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Biometric Evaluation of Eyes with Simple Myopia – Our Study

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ABSTRACT
The focusing system of eye is composed of several refracting structures which include cornea, aqueous humor, crystalline lens and vitreous humor. The overall refractive state of eye is determined by four components: Corneal power, anterior chamber depth, crystalline lens power and axial length. A state of emmetropia during development of eyeball is therefore the result of harmonious interplay of these components. Refractive error represents a mismatch between the eye's focal length and its axial length. In this study, in simple myopic eyes with refractive error correction, we have done the biometry to know any correlation between biometric measures and degree of refractive error. Mean axial length in myopic was about 24.35±0.85 mm, which was more than the emmetropic eye and we found that there was a positive correlation between degree of myopia and axial length .In myopia we found deep anterior chamber and mean was 3.59 ± 0.28, p = < 0.03 which indicates that there is positive correlation between degree of myopia and anterior chamber depth.*

Keywords: *Emmetropia, ammetropia, myopia, hypermetropia, astigmatism, keratometry, a-scan, axial length, biometric measure, fundoscopy.*

Introduction

As an optical instrument, eye is compared to a camera with retina acting as a unique kind of 'Film'.[1] The focusing system of eye is composed of several refracting structures which include cornea, aqueous humor, crystalline lens and vitreous humor. The overall refractive state of eye is determined by four components: Corneal power, anterior chamber depth, crystalline lens power and axial length.[2] A state of emmetropia during development of eyeball is therefore the result of harmonious interplay of these components. Refractive error represents a mismatch between the eye's focal length and its axial length.[3]

In physiologically normal eye, parallel rays converge upon retina to form a circle of least diffusion;[4] when the ideal conditions occur with eye in a state of rest, condition is termed emmetropia. The opposite condition is ametropia when parallel rays of light are not focused exactly upon retina with eye in a state of rest; such an eye has a refractive error. Individual eyes have different refractive status.[5]

Refractive errors may be of three main types:

1. The principal focus formed is situated behind the retina, it is hypermetropia

2. The principal focus formed is situated in front of retina, it is called myopia
3. No single focus is formed, it is called astigmatism

Biometry of the eye is the measurement of various dimensions of the eye and its components and their relationship.[6] It consists of keratometric reading together with ultrasonic measurement of axial length, anterior chamber depth, thickness of crystalline lens. Compared with other ocular components such as the cornea and crystalline lens, axial length is typically regarded as the primary determinant of refractive error. [7]The correlation with refractive error is larger for axial length than for any other component .[8] In this study, in simple myopic eyes with refractive error correction, we have done the biometry to know any correlation between biometric measures and degree of refractive error.[9,10]

Material and Methods

This study was conducted in the Department of Ophthalmology, M.K.C.G. Medical College& Hospital, Berhampur from the period of 1st September 2011 to 31st August 2013.

1. Tthe different biometric values like axial length, anterior chamber depth, lens thickness and corneal curvature in ametropic patients using keratometer and A scan machine.
2. The possible relationship between the biometric measures with the degree of refractive error was investigated.

110 patients of 213 eyes attending the outpatient department of Ophthalmology, M.K.C.G Medical College with the chief complaints of defective vision, headache, and eyestrain, from the period of 1st September 2011 to 31st August 2013 were selected for the study. This was an observational and co relational study.

The study was conducted on the patients between ages of 10-60 years.

Inclusion and Exclusion Criteria

All the patients having refractive error low to moderate myopia, hypermetropia and astigmatism with spectacle correction 6/6 were included in our study. Consent was taken and examined. Those patients with amlyopia, small pupil <1.5mm, distorted pupil, cornea plana, corneal opacity, any media opacity, corneal pathology, media pathology or lenticular pathology, fundal pathology were excluded from the study.

Patients with other ocular disorders like retinitis pigmentosa, keratoconus, retinal detachment, uveitis, macular hole, high myopia with degeneration etc were also excluded from study. Any type of eye surgery, post operative cases, pterygium, lack of cooperation are excluded from the study.

Patients with systemic disorders that are known to affect the eye or may affect eye like albinism, Down syndrome etc were also excluded from the study.

Examination Methods

1) Complete assessment of patient including age, sex, domicile of India, past ocular medical and surgical history was taken.
2) A detailed anterior segment examination was done.
3) The visual acuity of each eye was recorded separately using illuminated Snellen's chart. Pinhole improvement of visual acuity was recorded. If the patient was wearing glasses or contact lenses, their visual acuity with glasses and contact lens was checked and dioptric range of glasses was noted down.
4) Direct and indirect ophthalmoscopy was performed.
5) Retinoscopy was performed with a reflecting plane mirror retinoscope.
6) Subjective verification of retinoscopic refraction was done and data was recorded.
7) Automated refraction was done to know astigmatism.
8) Biometry including keratometry and A scan was done data was recorded.

Procedure

After recording visual acuity, determination of refractive errors in all the eyes was done clinically as well as on autorefractometer by the same examiner. The clinical retraction was invariably done first so as to obviate any possible examiner bias in the study.

Retinoscopy was performed with the reflecting plane mirror retinoscope. It was done with the use of a tropicamide (0.8%) plus phenylephrine(5%) eye drops. Autorefraction and subjective verification was done only after the effect of the drug ceased. Cylinder power and axis were confirmed using Jackson's cross-cylinder, in subjective verification, for comparison purposes, the refraction values which gives the best possible visual acuity was recorded.

All the eyes included in the study had a corrected visual acuity of 6/6. On all the patients, auto refraction was done with Grand Seiko GR-2100. According to the refractive status patients were divided into myopic, hypermetropic and astigmatism group.

Kerametry was done using Bausch and Lomb Keratometer. Corneal curvature (in mm) in the horizontal and vertical meridian was measured. Mean value of curvature was calculated.

A scan was done using Appasamy A scan machine. Eight readings were taken. Mean axial length, ACD, lens thickness in each eye was noted down. Statistical analysis was done with the help of Microsoft excel and Instat Graphpad (version 3.1). Clinical correlation statistics were done using Pearson correlation coefficient and analysis was done by linear regression method.

The patient data was recorded in the following format.

Case No. :
Name :
OPD No. :
Age: Sex:
History :
Presenting complaints :
Past History :
Diabetes Mellitus: Yes/No
Hypertension : Yes/No

Other:

Optical History

History of Spectacle Wear : Yes/No
If Yes, Power of Spectacles : RE: LE:
History of Contact lens wear : Yes/No
History of Ocular Surgery : Yes/No
(If Yes, Specify)

Family History

Ocular Examination: OD OS

- Ocular adenexa
- Conjuctiva
- Cornea
- Sclera
- Anterior chamber
- Iris
- Pupil
- Lens
- IOP

Funds (Direct & Indirect Ophthalmoscopy)

Visual Acuity:

DV	With PH	NV
RE		
LE		

With Previous SPECS: (If any)

Retinoscopy:

Subjective Correction:

	SPH	CYL	AXIS
	(VA attainted)		
RE:			
LE:			

Automated Refraction:

	SPH	CYL	AXIS	(VA attainted)
RE:				
LE:				

Keratometry

Eye	Horizontal Corneal Curvature (mm)	Vertical Corneal Curvature (mm)	Mean (mm)
RE			
LE			

A Scan

Eye	Mean AC depth (mm)	Mean Lens thickness (mm)	Mean Axial length (mm)
RE			
LE			

Observation and Discussion

Table-1 Refractive Error Distribution

	Number of patients	Percentage
Myopia	50	45
Hypermetropia	25	23
Astigmatism	35	32

In this study we had taken 213 eyes of 110 patients.

Among the 110 patients 45% were myopic, 23% hypermetropic and 32% were astigmatic.
According to **Stenstrom's study of Uppsala**, Sweden, prevalence of ametropia is as follows:[82]

- Low myopia (≤2D) :29%
- Moderate myopia (2-6D): 7%
- High myopia> 6D: 2.5%
- Emmetropia and hypermetropia (0-2D): 61%
- High hypermetropia : 0.5%

Table-2 Gender Distribution

Gender	No of patients	Percentage
Male	62	56
Female	48	44

Of the 110 patients 56% were male and 44% were female.

Myopia

Table-3 Age Distribution in Myopia

Age (in years)	Number of patients	Percentage
10-19	25	50
20-29	19	38
30-39	3	6
40-60	3	6

Patients ranged from 10years to 60 years with a mean age group of 21.52 years and myopia was more prevalent in 10-19years age group.

Gender Distribution in Myopia

Gender	No of patient	Percentage
Male	31	62
Female	19	38

In this study among the 50 myopic patient, 62% were male and 38% were female.

Degree of Distribution of Myopia

Degree of myopia	No. of cases	Percentage
-0.5 –(-1)	24	25.53
-1.25 –(-2)	21	22.34
-2.25 – (-3)	28	29.78
-3.25 – (-4)	6	6.38
-4.25 – (-5)	9	9.57
-5.25 – (-6)	6	6.38

We had taken mild to moderate myopic cases. Among the 94 eyes included the study,

72 eyes i.e 76.59% had mild myopia (≤3D).
21 eyes i.e 22.34% had moderate myopia (3D to 6D).

Table-6 Variation of Axial Length in Myopia

Degree of Myopia	Number of Cases	Axial Length (mm) (Mean)	SD
-0.5 –(-1)	24	24.05	0.50
-1.25 –(-2)	21	24.20	0.47
-2.25- (-3)	28	24.31	0.55
-3.25-(-4)	6	24.98	1.01
-4.25-(-5)	9	25.52	0.74
-5.25-(-6)	6	25.95	0.50

r^2 =0.41, F=65.55
P*< 0.0001, which was considered extremely significant.

The minimum value of axial length obtained in this study is 23.06 and the maximum value was 26.94.
Mean value is which 24.35±0.85 mm which is higher than normal value.
Normal value for axial length we had taken as 24mm

31 eyes had axial length below the normal value and 63 eyes had axial length above the normal value.

Positive correlation of axial length was seen with degree of myopia indicating a close relation with myopia. P value is <0.0001, which is highly significant.

Mc Brien and et al found that the largest difference in ocular component dimension is for axial length, mypoes having a mean axial length 0.82mm greater than emmetropes.[83]

Sanjeewa W et al found that axial length and vitreous chamber depth were the strongest determinants of refractive error[84]

Tien Yin Wong et al concluded that persons with minus spherical equivalent (myopia) had longer axial length, deeper ACD and longer vitreous chamber depth than subjects with plus spherical equivalent.[85]

Table -7: Variation of Anterior Chamber Depth in Myopia

Degree of Myopia	Number of Cases	Anterior Chamber Depth (mm) Mean	SD
-0.5 –(-1)	24	3.48	0.33
-1.25 –(-2)	21	3.56	0.25
-2.25- (-3)	28	3.74	0.20
-3.25-(-4)	6	3.67	0.23
-4.25-(-5)	9	3.69	0.18
-5.25-(-6)	6	3.59	0.09

r^2=0.048, F=4.68

P*=0.03, which was considered significant.

The minimum value of anterior chamber depth obtained in this study was 2.79 and the maximum value obtained was 4.2 mm.

Cumulative mean of anterior chamber depth for all eyes was 3.59±0.28 mm.

Deeper anterior chamber was seen in myopias in the range of -2 to -6 D range.

In this study p* = < 0.03 which indicates that there was a positive correlation between degree of myopia and anterior chamber depth.

Table-8: Variation of Lens Thickness with Degree of Myopia

Degree of Myopia	No. of Cases	Lens Thickness (mm)	SD
-0.5 –(-1)	24	3.66	0.34
-1.25 –(-2)	21	3.6	0.19
-2.25- (-3)	28	3.58	0.23
-3.25-(-4)	6	3.52	0.16
-4.25-(-5)	9	3.61	0.32
-5.25-(-6)	6	3.53	0.09

F=0.55, r^2=0.005

P*= 0.46, which is not significant.

The minimum value obtained in this study was 2.7mm and the maximum value obtained was 5.

The mean value of lens thickness for all the eyes was 3.5±0.33mm.

Table -9 Variation of Lens Thickness with Age

Age	Number of Cases	Lens Thickness (mm) (mean)
10-20	55	3.49
21-30	31	3.61
31-40	4	3.77
41-60	4	4.65

In our study it was found that lens thickness increases with age. There was no correlation with degree of myopia.

Table 10: Variation of Corneal Curvature with Degree of Myopia

Degree of Myopia	No. of Cases	Keratometry (mean in mm)	SD
-0.5 –(-1)	24	7.83	0.34
-1.25 –(-2)	21	7.74	0.31
-2.25- (-3)	28	7.80	0.26
-3.25-(-4)	6	7.68	0.38
-4.25-(-5)	9	7.62	0.40
-5.25-(-6)	6	7.66	0.29

F=0.122

P*=0.7277, which shows that it is not significant.

The minimum value obtained in this study was 7.23 and the maximum value was 8.73. mm.

The mean value of radius of curvature was 7.75±0.31mm for all range of myopia. This was less than the average mean in emmetropic population.

Normal radius of curvature was considered to be 7.8.

Table- 11: Range of Corneal Curvature

Corneal Curvature	No. of Cases	Percentage
< 7.8 (mm)	41	43.61
7.8 (mm)	8	8.51
>7.8 (mm)	34	36.17

T Grosvenor and R Scott[94] observed an increased corneal power in myopic eyes and in our study only 43.61% of eyes had increased corneal power.

Summery and Conclusion

Our study, consisting of 110 patients of either sex within the age group of 10-60 years, is carried out to evaluate the biometric measures in simple myopic patients with subjective verification of refractive error correction 6/6 by using Bausch and Lomb Keratometer and contact A scan machine.

A total of 213 eyes are studied and following results were obtained.

- Out of 110, 45% patients were myopic, 23% were hypermetropic and 32% patients were having astigmatism.
- Male and female distribution was about 56% and 44% respectively.
- Myopia and astigmatism were more common in 10-19 years age groups, hypermetropia in 40-49 age groups.
- Among the 94 myopic eyes included the study, 72 eyes i.e 76.59% had mild myopia(≤3D), 21 eyes i.e 22.34% had moderate myopia(3D to 6D).
- Mean axial length in myopic was about 24.35±0.85 mm, which was more than the emmetropic eye and we found that there was a positive correlation between degree of myopia and axial length and p*= <0.0001 which indicates that it was highly significant.
- In myopia we found deep anterior chamber and mean was 3.59 ± 0.28, p* = < 0.03 which indicates that there is positive correlation between degree of myopia and anterior chamber depth.
- Mean lens thickness were 3.5±0.33, 4.16±0.41 and is 3.68 ±0.36 mm in myopia, hypermetropia and astigmatism. We did not find any relation of thickness of lens with the refractive error rather thickness increases with age.
- The mean corneal curvature in myopia was 7.75±0.31mm,.We did not find any statistically significant relationship of corneal curvature with any of the refractive error.[11]

Axial length presents the strongest correlation with the subjective spherical equivalent.[12]

Axial length was most important in determining refractive error and plays a major role in ocular biometry.[13] As ACD, LT are components of axial length, separate models were calculated to assess which components were most influential in determining refraction.[14,15] In this study we had used contact A scan which has its own limitation. So to overcome this IOL master should be used to get more accurate result.

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