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Analysis of keratometry and axial length distribution in urban population of Gujrat, India

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Abstract

Aim: The aim of this study is to measure keratometry and axial length to get normative data for different age group population. That will help us to see for variation in corneal power and axial length in different age group, gender and between right and left eye. That will also allow us to compare this data with different ethnic population.

Materials and Methods: The study was conducted with measurement of keratometry with keratometer and axial length with contact A scan biometry of 294 eyes of 147 patients. Age distribution of patients are 11 to 75 years. Patients were selected randomly from daily OPD. Changes in keratometry and axial length were calculated by using paired sample t test, independent sample t test and T- test assuming equal variances.

Results: As per different age population normative data for keratometry in diopter in our age group A, B, C and D is mean±SD is 44.7082±1.4179, 44.3073±0.8552, 45.3186±1.4984 and 44.4210±1.2683 respectively. The normative data for axial length distribution in mm for the age group A, B, C and D is 23.089±1.0395, 22.5378±0.9570, 22.5561±0.8118 and 22.9575±1.0535 respectively. In present study there is no correlation between right and left eye keratometry and age as r value is (r=0.08, r=0.04)(p=0.29, p=0.59) (95% CI for r= -0.1961 to 0.1273 and 0.2203 to 0.1024). There is no co relation between right and left eye axial length and age as r value(r=-0.06, r=-0.03) (p=0.46, p=0.67) (95% CI for r = -0.1961 to 0.1273 and -0.2203 to 0.1024) In our study mean keratometric value for a given age group A, B, C, and D for right eye is 44.8006±1.5401 D, 44.2802±0.8156 D, 45.3727±1.4987 D and 44.3822±1.2437 D respectively. While mean keratometric value for left eye for a given age group is 44.6165±1.3084 D, 44.3345±0.9021 D, 45.2645±1.5135 D and 44.4597±1.309 D respectively. In paired t test for right and left eye keratometry difference is not statistically significant (p=0.6849)(95% CI -0.1192- 0.1810). For axial length mean±SD value for age group A, B, C and D for right eye is 23.0880±1.0910 mm, 22.5302±0.9724 mm, 22.6156±0.7861 mm and 22.9705±1.0636 mm respectively. While for the left eye axial length for group A, B, C and D is 23.0857±1.0069 mm, 22.5454±0.9532 mm, 22.4965±0.8416 mm and 22.9445±1.0585 mm respectively. In paired t test for right and left eye axial length difference is not statistically significant (p=0.1509)(95% CI -0.013- 0.089). In our study mean value for keratometry for a given age group A,B,C and D for male is 44.2076±0.5691 D, 44.1892±0.6806 D, 45.5231±1.3972 D and 44.0661±0.9158 D and for female is 44.2088±1.8045 D, 44.4050±0.9729 D, 45.1632±1.5669 D and 44.7561±1.4638 D respectively. Difference in right and left keratometry in male and female is not statistically significant as (p=0.1551,p=0.1281)(95%CI-0.7437 to 0.1195, -0.7629 to 0.0970) While for mean values for axial length for a given age group A,B,C and D for male 23.0546±0.8297 mm, 22.5447±1.1112 mm, 22.4497±0.8446 mm and 23.0464±1.0868 mm respectively. While for female is 23.1192±1.2303 mm, 22.5321±0.8211 mm, 22.6370±0.7849 mm and 22.8736±1.0292 mm respectively. Difference in right and left axial length in male and female is not statistically significant as (p=0.9698,p=0.9829)(95%CI-0.3163 to 0.3287, -0.3246 to 0.3177).

Conclusion: This study provides normative data for keratometry and axial length distribution for different age group for West Indian population. Study will help to improve current biometry practice. Study also shows no any significant difference in keratometry and axial length values in different age group included in our study and also no any statistical significant difference between right eye and left eye and in gender too.

Keywords: Kertometry, Axial length, Astigmatism, Biometry, IOL Power.

Introduction

Measurement of corneal power i.e. keratometry (K) and axial length (AL) is called biometry. These are different parameters of eye which exhibits wide variation in general population. Axial length and keratometry are one of them. These both parameters are important for calculation of intraocular lens power.(1) Factors that affect refractive power of eye include tear film, anterior and posterior surface of cornea, aqueous humour, lens, vitreous humour and axial length. Out of these corneal power and axial length affects more to the refractive error of eye. Phacoemulsification with foldable intraocular lens implantation is the standard surgery for cataract patient.(5) For calculation of Intraocular lens power by different formula accurate measurement of these two parameter are very much important.(6)

A Scan is an amplitude modulated ultrasound machine. It measures the axial length of eye. Axial length is measured by using applanation probe in contact with cornea. Other method available is immersion method in which contact with cornea is not required.(3) Here we have measured Axial Length with contact method.

Keratometry is measurement of corneal curvature on the anterior surface of cornea.(4) Usually all keratometer measure central 3 mm of anterior corneal curvature. Corneal curvature is usually measured on two axis having maximum and minimum corneal power and are known as K values. The difference between two K values is corneal astigmatism. Corneal curvature can be measured by keratometer which may be manual or automated. Here we are using autokeratometer. These both parameter are important in intraocular lens power calculation as change of 1 mm axial length produces approximately 3 diopter of change in refractive power of eye while 1 mm change in corneal curvature produces approximately 6 diopters of change in refractive power of eye following cataract surgery. Several studies shows correlations between axial length, keratometry and refractive error.[7-10]

Inclusion criteria: We have randomly enrolled 147 patients attending our daily OPD. Patients of age from 11 to 75 years of both sex and who had agreed to participate in study are enrolled in study.

Exclusion criteria: Patients with age more than 75 years are excluded. Having history of contact lens wear, any refractive surgery, any ocular surgery will not be enrolled in study. Patients having dry eye, corneal opacity, pterygium, significant myopia > 6 diopter and significant hypermetropia > 6 diopter are not enrolled in study. Patient having astigmatism > 4 diopter were also not included in study. In relation to patients having axial length <20 mm and > 26 mm are excluded from study. Patients having posterior staphyloma or previous injury were also excluded. Patients who refused to take part in study or who are physically handicap are excluded from study.

Materials and Methods

In total 147 patients from out patient department have taken part in this study. After patient had given consent to take part in study, study procedure is explained. All data related to name, age, gender, address were noted. Patients having history of any ocular surgery and ocular pathology are excluded from the study. Then ocular examination was done including visual acuity with best corrected vision, slit lamp anterior segment examination, dilated fundus examination with slit lamp boimicroscopy. Keratometry done first with automated keratometer and vertical and horizontal anterior corneal curvatures are measured. Three readings of keratometry taken and mean of all three reading is considered for study. Then anaesthetic agent is applied in both eyes and patient is asked to look straight forward. Axial length measurement is done by contact method for both the eyes one by one. Mean measurement value with standard deviation <0.1 is considered for study. For the ease of calculation of data we have divided age of patient in four group. Group A includes age 11-20 years. Group B includes 21-40, Group C includes 41-60 and Group D includes 61-75 years of age patients. Study was conducted after taking permission from Institutional Human Ethics Committee of Authority.

Results

Changes in keratometry and axial length were calculated by using paired sample t test, independent sample t test and T- test assuming equal variances. Keratometric and Axial Length data were recorded as the means ± standard deviation.

Table 1 shows mean keratometric and axial length data for a given age group of West Indian population of Gujrat.

For the keratometry for left eye with variable age correlation coefficient r=0.08724 and p=0.2934 with 95% CI for r is -0.07573 to 0.2457. Same way for the keratometry of right eye with variable age group correlation coefficient r=0.04397 and p=0.5969 with 95% CI for r is -0.1188 to 0.2044. Axial length for right eye with variable age group correlation coefficient r= -0.03536 and p=0.6707 with 95% CI for r= -0.1961 to 0.1273. And same for the axial length of left eye with variable age group correlation coefficient r= -0.06053 and p=0.4664 with 95% CI for r= -0.2203 to 0.1024. In present study there is no correlation between right and left eye keratometry and age as r value is (r=0.08, r=0.04) (p=0.29, p=0.59). So the difference is statistically is not significant. Deviation in keratometry values shows no major difference. There is no correlation between right and left eye axial length and age as r value (r=-0.06, r=-0.03) (p=0.46, p=0.67). So the difference in axial length with increasing age has no any correlation.

Table 2 shows distribution of mean values for keratometry for right and left eye.

In paired t test for right and left eye keratometry difference is not statistically significant (p=0.6849) (95% CI -0.1192- 0.1810) for given age groups.

Table 3 shows distribution of mean values for axial length for right and left eye.

In paired t test for right and left eye axial length difference is not statistically significant (p=0.1509) (95% CI -0.013- 0.089).

Table 4 shows gender distribution of keratometry value in given age group.

Difference in right and left keratometry in male and female is not statistically significant as (p=0.1551, p=0.1281) (95%CI -0.7437 to 0.1195, -0.7629 to 0.0970).

Table 5 shows gender distribution of axial length value in given age group.

Difference in right and left axial length in male and female is not statistically significant as (p=0.9698, p=0.9829) (95%CI -0.3163 to 0.3287, -0.3246 to 0.3177).

Table 1: Age distribution of Keratometry and Axial Length

Age (yrs)	Keratometry (Diopter)	Axial Length (mm)
11-20 (group A)	44.7082±1.4179	23.0869±1.0395
21-40 (group B)	44.3073±0.8552	22.5378±0.9570
41-60 (group C)	45.3186±1.4984	22.5561±0.8118
61-75 (group D)	44.4210±1.2683	22.9575±1.0535

Table 2: Eye distribution for keratometry in diopter

Age(yrs)	RE	LE
11-20 (group A)	44.8000±1.5401	44.6165±1.3084
21-40 (group B)	44.2802±0.8156	44.3345±0.9021
41-60 (group C)	45.3727±1.4987	45.2645±1.5135
61-75 (group D)	44.3822±1.2437	44.4597±1.3095

Table 3: Eye distribution for Axial length in mm

Age(yrs)	RE	LE
11-20 (group A)	23.0880±1.0910	23.0857±1.0069
21-40 (group B)	22.5302±0.9724	22.5454±0.9532
41-60 (group C)	22.6156±0.7861	22.4965±0.8416
61-75 (group D)	22.9705±1.0636	22.9445±1.0585

Table 4: Sex Distribution for keratometry in diopter

Age(yrs)	Male	Female
11-20 (group A)	44.2076±0.5691	44.2088±1.8045
21-40 (group B)	44.1892±0.6806	44.4050±0.9729
41-60 (group C)	45.5231±1.3972	45.1632±1.5669
61-75 (group D)	44.0661±0.9158	44.7561±1.4638

Table 5: Gender distribution for Axial length in mm

Age(yrs)	Male	Female
11-20 (group A)	23.0546±0.8297	23.1192±1.2303
21-40 (group B)	22.5447±1.1112	22.5321±0.8211
41-60 (group C)	22.4497±0.8446	22.6370±0.7849
61-75 (group D)	23.0464±1.0868	22.8736±1.0292

Table 6: Comparision of Keratometry and Axial Length values of different ethnic group

Study	Ethnicity	Axial Length			Keratometry		
		Male	Female	All	Male	Female	All
The Los angeles Latino Eye study[26]	Latinos	23.65	23.18	23.38	43.35	43.95	43.72
The Mongolian study[25]	Mongolians	23.43	23.08	23.13	43.65	44.24	43.95
The reykjavik study[29]	White	23.74	23.20	23.47	43.41	43.73	43.57
The Liwan Eye study[23,24]	Chinese	23.38	22.83	23.11	43.50	44.25	43.88
The South Nigerian study[30]	Nigerian	23.86	23.27	23.57	42.95	41.90	42.43
Our study	Indian	22.77	22.79	22.78	44.50	44.63	44.69

Discussion

Mean keratometry and axial length values for our study is 44.7080±1.3343 D and 22.7403±0.9793 mm respectively.

In our study deviation in keratometry and axial length distribution with age shows no major difference. This result is consistent with study result of China population.[15,21] And Consistent with our study, the Los Angeles Latino Eye Study and the Liwan Study also did not show an association between AL and age.[16,17] So This signifies that after the developmental age the keratometry i.e. corneal curvature and axial length have no changes. This evaluation can also be useful for IOL calculation in lasik eye. Because if the previous data of corneal curvature is available then it can be useful for proper calculation of IOL to be implanted. This study also provides normative data for specific age group population of Gujrat. Francois et al.[19] noted a difference of 0.40 mm in axial length in patients less than 40 years and above 40 and this decrease in axial length was statistically significant. Similar findings were noted by Gernet H et al., in 1964.[20] While in our study we have noticed decrease in axial length of 0.80 mm after age of 60 but the difference was not statistically significant. In our study, there was no correlation between Keratometry and age. Hayashi et al. reported that the degree of both horizontal and vertical corneal curvatures increases with age.[27] Consistent with our study, Lee et al. reported that after adjusting for the effects of other parameters, changes in corneal curvature did not have a statistically significant correlation with age.[21,28]

In our study mean±SD values for keratometry for male and female subjects are 44.4965±0.6872 D and 44.6332±0.4196 D respectively. While Axial Length values for male and female subjects are 22.7738±0.3218 D and 22.7904±0.2615 D respectively. Although female subjects showed longer axial length than the male counterparts, the difference in mean AL between them was not significant. Female subjects have slightly steeper corneal curvature compared to male subjects but difference between them was not statistically significant. This was consistent to the claim of Osuobeni.[18] In contrary to our study in Hui Chan study Male subjects had significantly longer Axial Length (23.68 mm versus 23.23 mm, $P < 0.001$).[21] Also a study conducted in Nepal shows females had significantly shorter axial length compared to males (22.85 mm versus 23.04 mm, p=0.023).[14] While flatter Ks for male (43.85D versus 44.50 D, $P < 0.001$) than female subjects is consistant with our study.[14,21] A study conducted in Rawalpindi shows females have more keratometric readings but shorter axial lengths than males**.** Gender based comparison showed that the mean ±SD K1 in males (42.95 ±1.54D) was less than 43.88 ±1.67D for females (p=0.0001). The mean ±SD K2 for males (43.9 ±1.66D) was also less in females (44.78 ±1.70D) (p=0.0001). This results are consistant with our study but contrary to our result, the mean ±SD axial length of eyes in males was 23.81 ±1.23mm significantly more than 23.16±1.08mm in females (p=0.0001).[22] So as per our study there is no any significant difference in keratometry and Axial length value for male and female, general normative value derived from our study can be used for any gender for ocular biometry.

In our study mean±SD for keratometry value for right and left eye is 44.7235±1.3518 D and 44.6926±1.3211 D respectively. While for the Axial Length it is 22.7593±0.9829 mm and 22.7214±0.9789 mm respectively. Study shows no any statistically significant difference in both values for right and left eye. As our study shows there is no any significant difference in keratometry values of right and left eye, in case of trauma or in a condition when keratometry of one eye is not possible, we can use keratometry values of other eye for IOL calculation. As study shows there is no any significant difference in k values between right and left eye, any major difference in k value between two eye should be seen precisely for suspecting any corneal weaking condition. As our study shows there is no any significant difference in Axial length values of right and left eye, in case of trauma or in a condition when Axial length of one eye is not possible, we can use Axial length values of other eye for IOL calculation. As study shows there is no any significant difference in Axial length between right and left eye, any major difference in Axial length between two eye should be seen precisely for suspecting any ocular condition in which there is increase in axial length like trauma, unilateral myopia, posterior staphyloma, posterior scleritis and sclera weakening etc.

Here we have compared our data with different ethnic group of world. Data shows that West Indian population has shorter axial length but steeper corneal curvature. These might be the natural mechanism to compensate to achieve emmetropia.

Conclusion

At the end of study we got the normative value of keratometry and Axial Length for West Indian population which is 44.7080±1.3343 D and 22.7403±0.9793 mm respectively. Study shows that there is no any significant difference in keratometry and axial length distribution with increasing age, gender and between right and left eye too.

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Conflicts of Interest: None

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