilateral, and bilateral cases of all age groups. The study was conducted after ethical clearance and a written informed consent. Clinical history, best corrected visual acuity, ocular fundus findings, axial length and refraction were determined. The results were analyzed using descriptive statistics, and chi square test.

Results: The mean age in high myopia was 36.28 ± 15.46 years and was significantly higher in males than females ($p=0.006828$). There was no significant difference in the age and gender distribution of unilateral (10.66%) and bilateral high myopia (89.33%). 76.05% of the eyes had SE between 6-12 D of which, 9 eyes were corrected to <6D of myopia following cataract surgery. The mean SE was $-9.57 \pm 4.4D$; the mean axial length was 27.39 ± 1.62 mm and the distribution of SE and axial length in males and females was statistically comparable. The most common fundus finding was temporal or annular crescent (73.94%) followed by tessellated fundus (41.54%). Severe visual impairment was seen in 14.78% and blindness was seen in 14.08% of the eyes and the distribution did not increase with increasing age ($p=0.1350$), but were significantly more in males than females ($p=0.0110$) and in eyes with myopic maculopathy than those without ($p < 0.00001$). The most common cause of blindness was myopic maculopathy (25.35%) comprising chorioretinal atrophy at the macula (12.69%), posterior staphyloma (11.79%) and choroidal neovascular membrane (6.33%) and was significantly more in eyes with longer axial lengths ($p < 0.00001$). Other causes of visual impairment included posterior sub-capsular cataract (19.01%), glaucomatous cupping (11.7%), optic disc pallor (2.8%), retinitis pigmentosa (1.4%). Lattice and other peripheral retinal degenerations were seen in 15.48% cases.

Conclusion: High myopia causes significant visual impairment affecting 28.87% of the eyes. The most common cause being myopic maculopathy. The visual impairment tends to be more with longer axial lengths, higher SE, and in males more than females.

Abstract

Delhi J Ophthalmol 2020;31:30-35; Doi <http://dx.doi.org/10.7869/djo.587>

Keywords: High Myopia, Blindness, Visual Impairment, Myopic Maculopathy, Posterior Staphyloma

Introduction

Myopia is a common cause of visual impairment. The worldwide prevalence of myopia threatens to double by the year 2050 from the current 22.9%.¹ Myopia is considered an epidemic in the Asian countries owing to the significantly high prevalence.²

High myopia is associated with an elongated eye and its definition varies in different studies. Whereas, high myopia is defined as axial length more than 26.5 mm or when the myopia is more than 8D, the joint report of the WHO on "the impact of myopia and high myopia" defines high myopia as spherical equivalent where the amount of myopia is more than 5D.^{3,4}

High myopia is associated with progressive retinal degeneration and visual impairment. Degenerative myopia accounts for nearly one third of low vision cases in an Asian study.⁵ Myopic retinopathy refers to a spectrum of changes ranging from tessellated fundus, diffuse or patchy chorioretinal atrophy and macular atrophy based on the International META-PM classification.⁶ It affects 0.2% of the general population in Central India and is associated with longer axial lengths and lower best corrected visual acuity.⁷ Vision threatening complications of myopia include choroidal neovascularization, traction myopathy,

macular degeneration, posterior staphyloma and myopic glaucomatous optic neuropathy.⁸

Etiology of myopia is multifactorial. It has been linked to 39 genetic loci in a Genome-wide association study.⁹ Genetically predisposed children tend to have early onset and faster progression of myopia.¹⁰ Environmental factors like continuous reading, close television viewing, use of fluorescent light have been found to be significant associations.¹¹ Myopia is also known to be linked to nutritional factors like vitamin D.¹²

Myopia influences quality of life. Myopia is associated with poor quality of sleep, depression and great loss of potential productivity due to visual impairment.^{13,14,15} Although optical correction in the form of spectacles or contact lenses and refractive surgeries provide optimal visual correction and medical measures like low dose Atropine are predicted to reduce the progression of myopia, they do not modify or reverse the degenerative changes and complications of pathological myopia.¹⁶

In view of the high and increasing prevalence of high myopia in Asia, its multifactorial etiologies, irreversible progressive degenerations, complications, visual impairment and health burden, this study was designed to understand the clinical profile and visual impairment in high myopia presenting to

the teaching hospital in South India. This is essential in order to plan strategies to minimize the health burden among myopic population.

The objectives were to study the clinical profile and visual impairment in eyes with high myopia presenting to a teaching hospital in south India.

Material And Methods

A cross-sectional observational study of high myopia conducted in the Ophthalmology out-patient department of the teaching hospital in a coastal town of south India over a period of one year from March 2015-16 after getting approval from the Institutional Ethics Committee. The Indian Council of Medical Research’s ethical guidelines and the Declaration of Helsinki were followed. Participants were included after taking written informed consent.

High myopia was defined as myopia more than 6D Spherical Equivalent and/or an axial length of more than 26 mm. Inclusion criteria included unilateral or bilateral high myopia with media clear enough for detailed fundus examination. Exclusion criteria were grade 3 or more nuclear cataracts likely to induce index myopia and average keratometric value >46 D likely to cause curvature myopia. The sample size was calculated to be 75 with a 5% prevalence of high myopia in this hospital, a confidence interval of 95% and allowable error of 5%.

The following data was collected: Clinical history with reference to myopia, best corrected visual acuity (BCVA), the spherical equivalent (SE), axial length (AXL),

keratometry reading (average of vertical and horizontal), ophthalmoscopy for myopic retinopathy and peripheral retinal degenerations. Myopic retinopathy was defined as the presence of staphyloma, lacquer cracks, Fuchs' spot or chorioretinal atrophy at the posterior pole.

Results

1. Demographics: 75 participants were enrolled (39 males and 36 females with a ratio of 1.08:1). There was no statistically significant difference in the distribution of high myopia in the different age groups ($\chi^2 = 5.7331$; $p= 0.056894$). The mean age was 36.28 ± 15.46 years and the males (40.98 ± 16.986 years) were older than the females (31.44 ± 12.961 years) with a statistically significant difference ($t\text{-value} = -2.78428$; $p=0.006828$).

67 (89.33%) cases were bilateral and 8 (10.66%) were unilateral. There was no significant difference in bilateral and unilateral cases gender-wise ($\chi^2 = 1.898$, $p=0.168$) and age-wise ($\chi^2 = 3.468$, $p= 0.176$). The distribution of high myopia is given in table 1.

Parental myopia was reported in 10 (13.33%) (one parent: 7 and both patents: 3) and did not differ among unilateral (12.5%) and bilateral cases (13.43%). Most wore spectacle correction, only 6 (8%) wore contact lenses.

2. High myopia: The highest power of high myopia among was -24D in males and -20.75 in females, with the mean myopia of $-9.507 D \pm 4.40$ (Males: $-10.25 D \pm 5.3$; Females $-8.9 D \pm 3.5$). The gender-wise distribution of high myopia into

Table 1: Age and gender-wise distribution of cases of high myopia

Age (years)	Males			Females			Grand total
	Uni Lateral	Bi Lateral	Total	Unilateral	Bi Lateral	Total	
<20	0	2	2	0	7	7	9
21-40	1	14	15	1	16	17	32
> 40	5	17	22	1	11	12	34
Total	6 15.39%	33 (84.61%)	39	2 (5.36%)	34 (94.44%)	36	75

Table 2: Distribution of visual impairment and high myopia

		Normal (6/6 to < 6/12)	Mild VI (6/12 to 6/18)	Moderate VI (<6/18 to 6/60)	No. of eyes with severe VI (<6/60 to 3/60)	No of eyes with blindness (<3/60)	Sub-Total	Total
SE<6D (corrected)	Males	2	0	2	0	2	6	9 (6.33%)
	Females	2	0	1	0	0	3	
SE 6 to <12D	Males	4	13	19	9	6	51	108 (76.05%)
	Females	19	10	19	7	2	57	
SE 12 to <18D	Males	0	0	1	0	4	5	12 (8.45%)
	Females	1	1	1	3	1	7	
SE 18D or more	Males	0	2	2	2	4	10	13 (9.15%)
	Females	1	1	0	0	1	3	
Total		29 (20.42%)	27 (19.01%)	45 (31.69%)	21 (14.78%)	20 (14.08%)		142

sub-groups is shown in table 2 and showed no statistically significant difference ($\chi^2= 4.0199, p= 0.2593$). The average axial length was 27.39 ± 1.62 mm, ranging from 26 mm to 32.29 mm. There was no statistically significant difference in the average axial length among males (27.7 ± 1.48 mm) and females (27.05 ± 0.89 mm) [$\chi^2= 5.76, p= 0.056$].

3. Visual impairment: Visual impairment and blindness as defined by ICD classification was more in males than in females and this difference was statistically significant ($\chi^2= 11.1335, p=0.0110$).¹⁷ The mean age in the sub-groups with normal vision, mild, moderate and severe visual impairment and blindness were 32.31, 36.40, 34.24, 40.42 and 42.1 years respectively, indicating that visual impairment increased with increasing age but the difference was not statistically significant ($p=0.135084$). The distribution of visual impairment and high axial myopia is detailed in (Table 2.) The 9 cases of high myopia which had SE < 6D included 8 pseudophakic eyes and 1 aphakic eye and were included on the basis of axial length being more than 26 mm. 103 eyes (72.53%) had clear lens, 3 (2.1%) had grade 1-2 nuclear sclerosis and 27 (19.01%) had posterior subcapsular cataract.

4. Posterior segment lesions: The common disc-related changes were peripapillary crescent, glaucomatous cupping, disc pallor, tilted disc and peripapillary atrophy. The macular changes included macular atrophy, posterior staphyloma and choroidal neovascular membrane or scar. Diffuse changes included tessellation of the fundus,

retinitis pigmentosa and reattached retinal detachment. The peripheral retinal changes included lattice degeneration, pavingstone degeneration, white without pressure and retinal break.

The distribution of these lesions in different degrees of high myopia and visual impairment are presented in tables 3 and 4, respectively. Most of the lesions in the posterior segment were more common in higher degrees of myopia but the difference in the distribution of each lesion cannot be statistically established.

5. Causes of visual impairment: In eyes with blindness, myopic maculopathy was the most plausible etiology of which chorioretinal atrophy affecting the macula was the most common, followed by posterior staphyloma and choroidal neovascular membrane/scar. Myopic maculopathy was seen in 25.35% of the eyes and was found to affect the males more than the females with a statistically significant difference ($\chi^2= 11.38; p=0.000739$). Myopic Maculopathy was also found to be significantly associated with the longer axial lengths ($\chi^2= 40.6466; P= <0.00001$). Visual impairment was also significantly more in myopic maculopathy than in eyes with no myopic maculopathy ($\chi^2= 39.41; p= <0.00001$). In 19% of the eyes, posterior subcapsular cataract was present and could be the attributable for visual impairment. This was followed by glaucoma, and one case each of retinitis pigmentosa and operated rhegmatogenous retinal detachment.

Table 3: Distribution of posterior segment findings with degrees of high myopia

	Corrected myopia (PCIOL/ Aphakia) (n=9)	6 to <12 D (n=108)	12 to <18 D (n=12)	18 and More (n=13)	Total number of eyes with the lesion (n=142)
Disc related changes					
Temporal or annular crescent	6 (66.66)	79 (73.14)	8 (66.67)	12 (92.3)	105 (73.94)
Glaucomatous cupping	1 (11.11)	6 (5.55)	2 (16.66)	2 (15.38)	11 (7.74)
Tilted disc	1 (11.11)	2 (2.3)	0	2 (15.38)	5 (3.52)
Optic disc pallor	0	3 (2.77)	1 (8.3)	0	4 (2.81)
Peri-papillary atrophy	1 (11.11)	2 (2.3)	1 (8.3)	0	4 (2.81)
Macular changes					
Chorioretinal atrophy-macula	1 (11.11)	6 (5.55)	3 (25)	8 (61.53)	18 (12.69)
Posterior staphyloma	2 (22.22)	7 (6.4)	2 (16.66)	6 (46.14)	17 (11.79)
CNVM/ Fuchs spot	1 (11.11)	5 (4.6)	1 (8.3)	2 (15.38)	9 (6.33)
Peripheral retinal changes					
Lattice degeneration	2 (22.22)	6 (5.55)	1 (8.3)	2 (15.38)	11 (7.74)
Other peripheral retinal degenerations	1 (11.11)	4 (3.7)	1 (8.3)	3 (23.07)	9 (6.33)
Diffuse changes					
Tessellated fundus	5 (55.55)	41 (37.96)	6 (50)	7 (53.84)	59 (41.54)
Retinitis pigmentosa	0	1 (1.6)	1 (8.3)	0	2 (1.40)
Treated case of retinal detachment (Buckle)	0	0	1 (8.3)	0	1 (0.7)

Discussion

The cross-sectional observational study on 142 eyes of 75 cases of high myopia showed no significant difference in the gender-wise distribution. Literature shows varying distribution of high myopia among males and females. Some studies show no significant difference; some show a higher prevalence in females; whereas a study in Central India found a higher prevalence of high myopia in males.^{18,19,20,21,22} Majority being bilateral in our study, the proportion of unilateral cases was only 10.6% and was less compared to other studies (22.6% in adults to 50% in a study on children).^{23,24} These differences could be because of different ethnic populations studied since myopia is known to be linked to several gene loci and is also influenced by environmental

factors. The mean age of high axial myopia in our study was 36.28 years with men being significantly older than women. The age distribution of high myopia varies broadly in different studies from 21 to 41 years.²⁵ This being a hospital (hyphen) based study in south India, the results are expected to differ from other geographical areas and from population-based studies.

The mean axial length was 27.39 mm similar to other studies ranging between 26 to 29.4 mm with no significant difference in the mean axial lengths among males and females.^{26,27} Longer axial lengths and higher refractive errors were associated with more lesions in the posterior segment lesions and more visual impairment although not statistically established. In this study, the common posterior segment changes seen in

Table 4: Distribution of clinical findings with categories of visual impairment

	Normal (6/6 to < 6/12)	Mild VI (6/12 to 6/18)	Moderate VI (<6/18 to 6/60)	No. of eyes with severe VI (<6/60 to 3/60)	No of eyes with blindness (<3/60)	Total number of eyes with the lesion
Visually less significant findings						
Temporal or annular crescent	18 (17.14)	22 (20.95)	36 (34.28)	15 (14.28)	14 (13.33)	105 (73.94)
Tessellated fundus	9 (15.25)	11 (18.64)	18 (30.5)	12 (20.33)	9 (15.25)	59 (41.54)
Lattice degeneration	4 (36.36)	0	0	2 (18.18)	5 (45.45)	11 (7.74)
Peripheral retinal degenerations	0	1 (11.11)	3 (33.33)	1 (11.11)	4 (44.44)	9 (6.33)
Peri-papillary atrophy	0	0	1 (25)	2 (50)	1 (25)	4 (2.81)
Visually significant findings						
Posterior sub-capsular cataract	0	4 (14.81)	9 (33.33)	7 (27.92)	7 (25.92)	27 (19.01)
Chorioretinal atrophy-macula	1 (5.55)	3 (16.66)	0	1 (5.55)	13 (72.22)	18 (12.69)
Posterior staphyloma	0	2 (11.76)	3 (17.64)	4 (23.52)	8 (47)	17 (11.79)
Glaucomatous cupping	0	2 (18.18)	2 (36.36)	3 (27.27)	4 (36.36)	11 (7.74)
CNVM/ Fuchs spot	2 (22.22)	0	0	3 (33.33)	4 (44.44)	9 (6.33)
Tilted disc	1 (20)	0	4 (80)	0	0 (0)	5 (3.52)
Optic disc pallor	0	0	0	2 (50)	2 (50)	4 (2.81)
Retinitis pigmentosa	0	0	0	0	2 (100)	2 (1.40)
Treated case of retinal detachment (Buckle)	0	0	0	0	1 (100)	1 (0.7)
Total	29 (20.42%)	27 (19.01%)	45 (31.69%)	21 (14.78%)	20 (14.08%)	142

high myopia were identical to the classical descriptions of degenerative myopia. Posterior staphyloma, is well known to be associated with high myopia and was present in 11.97% of the eyes in our study. The proportion of high myopia with posterior staphyloma varies in literature from 5.7 to 32% in various studies.^{28, 29, 30} In this study, almost half of the blind eyes had posterior staphyloma. Posterior staphyloma is a well-known association of visual impairment and is a component of myopic maculopathy. Chorioretinal atrophy at the posterior pole was seen in 12.69% of the eyes. Various studies show different proportions in the similar range from 3.7 to 20% of eyes with high myopia in the form of diffuse or patchy atrophic patterns.^{28, 29, 30, 31} Chorioretinal atrophy was associated with significant loss of vision in our study as also detailed by other studies.³² Choroidal neovascularization was found in 6.3% of the eyes with high myopia similar to another study in which the incidence of CNVM was 10.2%. CNVM is an important cause of visual impairment in high myopia and in our study, it was present in 72% of the eyes with blindness as also evidenced by other studies in which CNVM was associated with poor visual outcome.³³

Myopic maculopathy which was defined as the presence of posterior staphyloma, chorioretinal atrophy and/or choroidal neovascularization was seen in 25.35% of the total eyes and was significantly associated with blindness. In other studies, the prevalence ranged from 2.3 to 72%.^{34, 35, 36, 37} Myopic maculopathy was significantly associated with visual impairment similar to other studies on high myopia.³⁸ It was significantly associated with increased axial length and higher degrees of myopia as also seen in other studies. However, in our study, myopic maculopathy was associated significantly with the male gender and did not increase significantly with age and this was not the same in other studies.

Peripheral degenerations like lattice were less common in our study and were present in only 7.7% of the eyes whereas other studies show an incidence of about 12.2% to 33%.³⁹ Lattice was also found to be more common among moderate degrees (6-12D) of myopia rather than higher degrees (>18D) similar to other studies.

Conclusion

High myopia causes significant visual impairment affecting 28.87% of the eyes. The most common cause being myopic maculopathy. The visual impairment tends to be more with longer axial lengths, higher SE, and in males more than females.

bilateral myopia is more among males than females in terms of severity of myopia, axial lengths, occurrence of myopic maculopathy and severity of visual impairment when compared to females. Higher degrees of myopia and longer axial lengths were associated with visual impairment. Myopic maculopathy was found to be an important cause of visual impairment in high axial myopia. Visual impairment in high axial myopia is significant.

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Cite This Article as: Rejitha Chinnu Varghese, Uma Kulkarni High Myopia: A Hospital-Based Study of The Clinical Profile and Visual Impairment Delhi J Ophthalmol 2020 ; 31 (2) :30- 35.

Acknowledgments: Nil

Conflict of interest: None declared

Source of Funding: None

Date of Submission: 27 Jan 2020

Date of Acceptance: 20 May 2020

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