Comparing Refractive Error with Axial Length in the Subjects Having Refractive Error

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ABSTRACT

Introduction: Refractive error has now become the second most common cause of blindness across the world. There is necessity to explore the various factors having impact on refractive errors as they will certainly assist in the various modes of treatment aspect of the refractive errors. This study was carried out with the aim of comparing refractive error with axial length in the subjects with refractive error.

Material and methods: In this study, total of 500 adult cases were recruited. So total of 1000 eyes were examined upon. This study was carried out, over a total period of 2 years. General examination was carried out in each and every case. Afterwards, local examination was done. Then refractive error and axial length was measured. The data obtained from this study was analysed statistically.

Results: The results of our present study have showed that the spherical refractive error has statistically highly significant negative correlation with axial length, in right eye ($r=-0.836$, $p<0.01$) and in left eye ($r=-0.859$, $p<0.01$).

Conclusion: The observation made from this study says that on progressing from myopic to hyperopic refractive error, the axial length of the eye is found to decrease. In the refractive error of shortsightedness or myopia, the final image is formed ahead of retina.

Keywords: Long Sightedness, Short Sightedness, Axial Length, Corneal Curvature, Hyperopia, Myopia, Refractive Error.

INTRODUCTION

It has been estimated that one to two billion population is suffering from refractive error. Worldwide, this count varies from one region to another. For example, about 25% of European and 80% of Asian population is found to be affected.[1]

The total number of patients with uncorrected refractive errors has been reported to be 660 million. Out of this, 9.5 million were blind due to refractive error only.[2] Rrefractive error is found to be the most common cause along with the ocular disorders like cataracts, macular degeneration, and vitamin A deficiency responsible for vision loss.[3]

Refractive errors occur when the shape of the eye prevents light from focusing directly on the retina. It is caused due to the length of the eyeball changes in the shape of the cornea, or aging of the lens.

Near-sightedness, farsightedness, astigmatism and presbyopia are some common types of refractive errors. Near-sightedness is also called myopia. It is a condition where objects up close appear clearly, while objects far away appear blurry. With nearsightedness, light comes to focus in front of the retina instead of on the retina.

Farsightedness is also called hyperopia. It is a common type of refractive error where distant objects may be seen more clearly than objects that are near. However, people experience farsightedness differently. For people with significant farsightedness, vision can be blurry for objects at any distance, near or far.

Astigmatism is a condition in which the eye does not focus light evenly onto the retina and images to appear blurry and stretched out. Presbyopia is an age-related condition in which the ability to focus up close becomes more difficult.

Apart from other symptoms, blurred vision is the most common symptom of refractive errors. Refractive errors can be diagnosed with a comprehensive dilated eye examination. People with a refractive error often complaints of visual discomfort or blurred vision. However, some people don't know they aren't seeing as clearly as they could.

There is evidence of genetic predilection for refractive error. Individuals that have parents with certain refractive errors are more likely to have similar refractive errors.[4] Several genes that have been related with refractive error are clustered into common biological networks involved in connective tissue growth and extracellular matrix organization.[5] Though a large number of chromosomal localisations have been associated with myopia, few specific genes have been identified.[6] A correlation between environmental factors and the risk of developing myopia have been found in

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some studies.[7] Myopia has been observed in individuals with visually intensive occupations. Reading has also been found to be a predictor of myopia in children. It has been observed that children with myopia spent significantly more time reading than non-myopic children who spent more time playing outdoors .

As it is very much clear that the great burden of refractive errors on the society, their complications and dependence of the mode of treatment upon various ocular biometers such as length of the eyeball, so knowing in detail the association of refractive error with axial length of eye, if found any, would be quite interesting as well as very useful because it will open a number of gates in future for study on this important topic. Though lot of research has been done so far but the same has not been carried out here, in our region. Hence this study was carried out.

This study was done with the aim of finding the relation between refractive error and axial length in adult subjects. This study was carried out with the aim of comparing refractive error with axial length in the subjects with refractive error.

MATERIAL AND METHODS

In this study, total of 500 adult cases were recruited. So total of 1000 eyes were examined upon. This study was carried out, over a total period of 2 years after taking clearence from institutional ethical committee. Both the sexes - male and female, were included for this study. The cases belonged to Patiala and the surrounding areas. The subjects were recruited on the basis of: refractive error- myopia and hyperopia, aged between 20-40 years. In our study, we included the students of M.B.B.S. and B.D.S. courses, studying in our own medical college and also OPD patients visiting there, in the department of ophthalmology, having refractive errors, in the age group of my study. We used two instruments in this study: Auto refractor and A-Scan Ultrasound Biometer. These were used for measuring refractive error and axial length respectively. The whole procedure was thoroughly described to each subject. The written consent of the cases was taken. General examination was carried out in each and every case. Afterwards, local examination was done. Then refractive error and axial length was measured.

STATISTICAL ANALYSIS

The whole obtained data regarding the two parameters i.e. refractive error and corneal curvature was analyzed statistically, using students 't' test. The relationship thus obtained can be considered as: NS (not significant)–$p>0.05$, S (significant)–$0.01<p<0.05$, HS (highly significant)–$p<0.01$.

RESULTS

There were a total of 500 cases. 200 out of 500 i.e. 40% of total were males. The rest 300 cases i.e. 60% of total were females. 400 eyes out of 1000 i.e. 40% eyes were of male cases. Out of 1000 eyes, 600 i.e. 60% were of female cases (table-1). Out of total 500 cases, 259 i.e., 51.8% cases were found to be myopes. 241 cases out of 500 i.e. 48.2% cases were found to be hyperopes. 518 eyes out of 1000 i.e., 51.8% eyes were having myopic refractive error. 482 eyes out of 1000 i.e. 48.2% were found to be hyperopes.

From the data mentioned above, it is very much clear that refractive error of the right eye has highly significant negative correlation with right eye axial length ($r = -0.836$, $p<0.01$) and refractive error of the left eye has highly significant negative correlation with left eye axial length ($r = -0.859$,

Parameters	Mean±S.D.	N
AGE (YRS)	39.19±13.14	500
RT RE (D)	-0.61±3.09	500
LT RE (D)	-0.50±2.97	500
RT AL (mm)	23.53±1.52	500
LT AL (mm)	23.53±1.51	500

Table-1: Showing Mean and Standard Deviations of Various Parameters of Cases

	Age	RT (RE)	LT (RE)	RT (AL)	LT (AL)
Age	1	0.385**	0.372**	-0.300**	-0.296**
RT (RE)	0.385**	1	0.953**	-0.836**	-0.837**
LT (RE)	0.372**	0.953**	1	-0.851**	-0.859**
RT (AL)	-0.300**	-0.836**	-0.851**	1	0.981**
LT (AL)	-0.296**	-0.837**	-0.859**	0.981**	1

Table-2: Showing Coefficient of Correlation 'r' between Various Parameters of Cases

Group	Number of eyes	Refractive error (D)
A	6	-12.00 D and onwards
B	28	-12.00 to -8.00 D
C	88	-8.00 to -4.00 D
D	396	-4.00 to 0.00 D
E	460	0.00 to +4.00 D
F	22	+4.00 to +8.00 D

Table-3: Showing 6 groups according to type and degree of refractive error

Group	Range of refractive error (D)	Mean value and S.D. (D)
A	-17.00 to -14.00	-15.75±1.255
B	-11.00 to -8.25	-9.49±0.890
C	-8.00 to -4.25	-5.22±1.030
D	-4.00 to -0.25	-1.80±1.139
E	+0.25 to +4.00	+1.63±0.947
F	+4.25 to +7.50	+5.60±1.030

Table-4: Showing the range, mean value and S.D. of refractive error

Group	Range of axial length (mm)	Mean value and S.D. (mm)
A	24.04 to 30.22	27.93±2.479
B	23.78 to 28.59	26.11±1.257
C	22.22 to 26.35	24.82±0.822
D	20.69 to 25.98	23.17±1.433
E	20.06 to 24.76	22.89±1.270
F	20.78 to 23.45	21.35±0.357

Table-5: Showing the range, mean value and S.D. of axial length

p<0.01) (table-2).

The total numbers of eyes were distributed in 6 groups according to type and degree of refractive error.

DISCUSSION

The results of the present study showed that the right eye spherical refractive error is negatively correlated with axial length of right eye (r=-0.836, p<0.01) (table-3,4,5). Similarly, the spherical refractive error of left eye is also found to be negatively correlated with axial length of left eye (r==-0.859, p<0.01). therefore, it can be concluded that as we move from myopic to hyperopic refractive error, the axial length of the eye decreases proportionately.

The present study results are supported by several studies. According to Cheng et al axial length in myopes was found to be relatively higher than in hyperopes.[8] Grosvenor and Scott also revealed the similar results that significant correlation was present between refractive error and axial length.[9] Wang et al also observed the fact that as the refractive error increases, axial length increases.[10]

Strang et al showed in their studies that the myopic axial length was more as compare to hyperopes.[11] Touzeau et al concluded the fact of strongest correlation of axial length with spherical refractive error (r=-0.91, p<0.001).[12] Atchison et al resulted that in shortsightedness, axial length is relatively more than in farsightedness.[13] Llorente et al conducted a study on 24 myopes and 22 hyperopes. They found that axial length in myopes (25.16±1.23 mm) was significantly longer (p<0.01) than hyperopes (22.62±0.76 mm).[14] Park et al showed that shorter eyes i.e. eyes with decreased axial length show hyperopic shift while longer eyes i.e., eyes with increased axial length show myopic shift.[15] Iyamu et al conducted a study on 70 people and found that a highly significant negative correlation was present between spherical refractive error and axial length (r=-0.53, p<0.0001).[16] In myopia image is formed in front of the retina. Increase in myopic refractive error is found to be in close association with elongation of eyeball i.e. decreased axial length. Similarly in hyperopia, the finding of shortening of eyeball i.e. decreased axial length favors it as the image is formed behind the retina. Though, results of some studies were found to be in contrary to the results of present study regarding the relation between the two concerned ocular parameters. Grosvenor and Goss observed that myopic eyes had relatively steeper cornea than hyperopic eyes.[17] Mainstone et al did not found any significant relation between refractive error and axial length.[18] The results obtained by several studies on the axial length and refractive error, some disparities have definitely been observed. The reason could be due to differences in age groups, range of refractive errors, the size of the sample, subjects from various populations, the differences in ethnicities, use of the statistical method and also different measurement methods of the parameters of the eye or the various instruments used and also the variations in the exclusion criteria for the subjects in the different studies.

CONCLUSION

We can conclude that the relationship between axial length of the eye and refractive error is very much clear. The findings of the study will certainly help us in various spheres like, screening of recruitment of various jobs, e.g traffic policemen, drivers, railway services, military services, aviation/pilots, navy services, and many more, as these fields require much accuracy of vision. With the advancement of technology, use of LASIKs is increasing day by day. For this methodology of correction of refractive error, such information procured from these studies, are of vital importance. More and more work needs to be carried upon that may assist us to explore the various factors which may affect directly/ indirectly refractive error. And this data is of great significance, for example, genetic influence, nutritional factors or various metabolic disorders. So if we are clear from much of the research work, about all those factors that affect refractive error, then accordingly that information can be applied to prevent the innumerable complications related with the refractive error. These results from some studies invite other studies to be held on same ocular parameters in future. And hence this way, the way to new and more research work is laid down.

REFERENCES

1. Denniston, Alastair; Murray, Philip (2014). Oxford Handbook of Ophthalmology (3 ed.). OUP Oxford. p. 826. ISBN 9780191057021. Archived from the original on 2016-08-15.
2. Global Burden of Disease Study 2013, Collaborators (22 August 2015). "Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013". Lancet. 386 (9995): 743–800.
3. Pan, CW; Dirani, M; Cheng, CY; Wong, TY; Saw, SM. The age-specific prevalence of myopia in Asia: a meta-analysis. Optometry and Vision Science. 2015;92: 258–66.
4. https://nei.nih.gov/sites/default/files/health-pdfs/Refractiveerrors.pdf
5. Wojciechowski, Robert. Nature and Nurture: the complex genetics of myopia and refractive error. Clin Genet. 2011;79: 301–320.
6. Morgan, Ian; Kyoko Ohno-Matsui. Myopia. The Lancet. 2012;379: 1739–1748.
7. Genome-wide meta-analyses of multiancestry cohorts identify multiple new susceptibility loci for refractive error and myopia. Nature Genetics. 45 (3): 314–8.
8. Cheng H, Singh O, Kwaong K et al. Shape of the myopic eye as seen with high resolution magnetic resonance imaging. Optometry and Vision Science 1992; 62: 698-770.
9. Grosvenor T and Scott R. Role of axial length-corneal curvature ratio in determining the refractive state of the eye. Optometry and Vision Science 1994; 71: 573-79.
10. Wang FR, Zhou XD, Zhou SZ. A CT study of the relation between ocular axial biometry and refraction.

Zhonghua Yan Ke Za Zhi 1994; 30: 39-40.
11. Strang N, Schmid K, Carney L. Hyperopia is predominantly axial in nature. Current Eye Research 1998; 17: 380-83.
12. Touzeau O, Allouch C, Borderie V et al. Corelation between refraction and ocular biometry. J Fr Ophtalmol 2003; 26: 355-63.
13. Atchison DA, Jones CE, Schmid KL et al. Eye shape in emmetropia and myopia. Invest Ophthalmol Vis Sci 2004; 45: 3380-86.
14. Llorente L, Barbero S, Cano D et al. Myopia vs hyperopic eyes: axial length, corneal shape and optical aberrations. Journal of Vision 2004;4: 288-98.
15. Park SH, Park KH, Kim JM et al. Relation between Axial Length and Ocular Parameters. Opthalmologica 2010; 224: 188-93.
16. Iyamu E, Iyamu J, Obiakor CI. The Role of Axial Length-Corneal Radius of Curvature Ratio in Refractive State Categorization in a Nigerian Population. ISRN Opthalmology 2011 Apr; 1-6.
17. Grosvenor T and Goss DA. Role of the cornea in emmetropia and myopia. Optom Vis Sci 1998; 75: 132-45.
18. Mainstone JC, Carney LG, Anderson CR et al. Corneal shape in hyperopia. Clin Exp Optom 1998; 81: 131-37.

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