A CLINICAL STUDY OF AXIAL MYOPIA USING OPHTHALMIC A-SCAN ULTRASONOGRAPHY

Jibi Joy1, Sarita Aggarwal2, Shahzar Naimi3, Pallavi Sharma4

1 Third Year Junior Resident, Department of Ophthalmology, Santosh Medical College and Hospital, Ghaziabad.
2 Professor and HOD, Department of Ophthalmology, Santosh Medical College and Hospital, Ghaziabad.
3 Third Year Junior Resident, Department of Ophthalmology, Santosh Medical College and Hospital, Ghaziabad.
4 Third Year Junior Resident, Department of Ophthalmology, Santosh Medical College and Hospital, Ghaziabad.

ABSTRACT

BACKGROUND
Myopia is the most common refractive error that affects all the age groups. Axial length is the primary factor for the determination of myopia and the purpose of this study is to measure the axial length in myopic patients using A-scan ultrasonography and study their correlation with various entities. The aim of this study was to find axial length in myopic patients using A-scan ultrasonography in patients above 20 years of age group.

MATERIALS AND METHODS
Data of 100 patients (200 eyes), who were all myopic above 20 years of age attending our OPD from December 2016 to May 2018 was analysed. The measurement of axial length was performed respectively in 200 eyes by A-scan ultrasonography. Three to four readings were taken for each eye. Keratometry reading was taken and readings noted in millimeter. A detailed slit lamp biomicroscopy and fundus examination with direct, indirect ophthalmoscopy and 90D was done.

RESULTS
The axial length of myopic eyes varies from 22.86 mm to 31.81 mm using A-scan ultrasonography. There was significant increase in axial length with advance in age. There is increase in mean axial length with increase in degree of myopia. The degenerative changes and complications increased with increase in axial lengths.

CONCLUSION
Axial length increases with increase in age and increase in myopia. It was also found that myopia is higher in females than males.

KEYWORDS
Axial Length, Myopia, Degenerative Fundus Changes, A-Scan.


BACKGROUND
Myopia, or near sightedness, is a worldwide common type of refractive error. Myopia is a major threat for vision health across the world. 75% is responsible for refractive error related complication and their consequences. Even the complications of high myopia are lacquer cracks, retinal detachment, chorioretinal atrophy and glaucoma.

The prevalence of myopia in Western Europe is estimated to be 25%. Even regions like Middle East and South America have similar results. 161 million people have been affected by visual impairment caused by myopia and other ocular disorders, according to a report in 2002 by World Health Organization (WHO). Myopia can be etiologically classified as axial myopia, curvature myopia, index myopia and myopia due to excessive accommodation. Axial length is considered to be the most important factor for the determination of refractive error in comparison with other ocular components such as cornea and crystalline lens. The axial length usually increases with increase in myopia.

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 of >20 years of age attending the ophthalmology OPD in the Santosh Medical College & Hospital, Ghaziabad for diminution of vision.

MATERIALS AND METHODS
The study was hospital based simple random sampling clinical study carried out for a period of 1 and half years from December 2016 to May 2018. Relevant data and consent for the study was obtained from the patients. A detailed history regarding their complaints, duration and onset of complaints and past history of wearing spectacles was inquired of 100 patients aged >20 years attending OPD with refractive error were taken for the study.
A detailed slit lamp biomicroscopy and fundus examination with direct, indirect ophthalmoscopy and 90D was done. Patients' refraction readings were determined with a retinoscope in a dark room after using a cycloplegic and subjective correction was given the next day. Keratometry reading were taken and readings noted in millimeter.

The patients were then explained the procedure of A-scan and axial lengths were measured. Three to four readings were taken for each eye and if the difference was more than 0.1 mm the reading was discarded. A mean of three readings was taken. To avoid any variation A scan of 200 eyes was done by same person.

Inclusion Criteria
All patients above 20 years attending the ophthalmology OPD at Santosh Medical College and Hospital, Ghaziabad for diminution of vision.

Exclusion Criteria
All patients attending the ophthalmology OPD at Santosh Medical College and Hospital, Ghaziabad which are:

- Below the age of 20 years.
- With irregular astigmatism.
- With index myopia.
- With corneal lesions and lens defects.
- With uveitis and infections of the eye.

RESULTS
In our study the range of axial lengths in different age group was found to be least in 21-30 years of age group (48% of total) followed by 31-40 years of age group (25% of total) while 51-60 years (15% of total) constituted largest range of axial length. (Table 1)

Myopia is more common in female (60%) than male (40%) out of the total 100 cases.

<table>
<thead>
<tr>
<th>Age Group (Yrs.)</th>
<th>No. of Cases Observed</th>
<th>% of Cases</th>
<th>Range of Axial Length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>48</td>
<td>48%</td>
<td>22.86-24.53</td>
</tr>
<tr>
<td>31-40</td>
<td>25</td>
<td>25%</td>
<td>25.20-27.47</td>
</tr>
<tr>
<td>41-50</td>
<td>12</td>
<td>12%</td>
<td>27.47-29.86</td>
</tr>
<tr>
<td>51-60</td>
<td>15</td>
<td>15%</td>
<td>29.86-31.18</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Range of Axial Lengths in Different Age Groups

It was observed that range of axial length increases as the degree of myopia increases. It was least (24.03±1.17) in the patients who had myopia of 0 to -3 D and highest (29.01±2.17) in patients having myopia of -12 to -15 D. A wide range of axial lengths are seen ranging from 22.86 mm to 31.18 mm. (Table 3)

<table>
<thead>
<tr>
<th>Degree of Myopia (Dioptre)</th>
<th>Range of Axial Length (mm) (Both)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to -3</td>
<td>22.86-25.20</td>
</tr>
<tr>
<td>-3 to -6</td>
<td>23.10-26.84</td>
</tr>
<tr>
<td>-6 to -9</td>
<td>24.06-27.47</td>
</tr>
<tr>
<td>-9 to -12</td>
<td>26.02-29.86</td>
</tr>
<tr>
<td>-12 to -15</td>
<td>26.84-31.18</td>
</tr>
<tr>
<td>Total</td>
<td>22.86-31.18</td>
</tr>
</tbody>
</table>

Table 3. Correlation Between Axial Length and Degree of Myopia

The widest range of dioptic powers (-1.0 to -12.0) was seen the 21 to 30 years age group and smallest range of dioptic powers (-2.0 to -4.0) was seen in the 51 to 60 years age group. (Table 4)

<table>
<thead>
<tr>
<th>Age Group (yrs.)</th>
<th>Range of Degree of Myopia</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30</td>
<td>-1.0 to -12.0</td>
</tr>
<tr>
<td>31-40</td>
<td>-3.0 to -10.0</td>
</tr>
<tr>
<td>41-50</td>
<td>-1.0 to -5.0</td>
</tr>
<tr>
<td>51-60</td>
<td>-2.0 to -4.0</td>
</tr>
</tbody>
</table>

Table 4. Range of Degree of Myopia in Different Age Groups

In our study it showed that the lesser degree of myopia (-3 to -6 D) with mean axial length 24.03 mm had physiological or intermediate fundus changes. And higher degrees of myopia (-12 to -15 D) with mean axial length >29.01 mm had pathological fundus changes. (Table 5)

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of Cases</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>40</td>
<td>40%</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>60%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2. Incidence of Myopia in Two Sexes
The most common fundus changes seen in myopic eyes was myopic crescent (60%) followed by Tessellated fundus which was observed in 80% of myopic eyes. 21.00% of myopic eyes showed chorioretinal degenerations and 5.00% showed peripheral retinal degenerations. 1.50% showed Foster Fuchs's spot and 1% showed choroidal haemorrhage. (Table 6)

Myopic Fundus Changes | No. of Eyes Examined | Percentage (%)  
--- | --- | ---  
Myopic Crescent | 120 | 60.00%  
Tessellated Fundus | 80 | 40.00%  
VC | 30 | 15.00%  
CRD | 42 | 21.00%  
Peripheral Retinal Degenerations | 10 | 5%  
Foster Fuchs Spot | 3 | 1.50%  
Choroidal Haemorrhage | 2 | 1.00%  

Table 6. Number and Percentage of Myopic Eyes Showing Fundus Changes

**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. Axial length is regarded as the primary determinant of refractive error as compared to other ocular components such as the cornea and crystalline lens. We have undertaken a study to establish a correlation between the axial length and the degree of myopia using A-scan USG in 100 myopic patients (200 eyes) of >20 years of age attending the ophthalmology OPD for diminution of vision in the Santosh Medical College and Hospital, Ghaziabad. We also attempted to establish a correlation between degree of myopia, axial length, the degenerative changes and complications of myopia.

**Demographics**

We found the majority of the patients (40%) were of 21-30 years of age followed by patients of 31-40 years of age (25%); 41-50 years of age (12%) & 51-60 years of age (15%). The highest degree of myopia was seen in patients of 21-30 years of age followed by age of 31-40 years and then age of 51-60 years.

The findings of our study are in line with published literature. According to literature, myopia prevalence varies with age, race and sex, increasing at least through adolescence.

We also found increase in axial length with advance of age. Age-related AL differences were also noted in earlier studied by some researchers. It is found that older people were likely to have shorter AL than younger participants. Warrier et al suggested that these differences were located to cohort effects. For example, near work was more intensive in the younger age group, which is a factor increasing AL probably due to a defocus-induced disturbance of emmetropisation. Biino et al showed a quadratic relationship between AL and age and reported that the average axial length for full-term infants increases from 16.8 to 23.6 mm when they become adults. However, the Los Angeles Latino Eye Study did not reveal an age-related AL difference based on a population of 5,588 participants over a period of 40 years.

We also found that the myopia is more common in female (60%) than male (40%). This finding is in line with published literature. Renz et al also reported that the myopia occurs slightly more frequently in females than in males. The slightly more incidence of myopia in female can be explained by the fact that women tend to have a longer AL, which is again partly explained by comparatively short stature of women. Myopia in this study, the majority of patients (37.33%) had low myopia (0 to -3 D). This was followed by patients with moderate myopia (-3 to -6 D) in 35% patients and high myopia (<-6 D) in remaining patients. Very few patient (0.67%) had myopia > -21 D.

**Myopia and Axial Lengths**

We found that mean axial length increases as the degree of myopia increases.

It was least (24.03±1.17) in the patients who had myopia of 0 to -3 D and highest (29.01±2.17) in patients having myopia of -12 to -15 D. The findings of our study is in line with published literature which indicate that AL is the largest determinant of refractive error. The longer the AL, the severer the myopia.

As early as the mid last century, researchers found that AL showed a bimodal distribution in an adult myopic population. A first peak appears around the AL of 24 mm for low myopia (–6 D < refractive error < 0 D) while the second peak appears roughly at the AL of 30 mm for high myopia (refractive error <-6 D). Meanwhile, the distribution of AL is reported to be positively skewed in the general population, and it is under a normal distribution in some selected cohorts. Olsen et al found that axial length explains the majority of variation of refraction in populations.

**Degenerative Changes & Complications**

Pathological myopia usually refers to a condition where there is greater than six dioptres of myopia or an axial length
greater than 26-27 mm. 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 subcapsular and nuclear cataract.

In our study, we found physiological and intermediate changes in patients who had low myopia (0 to –3 D); physiological, intermediate and pathological changes in patients who had moderate myopia (-3 to -6 D) and intermediate and pathological changes in patients who had high myopia (< -6 D). To be more precise, in our study, physiological fundus changes were more in patients who had low myopia (0 to –3 D); intermediate fundus changes were more in patients who had moderate myopia (-3 to -6 D) and pathological fundus changes were more in patients who had high myopia (< -6 D).

In our study, myopic crescent was seen in 60% eyes; tessellated fundus in 40% eyes; VC in 15% eyes; CRD in 21% eyes; peripheral retinal degenerations in 5% eyes; foster Fuchs spot in 1.5% eyes and choroidal haemorrhage in 1% eyes.

We also found an axial length more in patients who developed intermediate and pathological fundus changes. Curtin and Karlin\textsuperscript{10} found optic disc crescents in all eyes which had an axial length of 28.5 mm or more. Temporal and annular crescents predominated. Other studies have found that the width of the crescent was strongly associated with the degree of myopia.

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.

Akiiba\textsuperscript{11} suggested that in high myopia, PVD develops increasingly with age and the degree of myopia, and that it may be seen as much as 10 years earlier in highly myopic eyes compared to emmetropic eyes. In a study of 218 patients with myopia of six dioptres or more in both eyes, Celorio and Prüett found that one third had lattice degeneration, with the greatest prevalence being in eyes having six to nine dioptres of myopia. Lattice degeneration represents vulnerable areas of retinal thinning. It is non-age specific and is seen in about 40% of eyes with retinal detachment.

It has been estimated that potentially up to 80% of eyes suffering retinal detachment have some degree of myopia. Also, a person with five dioptres 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 refractively correct the myopia.

Increase in axial elongation in high myopia can lead to the stretching and thinning of retina leading to various degenerative changes. High myopia can cause retinal complications such as retinal tears, peripheral retinal degenerations, retinal detachment, macular haemorrhages, retinal pigment epithelium atrophy, posterior staphyloma, chorioretinal atrophy, lacquer cracks and choroidal neovascularisation (CNV).\textsuperscript{12}

**CONCLUSION**

- The incidence of myopia is more common in female (60%) than male (40%).
- The axial lengths of myopic eyes vary from 22.86 mm to 31.18 mm. A correlation between the axial lengths and degree of myopia was seen.
- The highest degree of myopia was seen in patients of 21-30 years of age followed by age of 31-40 years and then age of 51-60 years.
- We also found increase in axial length with advance of age.
- We also noted that mean axial length increases as the degree of myopia increases.
- A statistical correlation between the degree of myopia, axial length and the degenerative changes and complications of myopia was seen. Physiological and intermediate fundus changes were seen in patients who had low myopia (0 to –3 D); physiological, intermediate and pathological fundus changes in patients who had moderate myopia (-3 to -6 D) and intermediate and pathological fundus changes were seen in patients who had high myopia (> -6 D). The degenerative changes and complications increased with increase in axial lengths.
- A statistical correlation between the degree of myopia, axial length and the visual acuity was seen. Lower degrees of myopia had good uncorrected and corrected visual acuities compared to higher degrees of myopia having large axial lengths.

**REFERENCES**


