Original Research Article

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20204455

Ocular biometric analysis of cataract surgery candidates, referred from community outreach camps, organized at rural areas of central India

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Received: 23 September 2020 Accepted: 08 October 2020

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ABSTRACT

Background: Aim of this study was to analyse the ocular biometric parameters and their associations in a population of cataract surgery candidates.

Methods: Ocular biometry records were retrospectively analyzed for 84634 patients with cataracts (84634 eyes) who were treated at Northern Indian region. Ocular biometry characteristics such as Axial length (AL), the Keratometry readings (K1 and K2), and Posterior chamber intraocular lens (PCIOL) power of patients were assessed to find mean, standard deviation, minimum value and maximum value. Statistical analysis was done in Statistical package for social sciences (SPSS) 22.0.

Results: Age ranged from 1.0 years to 111 years (mean 63.9 ± 9.24). Males were 43421 (51.3%) and females were 41213 (48.7%). Mean AL was 23.36 ± 3.99 mm. Mean K1 was 44.79 ± 2.11 D. Mean K2 was 45.05 ± 2.25 D and the average K was 44.92 ± 2.01 D. Significant differences were observed in all the parameters when the findings for females and males were compared.

Conclusions: The present study presents normative biometric parameters and their relationships in a rural Indian population. These results may be relevant not only in the evaluation of the refractive error but also in the Intraocular lens (IOL) calculation for cataract surgery. The greatest predictor of the ocular biometrics was age and gender. This would serve as initial normative data for the biometry values in the Indian adults going through cataract surgery because such facts are lacking in Indian population.

Keywords: Cataract surgeries, Biometric parameters, Intraocular lens power, Axial length of eye, Keratometry

INTRODUCTION

Cataract is one of the most common causes of visual impairment in the world. According to the World Health Organization (WHO), cataract is the leading cause of blindness all over the world, responsible for 47.8% of blindness and accounting for 17.7 million blind people.^{1,2} In India, 80% of the blindness is due to cataract.^{3,4} Cataract surgery is amongst the most commonly carried out surgical procedures worldwide. Advances in the surgical instruments and the intraocular lens design have boosted

the patients expectations of good visual outcome without the use of spectacles. Therefore, accurate biometric measurements are essential. Knowledge of these measures is fundamental for obtaining precise calculations for the intraocular lens (IOL) power, which is primarily based on formulas derived from normative ocular biometric parameters.

It is known that ocular biometric parameters such as axial length (AL), corneal power (K), and anterior chamber depth (ACD) (corneal epithelium to anterior lens) vary

with gender, age, and ethnicity, and hence are different among different populations.⁵⁻¹⁰

The WHO vision 2020 proposal and similar plans have led to the increase in the surgical involvements performed to combat the epidemic of the preventable blindness. Though, the occurrence of cataracts as the public health issue continues to increase as the world-wide mean life expectancy rises.¹¹

Although there are several studies that explain these mean parameters in European-Caucasian population, but there has been very little attention to the studies carried out in Asian, Black and Hispanic populations.¹²

There has not before been a large study of biometric values for rural Indian population. The objective of our study is to describe ocular biometric parameters and their correlations in the population of the cataract surgery candidates in rural central India.

METHODS

This was a hospital-based retrospective study of ocular biometric analysis of patients, who underwent cataract surgery at a tertiary eye care center and referred from outreach screening camps, organized in rural part of central India. The study was approved by the Institutional review board of the parent institution and adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from patients before undertaking treatment options.

Local language was preferred to ask each patient's history and it was taken using a confidential questionnaire formulated by the staff members. The questionnaire included questions providing information on personal data, which were next properly encoded. The clinical data given by patients were then complemented with information on diagnosis of the disease, the treatment administered (present and/or past), adverse effects reported, and laboratory findings.

Medical records of 85000 consecutive patients referred to tertiary eye care center from January 2017 till December 2019 were reviewed and analyzed in year 2020.

All the patients referred to base hospital underwent a comprehensive ophthalmic and systemic examination which included detailed history taking, visual acuity, slit lamp evaluation, intraocular pressure (IOP) measurement by rebound tonometry (iCare), fundus evaluation, nasolacrimal sac syringing, blood pressure assessments and random blood sugar examination.

Patients with cataract, at least in one eye, age 1 year or above and with no history of any corneal pathology were included in this study. Patients with complicated cataract, astigmatism >3.0 D and requiring ocular surgery other than the cataract extraction were excluded from the study. All patients fulfilling inclusion criteria and posted for cataract surgery underwent ocular biometric examination.

AL was measured by using ultrasound applanation A-scan probe placed directly on the corneal surface by holding the ultrasound probe by hand, which uses the signals from tear film and the retina (ILM) to calculate AL. AL measurements were done a minimum of 5 times in each eye, AL was obtained from combined mean value of 5 measurements. Keratometry was performed bv autorefracto-keratometer. Minimal K (i.e. K1) and maximal K (i.e. K2) were determined at minimal and maximal radii of the curvature, and two values were averaged to obtain K. The SRK-T formula (as per the AL) was used for the statistical analysis of the theoretical IOL powers, and the target refraction was set as 0.00 D.

The sample was calculated on the basis of prevalence using the formula.

$$n = Z^2 p(1-p) \div d^2$$

Z is the statistic corresponding to level of confidence, p is expected prevalence, d is precision (corresponding to effect size). With the assumption of 65% as and with absolute precision of 5% and 95% confidence interval (CI) and a design effect of 1.96, the minimum sample size came out to be around, n=350

Collected data was analyzed using IBM Statistical package for social sciences (SPSS) statistics software version 22.0 (IBM Corp, Armonk, New York, USA). First, we determined the overall percentage of patients by age, gender, and they were compared with various biometric parameters using the independent sample t-test. Regression models considering gender, age, were constructed to establish associations with most relevant ocular biometric parameters (AL and K). The level of statistical significance was 5.0% in this study.

RESULTS

In this study, we reviewed 85000 patients out of which 366 were not satisfying the inclusion criteria therefore the final study population was 84634 cataract patients.

Out of 84634 cataract patients, 43421 (51.3%) were men and 41213 (48.7%) were women. Average age of patients was 63.9 ± 9.24 years, ranging from 1 to 111 years. Table 1 shows demographic details of the patients.

The population was divided into six age groups: ≤ 20 years: 0.2% of the total population, 21-35 years: 0.4%, 36-50 years: 6.6%, 51-65 years: 50.4%, 66-80 years: 39.6% and above 80 years: 2.8%.

The AL distribution $(22.78\pm1.58 \text{ mm})$ and The K distribution $(44.79\pm2.11 \text{ D})$ and their association with gender was statistically significant (p<0.05). Mean AL was significantly longer in men $(22.90\pm1.71 \text{ mm})$ than in

women (22.63 \pm 1.41 mm, p<0.001). Conversely, mean K was significantly greater in women (45.32 \pm 1.92 versus 44.54 \pm 2.02 D, p<0.001), (Table 2).

Table 1: Demographic details.

Variable	Ν	%
Gender		
Male	43421	51.3
Female	41213	48.7
Age (years)		
≤20	204	0.2
21-35	311	0.4
36-50	5570	6.6
51-65	42620	50.4
66-80	33550	39.6
>80	2379	2.8
Mean age (mean±SD)	63.9±9.24	
Right eye	44374	52.4
Left eye	40260	47.6

Table 2: Association gender with biometric parameters.

Parameters	(n=	(n=	(n=	P
	84634)	43421)	41208)	value
Axial length (mm)	22.78 ±1.58	22.90 ±1.71	22.63 ±1.41	< 0.001
Average	44.79	44.54	45.32	0.025
km (D)	±2.11	±2.02	±1.92	

Table 3: Association of age with biometricparameters.

Age (years)	Ν	Axial Length (Mean±SD)	Keratometry (Mean±SD)
≤20	204	20.28±8.22	38.89±14.7
21-35	311	22.72±1.26	44.73±1.89
36-50	5570	22.85±1.47	44.78±1.91
51-65	42620	22.78±1.71	$44.94{\pm}1.87$
66-80	33550	22.76±1.29	44.95±1.84
>80	2379	22.73±1.07	44.87±1.73
P value		< 0.001	< 0.001

Table 4: Matrix of correlations of ocular biometric parameters in Indian population.

Age	Axial length	Keratometry
1	0.013	0.050
0.013	1	-0.103
0.050	-0.103	1

**correlation is significant at the 0.01 level (2 tailed).

The mean AL and K showed a trend of increase with increasing age (p<0.001), (table 3). Age shows positive Pearson constant with AL (0.013) and K (0.050) and the

association was found to be highly statistically significant (p<0.001). AL was negatively statistically associated with K (-0.103), (Table 4).

DISCUSSION

The aim of our study was to describe the ocular biometric parameters and their associations in a population of cataract surgery candidates referred from rural part of central India and we found that the mean age of the total studied patients was 63.9 ± 9.24 years and the majority of the patients were or the age 51-65 years (50.4%), followed by 66-80 years (39.6%). Our findings were similar to the study performed by Shoaib et al who reported the mean age of their studied patients as 63.05 ± 10.52 years.¹³ Age at the time of cataract operation varies from country to country example, in southern Chinese11 mean age was 70.4 ± 10.5 years about 7 years older than our patients. The mean age 64.04 ± 10.81 years was reported Natung et al.¹² This implies that the cataract problem increases with age and it mainly occurs in 7th decade of life.

In our study the majority of the patients were male (51.3%) followed by females (48.7%). Our findings were in accordance with Shoaib et al, who reported that in their study male were 412 (54.79%) and females were 340 (45.2%).¹³ There were 334 males and 307 females in the study performed by Natung et al.¹² In a study by Nigam et al reported 73 (55.30%) patients were male and 59 (44.70%) were female.¹¹

The mean AL of all studied patients was 22.78±1.58 mm, whereas in males it was 22.90±1.71 mm and females it was 22.63 ± 1.41 mm that is the mean AL was significantly longer in men than women (p<0.001). Similarly mean keratometry finding for all the patients was 44.79±2.11 D and mean K was significantly greater in women (45.32±1.92 versus 44.54±2.02 D, p<0.001). Similarly different readings of AL and corneal curvature have been reported from different areas of the world. In West, Norfolk Island residents (descended from the English bounty mutineers and their polynesian wives) findings for AL, and mean K (km) were 23.5 mm, and 43.52 D respectively.16 Also these findings are comparable to another European study (Portugal) where mean AL, and Km have been 23.87±1.55 mm (19.8-31.92 mm), and 43.91±1.71 D (40.61–51.14 D) respectively.¹² Naturg et al reported that the mean AL in males (23.58±0.99 mm) was longer than the females (23.07±1.19 mm) and was (p=0.001).¹⁵ statistically significant Fifty-seven participants (8.9%) had AL <22 mm, 521 (81.3%) had between 22 and 24.5 mm, 48 (7.5%) had between 24.51 and 26 mm, and 15 (2.3%) had >26 mm. The mean K was 44.41±1.50 D. There was a statistically significant difference in the mean K between the males and the females (p=0.00). Our study findings were also supported by Huang et al who reported that the mean AL was significantly higher in males (24.79±2.48) than females (23.88±2.27) (p<0.001).¹⁴ On comparing the studies on comparing the studies for AL measurement, the mean AL

in our study was longer than the AL of Chinese population from Singapore and rural China and Iranians.¹⁷⁻¹⁹ It was shorter than the AL of Whites, Chinese of Southern China, Malay, and Singaporean Indians.^{20,23-25} Greater mean K in women indicates higher corneal refractive power, which may be an emmetropizing mechanism to compensate for shorter AL.

In our study we found that the mean AL and K showed a trend of increase with increasing age (p<0.001). Our findings were supported by Natung et al who reported that the AL decreased initially and then increased with the increase in age, which was statistically significant (p=0.004).¹⁵ The mean K increased initially and then decreased with the increase in age but the change was not statistically significant (p=0.074). Huang et al also reported the significant association of age with both Al and K in their study (p<0.001).¹⁴

In contrast most studies, there was no significant correlation between age and AL, ACD, or K.^{24,25} The interpretation of these differences is complex and would require adjustments for the refraction, height, age, and even educational level of the studied population.

In the present study age shows positive Pearson constant with AL (0.013) and K (0.050) and the association was found to be highly statistically significant (p<0.001). AL was negatively statistically associated with K (-0.103).

Similar to the present study Ferreira et al reported there was the positive association between AL, K and ACD (p>0.05) and CD, and the negative association between AL and LT.¹² These results are in concurrence with those presented in the literature except for K, whose association with AL is inverse in most series, showing emmetropic association between corneal curvature and AL.²⁶⁻²⁸ Although there may be population differences and the correlation with refractive error has not been addressed in this study, the different published studies in the literature reported keratometry, and these values cannot be compared directly with ours because of different methods of measurement and refractive indices used.

Majority of the authors have used cross-sectional prospective study and their sample size was also small. We have chosen a retrospective design of study so that we can test a large population who went through the cataract surgery and check their biometric parameters as there were almost no Indian retrospective studies testing the biometric parameters of the cataract patients.

Limitation of our study is that a few readings were missing in the analyzed data also a few other parameters must be used to get better analysis and cannot determine causation, only association. However, besides these limitations, relatively a large sample size was analysed and identified the association very well. Up to our knowledge, this is the first study providing potential predictive biometric parameters for the change of biomechanical values due to cataract surgery. More such types of studies with other biometric parameters are required to get a better analysis.

CONCLUSION

In conclusion, the present study presents normative biometric parameters and their relationships in a rural Indian population. These results may be relevant not only in the evaluation of the refractive error but also in the IOL calculation for cataract surgery. The obtained AL, and mean K values were closer to the US population than most published series in different European Caucasian populations. This would serve as initial normative data for the biometry values in the Indian adults going through cataract surgery because such facts are lacking in Indian population. This data would also help ophthalmologists in choosing correct IOL and the incision location, thereby enhancing the surgical outcome in phacorefractive or phacoemulsification surgeries.

Funding: No funding sources Conflict of interest: None declared Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Bhardwaj R, Jaiswal N, Sharma S, Kohli A, Singh S, Pal VK, et al. Ocular biometric analysis of cataract surgery candidates, referred from community outreach camps, organized at rural areas of central India. Int J Community Med Public Health 2020;7:4592-6.