



BIOMETRIC INDICES AND CORNEAL ASTIGMATISM IN INDIAN SUBJECTS WITH CATARACT

Ophthalmology

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ABSTRACT

Purpose: To evaluate the biometric indices and keratometry values in 250 subjects with cataract.

Methods: An observational study where keratometry and biometric indices of 250 subjects with cataract were taken. These included axial length (AL), anterior chamber depth (ACD) and keratometry readings (K). The mean value and range for each parameter was assessed. In addition, the measurements for AL and ACD were evaluated in relation to age and sex of the participants.

Results: Our study included 250 eyes of 250 patients who presented with cataract. Out of these, 148 were women (59.2%) and 102 were men (40.8%). Also, females presented for cataract surgery at a slightly older age than males ($P=0.5$). The mean AL and ACD were 22.76 ± 2.08 and 2.49 ± 0.75 mm respectively. The mean corneal astigmatism was $1.0 \pm 0.50D$, with 91 (36.4%) eyes showing astigmatism $\geq 1 D$. Men had significantly longer AL, higher ACD in comparison to women ($P < 0.001$). With advancing age, the mean AL ($r = 0.12$; $P < 0.001$) and the mean ACD ($r = 0.23$; $P < 0.001$) were found to decrease.

Conclusion: Our study provides the normative biometric indices and their relationship with age and gender in Indian subjects with cataract. We encourage ophthalmologists to personalize the formulas' keeping in consideration the variations in biometric and keratometric indices encountered in the Indian population.

KEYWORDS

INTRODUCTION

Cataracts are among the most common causes of decreased vision and blindness [1]. The evidence to date supports a higher prevalence of cataract in various Asian populations [2] and it is believed to be responsible for nearly 50-80% of the bilaterally blind in India [3]. Cataract is known to affect nearly 9–12 million Indians annually after the age of 50 years [4]. Thus, suggesting that senile cataract is a major morbidity encountered in the elderly Indian population [5]. Cataract surgery is the most commonly performed ocular surgery worldwide and phacoemulsification is the most commonly used surgical method. Axial length (AL), anterior chamber depth (ACD) and corneal curvature (K) are considered the most important determinants for accurate intraocular lens (IOL) power calculations. The IOLMaster (Carl Zeiss Meditec, Germany), approved by the United States Food and Drug Administration in March of 2000 is a non-contact optical device based on partial coherence interferometry that measures the distance from the corneal vertex to the retinal pigment epithelium. It provides highly repeatable and reproducible corneal parameters, ACD and AL values with an ultra-high precision (5 mm or less) and good resolution (12 mm) [6].

Basic anatomical parameters in ophthalmology are known to vary with age, gender and ethnicity, therefore individuals from different countries with a varied ethnicity may present with anatomical parameters which are significantly different from those of other countries. Determination of the normal range of these parameters will provide ophthalmologists with important information that can lead to an improvement in cataract surgical outcomes. Although there are many studies that describe these mean parameters in subjects with cataract in the Western population, there has been little evidence to document the same in Indian subjects. The aim of this study was to determine the axial length AL, ACD and keratometric values in Indian subjects with cataract presenting to a North Indian Eye hospital and also to compare the indices with those reported from the Western literature.

Methods

Study design

A cross-sectional study was carried out over a period of six months where, the biometry data of 250 cataractous eyes of 250 patients was extracted. The study conformed to the HELSINKI declaration of medical ethics and was approved by the centre's ethics committee. All patients provided written informed consent. Subjects older than 40 years of age presenting with cataract and with no corneal or retinal

pathology were included. Cases of traumatic cataract, phacomorphic glaucoma and with history of previous ocular surgery were excluded.

Data collection

Routine eye examinations were performed before surgery, including visual acuity, refraction, tonometry, slit lamp evaluation, and dilated fundus evaluation. All biometric measurements were performed with the IOLMaster (Carl Zeiss Meditec, Germany). The following biometric measurements were recorded for each patient: (1) AL in millimeters (mm), defined as the axial distance between the anterior corneal surface and the anterior retinal surface; (2) ACD in mm, defined as the axial distance between the anterior surface of the cornea and the anterior surface of the lens; and (3) keratometric values using a keratometric index of 1.3375, and the readings were taken in diopters (D). It was measured in 2 meridians: flat keratometry (K1) and steep keratometry (K2). The K value was taken as the mean of K1 and K2.

Statistical Analysis

All data was analyzed by the SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). The mean values ($\pm SD$) of all measurements were calculated and the AL and ACD values were evaluated in relation to age and sex. Regression models considering age and gender were constructed to determine associations with AL and ACD. Paired t tests were performed to establish whether there was a statistically significant difference between the values under study. A P value less than 0.001 was considered statistically significant.

RESULTS

Demographic data:

Our study included 250 eyes of 250 patients who presented with cataract. Out of these, 148 were women (59.2%) and 102 were men (40.8%). The mean age of the patients was 58.8 ± 9.1 years (Table 1). Females presented for cataract surgery at a slightly older age than males ($P=0.5$).

Table 1: Demographic data

Parameter	Mean \pm SD
Eyes (n)	250
Patients (n)	250
Age (years)	58.8 ± 9.1
Females n, (%)	148 (59.2%)
Males n, (%)	102 (40.8%)

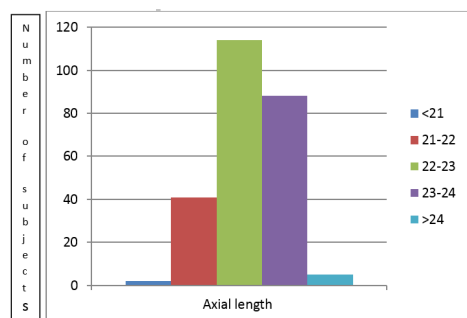
Mean ocular biometric indices:

The mean AL was 22.76 ± 2.08 mm, whereas, the ACD showed a mean value of 2.49 ± 0.75 mm. The mean corneal astigmatism was 1.0 ± 0.50 D, with 91 (36.4%) eyes showing astigmatism ≥ 1 D. (Table 2)

Table 2: Mean ocular biometric indices

Parameter	Total	Males	Females
Axial length (mm) \pm SD	22.76 ± 2.1 mm	23.01 ± 2.08	22.53 ± 1.8
Anterior chamber depth (mm) \pm SD	2.49 ± 0.75 mm	2.6 ± 0.7	2.31 ± 0.59
Mean keratometry (D) \pm SD	43.87 ± 1.82	43.41 ± 1.21	44.10 ± 1.17

Figure 1: Axial length distribution



Correlation of biometric indices with gender and age:

Men had significantly longer AL in comparison to women (23.01 ± 2.08 mm vs. 22.53 ± 1.8 mm; $P < 0.001$). The mean ACD was 2.49 ± 0.75 mm. The overall ACD was statistically higher in men in comparison to women (2.6 ± 0.7 mm vs. 2.31 ± 0.59 mm, $P < 0.001$). Therefore, male eyes had longer ALs, deeper ACDs and flatter corneas than female eyes, all the values being statistically significant ($P < 0.001$). With advancing age, the mean AL ($r = 0.12$; $P < 0.001$) and the mean ACD ($r = 0.23$; $P < 0.001$) were found to decrease.

DISCUSSION

This study evaluated the normative values of ocular biometric parameters and keratometry measured using the IOLMaster device in Indian subjects with cataract. To the best of our knowledge, this is the first study to characterize these parameters using the IOL Master in this study group. In our series, the number of women presenting with cataract were more than men (59.2% versus 40.8%). Also, the women presented for surgery at a slightly older age than men. In our study, the mean AL was 22.76 ± 2.1 mm, which is lower than the AL values reported in Western literature {Haigis (23.48 ± 1.67 mm) [7], Olsen et al. [8] (23.47 ± 1.56 mm), Shammas [9] (23.45 ± 1.48 mm) and Hoffer [10] (AL of 23.65 ± 1.35 mm)}.

In our study, the mean ACD as measured using the IOL master was found to be 2.49 ± 0.75 mm. The ACD tended to decrease with increase in age ($r = 0.23$; $P < 0.001$). The values were lower than those reported in Western literature by Nemeth et al (2.87 ± 0.4 mm) [11] and Jivrajka, R et al (2.96 ± 0.45 mm) [12].

It is known that about 29 to 40% of patients undergoing cataract surgery have corneal astigmatism greater than 1 D [13]. In our study, the vast majority of eyes with cataract had a corneal astigmatism between 0.5 D and 1.0 D. The mean corneal astigmatism was 1.0 ± 0.50 D, with 91 (36.4%) eyes showing astigmatism ≥ 1 D. These values are higher than those reported in most studies, such as those by Ferrer-Blasco et al. [13] (34.8%) in Spain and by Hoffmann et al. [14] in Germany (36%).

In this study, male eyes had longer ALs, deeper ACDs and flatter corneas than female patients did, and these results are in accordance with those reported in the Western literature [14, 15, 16]. It is believed that the variation in height of individuals can account for the differences in biometric indices found between the genders [15].

CONCLUSION

Our study provides the normative biometric indices and their relationship with age and gender in Indian subjects with cataract. All newer formulas depend on the AL, ACD, as well as on the K readings, for accurate IOL power calculations. Since gender and race appear to be important determinants of ocular biometric parameters, it may be

important to consider them in the calculation of the IOL for cataract surgery, as shown by the appearance of the first 5th-generation formula, the Hoffer-H-5, which uses the same basic structure as the Holladay 2 formula but considers gender and ethnicity to reduce the error associated with the use of generalized population regression factors. We encourage ophthalmologists to personalize the formulas' keeping in consideration the variations in biometric and keratometric indices encountered in the Indian population.

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