

Axial Length Variability in Cataract Surgery

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ABSTRACT

Objective: To determine the mean axial length and biometric measures in patients undergoing cataract surgery and further compare the variability of axial length between the gender and with age.

Study Design: Cross-sectional observational study.

Place and Duration of Study: Eye Unit I, Department of Ophthalmology, Liaquat University of Medical and Health Sciences, Hyderabad, Pakistan from January 2010 to December 2012.

Methodology: All patients referred for cataract surgery were assessed. The study included 886 eyes which were straightforward cataract cases with no other ocular problem. The data was collected for axial length, keratometric values and Intra-Ocular Lens (IOL) power prior to cataract surgery. The collected data was then analyzed using SPSS version 19 for windows software.

Results: Gender based comparison showed significant difference in age, axial length, keratometric values and IOL power between the two groups ($p=0.000$). 86% of the eyes had an axial length between 21.00 mm and 23.99 mm. In univariate analysis there was significant ($p=0.000$) relation between overall age and axial length. The keratometric values ranged between 36.75 D and 52.50 D. Majority of the IOL powers ranged between 20.00 D and 23.00 D.

Conclusion: The mean axial length of patients undergoing cataract surgery was 22.96 ± 1.04 mm, was comparable to Indian and Chinese population but shorter than the Western population. Females had shorter axial lengths, similar to other studies. Axial length was positively associated with age among the females, the cause of which is yet to be determined.

Key Words: Axial length. Biometry. Cataract surgery. Intraocular lens power.

INTRODUCTION

Cataract surgery is one of the most common surgeries to be performed in any ophthalmology setting. The most important pre-requisite of a successful cataract surgery is the Intraocular Lens (IOL) power calculation, which requires the axial length and keratometric values. The axial length is defined as the distance between the anterior surface of the cornea and the sensory retina, measured by A-scan ultrasound biometry. The corneal power is defined in terms of keratometric values: K1 which is the power of the cornea in the vertical meridian and K2 which is the power of the cornea in the horizontal meridian. The keratometric values are measured with keratometer. The assessment of intraocular lens power is the most important and crucial part of cataract surgery and requires precise biometric measures specially the axial length and keratometric values.^{1,2} The variability in these parameters can lead to significant refractive errors postoperatively requiring use of glasses which would negate the sole purpose of cataract surgery.

The most important factor affecting the calculation of intraocular lens power is the axial length.³ A number

of studies have determined the relationship of age, refractive error, education and socio-economic conditions with axial length.⁴⁻⁷

The aim of this study was to determine the mean axial length and biometric measures in patients undergoing cataract surgery and further compare the variability of axial length between the genders and with age.

METHODOLOGY

The study was carried out at Eye Unit I, Department of Ophthalmology, Liaquat University of Medical and Health Sciences, Hyderabad, from January 2010 to December 2012. All patients referred for cataract surgery were assessed and only uncomplicated straightforward cataract cases were included in the study, which had no other ocular problem. The data was collected for axial length, keratometric values and IOL power prior to cataract surgery. SRK-T formula was used for calculating the IOL power.

The collected data was then arranged and analyzed using Statistical Package for Social Sciences (SPSS) version 19 for windows software. Three steps data analysis was performed. In the first step, the data was analyzed as a whole in which frequency and descriptive statistics were evaluated for age, gender, axial length, keratometric values and IOL power. Secondly, the subjects were divided on the basis of gender into males and females. The student t-test was applied to compare age, axial length, keratometric values and IOL power among the two groups. The axial length was further

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divided into four groups: ≤ 20.99 mm, 21.00 - 23.99 mm, 24.00 - 26.99 mm, ≥ 27.00 mm. The percentages were calculated for each group of axial lengths. In addition, the axial length groups were compared between males and females. Univariate analysis was done with axial length as the dependent factor with overall age and also with age of both groups using 95% confidence interval and p-value of < 0.05 was taken as significant.

RESULTS

Of all the cases, 886 eyes met the criterion and were included in the study. Table I shows the detailed descriptive statistics of age, axial length, keratometric values and IOL power. The mean age was 55.08 ± 14.52 years and gender based distribution showed that 445 (51.4%) were females, while 431 (48.6%) were males. The keratometric values ranged between 36.75 dioptres (D) and 52.50 D. On comparison between the gender, significant difference was found in age, axial length, keratometric values and IOL power ($p < 0.001$, Table II). The IOL power distribution showed that majority of the IOL powers were between 20.00 D and 23.00 D (Figure 1). Overall axial length classification showed that 86% of the eyes had an axial length between 21.00 mm and 23.99 mm, while only 1% and 2% eyes were in ≥ 27.00 mm and ≤ 20.99 mm respectively (Figure 2). The comparison of axial lengths between males and females showed (Figure 3) that the majority of both groups had an axial length between 21.00 - 23.99 mm (F: 88.35% M: 82.83%). Females outnumbered males in both ≤ 20.99 mm (F: 2.19% M: 1.62%) and ≥ 27.00 mm group (F: 1.09% M: 0.46%), while more males (15.08%) ranged between 24.00 - 26.99 mm axial length as compared to females (8.35%). In univariate analysis, there was a significant ($p < 0.001$) association between the overall age and axial length. Between these two groups, axial length was significantly associated with age of females ($p < 0.001$) while it was insignificant for the age of males ($p = 0.014$).

Table I: Descriptive statistics of age, axial length, keratometric values and IOL power (n = 886).

	Mean \pm SD	Minimum	Maximum
Age (years)	55.08 \pm 14.52	4	95
Axial length (mm)	22.96 \pm 1.04	19.50	30.40
K1 (dioptres)	44.00 \pm 1.83	36.75	52.50
K2 (dioptres)	44.78 \pm 1.88	37.75	52.50
IOL power (dioptres)	21.10 \pm 2.50	4.00	35.00

Table II: Comparison of age, axial length, keratometric values and IOL power between males and females.

Mean	Males (n=431)	Females (n=455)	p-value
Age (years)	56.43 \pm 15.16	53.81 \pm 13.79	< 0.001
Axial length (mm)	23.13 \pm 1.00	22.81 \pm 1.05	< 0.001
K1 (dioptres)	43.68 \pm 1.80	44.31 \pm 1.80	< 0.001
K2 (dioptres)	44.47 \pm 1.81	45.05 \pm 1.89	< 0.001
IOL power (dioptres)	20.89 \pm 2.24	21.22 \pm 2.70	< 0.001

DISCUSSION

Worldwide there has been a variation in the mean age of patients undergoing cataract surgery, ranging from 49.46 years to 64.46 years.⁸⁻¹² Local studies reported a similar range of keratometric values (36.00 - 52.00 D) which slightly differed from Elder's range (40.25 - 47.87 D).^{8,13,14} Gender based comparison of keratometric values (M: 43.68 ± 1.80 F: 44.31 ± 1.80) was comparable to a Canadian study (M: 43.54 ± 1.47 F: 44.21 ± 1.40).¹⁵ The IOL power range was concurrent with local literature, however, Elder's IOL range (12.00 - 27.00 D) was different.^{8,13,14,16}

Ethnicity has been reported to affect the axial length of the eye due to difference in height, weight and other parameters. A comparative data among different ethnicities revealed that the axial length of Asians (East Asian 23.89 mm, South Asian 23.60 mm) was longer than Caucasians (23.24 mm) and Middle Eastern (23.45 mm) population.¹⁷ In contrast to this, our mean axial length (22.96 mm) was slightly less than other ethnicities, however, it was comparable to local studies but the range was greater. Naz¹³ reported axial length range of 21.00 - 28.00 mm and Rashid *et al.*⁸ reported between 18.00 - 29.31 mm while our range was 19.50 - 30.40 mm. The Beijing Eye Study¹⁸ reported the range of axial length between 18.96 - 30.88 mm which is comparable to this study. Indian population^{9,10,19} has shown similar axial lengths while the Mongolian⁶ and Chinese²⁰ population had longer axial length. There has been variability in the mean axial length among the Chinese population. The Tanjong Pagar Study²¹ and the Beijing Eye Study¹⁸ reported the mean axial length of 23.25 mm and 23.26 mm respectively, while another Chinese study²⁰ reported a mean axial length of 24.75 mm.

There was no significant difference between the mean axial length of males and females (M: 23.80 mm F: 23.29 mm) in the Epic Norfolk Study conducted on British adults using partial coherence laser interferometry.²² In contrast to this, in this study, females had a shorter mean axial length as compared to males (F: 22.81 mm, M: 23.13 mm). Several studies have reported that females have smaller eyes and, therefore, shorter axial length compared to males.^{23,24}

Axial length has been positively associated with age in a number of studies.^{10,18} The association of axial length and age was further analyzed between males and females. Interestingly, there was a significantly positive association of axial length and age among females only. One study¹² suggested that there was no relation between axial length and age, while another⁴ concluded that axial length decreased with age. The authors hereby suggest more studies should be conducted to explore the variation in the axial length and age between the genders, principally to find the cause of positive association among the females.

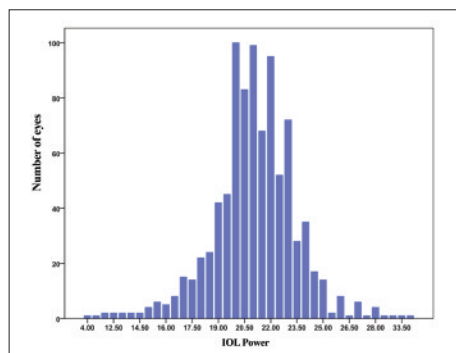


Figure 1: Bar graph showing distribution of intraocular lens power in diopters.

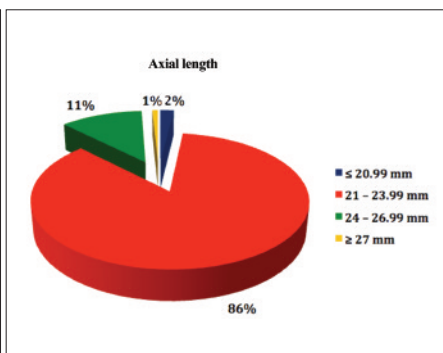


Figure 2: Pie chart showing overall axial length distribution.

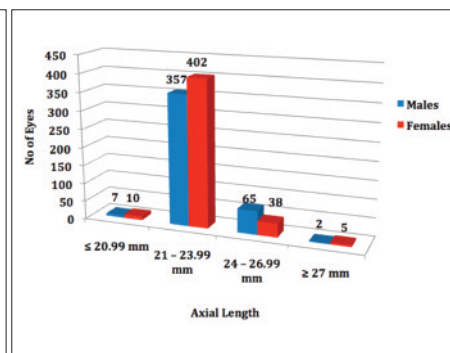


Figure 3: Bar graph showing axial length comparison between males and females.

CONCLUSION

The mean axial length of patients undergoing cataract surgery was 22.96 ± 1.04 mm, comparable to Indian and Chinese population but shorter than the Western population. Females had shorter axial lengths, similar to other populations. Univariate analysis showed that axial length was positively associated with age among the females, the cause of which is yet to be determined. The mean keratometric values were K1: 44.00 ± 1.83 D; K2: 44.78 ± 1.88 D and the mean IOL power was 21.10 ± 2.50 D.

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