Relationship of Axial length of the Eye and IOL power in indigenous people of North East India

Dr.Lhingkhohat Haokip[1],Dr.K.Sorojini Devi[2]

[1]Assistant Professor of Ophthalmology, Department of Ophthalmology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India
[2]Assistant Professor of Ophthalmology, Department of Ophthalmology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India
Corresponding Author: Dr.K.Sorojini Devi

Abstract: *Cataract surgery, the most commonly performed surgical procedure worldwide depends on many factors to perform successfully. Some of the factors to mention are advanced surgical instruments, skill of the surgeons and intraocular lens design for satisfactory postoperative refractive results. For achieving this goal, accuracy in biometric measurements is crucial. The ocular biometric characteristics of a population, including axial length (AL), keratometric power (K) are important for selection of most appropriate lenses to be implanted during cataract surgery To our knowledge, publications on studies about the values of ocular biometry parameters from North East India were not much reported.. The present work aims at the first hospital-based population study of ocular biometric characteristics of cataract in older patients of 57yrs to 85yrs fromNorth East India.*
Materials and methods: *Senile cataract patients who had attended outpatient department (OPD) were included in the study. Keratometric readings of vertical and horizontal corneal median (K1 & K2) were measured with manual keratometer and axial length was measured with contact A-scan.Power of IOL was calculated by using SRK-T formula. The data was analysed with descriptive statistics, independent sample t–test and correlation using IBM SPSS Statistics (2015).*
Results:*A total of 160 senile cataract patients were evaluated in the study and out of which 96 (60%) were females and 64(40%) were males. Their age ranged from 57 years to 85 years with a mean of 68.05±6.31 years.The mean±SD keratometric readings(K1 & K2) were 44.34± 1.75 D and 44.36± 2.15 D respectively.The mean±SD axial length was 22.59±0.90 mm in all the variables. The mean ±SD intra ocular lens power was 21.65.22±1.72D. Comparison based on gender showed that the mean±SD K1 in males(44.10±1.75) wasfound lessin females (44.53±1.45, p>0.05).The mean±SD K2 for males (44.17±2.15) was also less in females(44.49±1.45, p>0.05).The mean±SD axial length of eyes in male was 22.97±0.90 mm significantly more when compare to that of females (22.33±0.69 mm p<0.05).The mean±SD IOL power was 20.86±1.72D in males and 22.17±1.42 D in females (p>0.05).AL correlated negatively with K1 (Correlation coefficient 'r'-0.543,p<0.05), K2 (-0.452, p<0.05) and IOL (-0.752, p<0.05).*
Conclusion: *The result shows that older cataract patients from North East India have similar ocular biometric characteristic as other populations. Females tend to have more keratometric readings but shorter axial lengths than males thereby females required higher IOL power to be implanted after cataract surgery. It is also found that there is negative strongcorrelation between ocular axial lengthswith the power of IOL.We observed as the axial length increases the power of IOL decreases significantly.*
Key Words: *Axial Length, A Scan Ultrasound, Biometry, IOL, Keratometry*

I. Introduction

Cataract is the commonest cause of curable blindness worldwide [1] and approximately 17.2% of the population over 40years old in the US will develop a cataract in at least one of their eyes [2]. It is commonly treated by surgical removal of cataractous lens and implantation of appropriate power of intra ocular lens (IOL).However in order to achieve a post-operative vision without the need of refractive correction accurate calculation of IOL power is mandatory. This depends on various parameters such as axial length (AL) and keratometric values (K). The axial length (AL) is the distance from the corneal surface to an interference peak corresponding to retinal pigment epithelium/Bruch's membrane [3] and usually measured by A-scan ultrasonography or optical coherence biometry. A majority of axial length elongation takes place in the first 3 to

---

6 months of life and a gradual reduction of growth over the next two years [4] and by three years the adult size is attained. It is also found that these parameters of the eyes are variable in different countries according to ethnicity, genetics and environmental factors. This may affect in results some parameters such as IOL power calculations, yet, not much study has been specifically done on this matter [5, 6]. Inaccuracy of axial length measurement by 1 mm leads to post-operative error by 2.5 D-3.5 D.It becomes important thatbesides precise measurement of axial length and keratometric values, understanding on region and race regarding the IOL power calculation is essential for cataract surgery.

Though studies have been done in other parts of the world but not much studies have been done in this region of India .So our study aims to find out the variations in keratometric readings (K), axial length (AL) of the eye and intra ocular lens (IOL) power observed during biometry of cataract patients who had undergone cataract surgery in a tertiary hospital and to find out any significant gender difference in indigenous people of North Eastern India

II. Materials And Methods

With an approval from the institutional ethics committee and written informed consent from all the participants, this cross sectional observational study was undertaken at Department of Ophthalmology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur, India during the period of March 2017 to March 2018. Senile cataract patients older than 50 years of age who had attended outpatient department (OPD) were included in the study. Keratometric readings of vertical and horizontal corneal median (K1 & K2) were measured with manual keratometer and axial length was measured with contact A-scan ultrasonography. Power of IOL was calculated by using SRK-T formula. Statistical analysis was performed using IBM SPSS Statistics (2015).The data was summarised usingdescriptive statistics such as mean, standard deviation, minimum, maximum and percentage.Comparison between variables was done using independent sample t–test in normally distributed data and correlation of variables was evaluated by Pearson's moment correlation coefficient(r).

III. Results

Out of 160 senile cataract patients evaluated in the study, 96 (60%) were females and 64(40%) were males. Their age ranged between 57 years to 85 years with a mean age 68.05±6.31 years. The K distribution (mean±SD of K1, 44.34± 1.75 D and K2, 44.36± 2.15 D) was positively skewed (0.499 and 0.976. p <0.05).TheAL distribution (mean±SD, 22.59±0.90 mm) was relatively symmetrical (0.029, p<0.05). The mean ±SD intra ocular lens power was 21.65.22±1.72D and negatively skewed (-0.582, p<0.05)*(Table1).*Comparison based on gender showed that the mean±SD K1 in males (44.10±1.75 D) was less than females (44.53±1.45D,p<0.05).The mean±SD K2 for males (44.17±2.15) was also less in females (44.49±1.45,p<0.05).The mean±SD axial length of eyes in male was 22.97±0.90 mm significantly more than females (22.33±0.69 mm, p<0.05).The mean±SD IOL power was 20.86±1.72D in males and 22.17±1.42 D in females (p<0.05)*(Table 2).*K1 correlated positively with K2 (Correlation coefficient, 0.775,p<0.05) and negatively with AL(-0.543,p<0.05).K2 correlated positively with K1(0.775,p<0.05) and negatively with AL (-0.452,p<0.05).The AL correlated negatively with K1(-0.543,p<0.05) ,K2(-0.452,p<0.05) and IOL(0.752,p<0.05).The IOLcorrelated negatively with AL(-0.752,p<0.05)*(Table 3)*.

Table 1. Descriptive statistics of Age, Keratometric values, Axial length, and IOL Power.

	Mean±SD	Min	Max	p-Value
Age (Years)	68.05±6.31	57	85	.000
K1(diopters)	44.34±1.75	40	51	.000
K2(diopters)	44.36±2.15	32	51	.000
Axial length(mm)	22.59±0.90	20.44	26.78	.000
IOL power(diopters)	21.65±1.72	13.5	26.02	.000

Table 2. Comparison of mean-age, axial length, keratometric values and IOL power inmale and female.

Mean	Male (40%) n=64,	Female (60%) n=96	p-Value
Age(Years)	69.29±6.31	67.23±6.29	.000
K1(diopters)	44.10±1.75	44.53±1.45	.000
K2(diopters)	44.17±2.15	44.49±2.22	.000
Axial Length(mm)	22.97±0.90	22.33±0.69	.000
IOLpower (diopters)	20.86±1.72	22.17±1.47	.000

Table 3: Correlations among the axial length (AL), keratometric power (K) and IOL Power.

	K1(D)	K2(D)	AL(mm)	IOL(D)
K1	1	.775**	-.543**	.100
K2	.775**	1	-.452**	.095
AL	-.543**	-.452**	1	-.752**
IOL	.100	.095	-.752**	1

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

IV. Discussion

This study aimed to describe the distribution of ocular biometric parameters in older people ofNorth Eastern India which is mostly populated by the indigenous people of the region. The result of which may represent, to some extent the larger population of the region. The AL distribution in our study population showed positive skew,similar to that observed in healthy Caucasian population [7].The mean AL was shorter in our study population (22.59±0.90 mm) than the cataract patients from Eastern China (24.86±2.72 mm) [8],Europe (23.43±1.51 mm) [9].This may possibly be due to the inclusion of younger age group in their study whereas in our study only the senile cataract were included thereby making their mean AL longer than ours. Another possibility may be due to ethnicity of the study population who have shorter stature and smaller eye ball.

Sex-related difference in biometry has been documented in several populations.In general men have longer eyes, deeper anterior chambers, and flatter corneas than women as measured by A-scan ultrasound[10] In our study population, females (22.33±0.69 mm) had shorter mean AL than males (22.97±0.9mm) *(Table 2)*. These patterns are similarto those observed in the Tanjong Pagar Survey (TPS) [11], a population based study of Singaporean Chinese that used A Scan ultrasound for measuring the biometry rather than the IOLMaster.In many cross sectional studies it was found that body height was positively correlated with AL, male have taller stature than women and the association between male gender and longer AL. It might be a reflection of difference in stature between sexes [12].

The K distribution in our study was that K1 (44.53±1.45D)and K2(44.49±2.22 D)in females were greater than malesK1 (44.10±1.75D) and K2(43.88±2.70D) respectivelyand comparable to other studies [13] indicating women have higher corneal refractory power which may be an emmetropizing mechanism to compensate for shorter AL [14].

AL in our study population have strong co-relationship negatively with IOL power (r)– **0.752)** as reported in other studies [15,16]*(Table 3).*The negative correlation with IOL may reflect a tendency of shorter eyes to have steeper corneas and longer eyes to have flatter corneas [17].

The present studies in a tertiary hospital appears to be one of the first description of ocular biometric characteristic amongst the population of cataract surgery patients of North Eastern India though we cannot exclude selection bias because ours is a hospital based population from a single hospital.

V. Conclusion

In conclusion, in our study we found that females have high keratometric value and shorter axial length as compare to male comparable to other studies .The findings of shorter axial length and higher IOL power calculation observed in both sexes in the study may be due to ethnicity of the study population who have shorter stature and smaller eye ball. It is advocated that further study may be undertaken in the future with larger study population and with consideration of other parameters such as anterior chamber depth and different age group etc.

References

[1]. Hong T, Mitchell P, Fong CS, Rochtchina E, de Loryn T, Wang JJ. Patients' Short-term Satisfaction With Cataract Surgery and Long-Term Sustainability of Improved Visual-Related Quality of Life Over 3 Postoperative Years. *Asia Pac J Ophthalmol (Phila) 2014; 3(2):83–7.*

[2]. Parsons C, Jones DS, Gorman SP. The intraocular lens: challenges in the prevention and therapy of infectious endophthalmitis and posterior capsular opacification.*Expert Rev Med Devices. 2005; 2(2):161–73.*

[3]. Hitzenberger CK.Optical measurement of axial length by laser Doppler interferometry. *Invest Ophthalmol Vis Sci.1991; 32:616-20.*

[4]. Duke elder WS.*System of ophthalmology*(Ophthalmic optics and refraction.1970; Vol V: 238).

[5]. Chen H, Lin H, Lin Z, Chen J, Chen W. Distribution of axial length, anterior chamber depth, and corneal curvature in an aged population in South China.*BMC Ophthalmol. 2016;16(1):47.*

[6]. Hashemi H, Khabazkhoob M, Miraftab M, Emamian MH, Shariati M, Abdolahinia T, et al. The distribution of axial length, anterior chamber depth, lens thickness, and vitreous chamber depth in an adult population of Shahroud, Iran. *BMC Ophthalmol. 2012; 12:50.*

[7]. Fotedar R, Wang JJ, Burlutsky G, Morgan IG, Rose K, Wong TY, Mitchell P.Distribution of axial length and ocular biometry measured using partial coherence laser interferometry (IOL Master) in an older white population.*Ophthalmology,2010;117:417-23.*

[8].   Feng CL,Yuan YZ,Yuan F,Ma XP,Zhang CH.Biometric analysis of adult cataract surgery candidates in shanghai,China,*West Indian Med J.2015*

[9].   Hoffmann PC,Hutz WW.Analysis of biometry and prevalence data for corneal astigmatism in 23,239 eyes.*J Cataract Refarct Surg.2010;36:1479-85.*

[10].   Warrier S, Wu HM, Newland HS, Muecke J, Selva D, Aung T, Casson RJ.Ocular biometry and determinants of refractive error in rural Myanmar: the Meiktila Eye Study.*Br J Ophthalmol. 2008 Dec;92 (12):1591-4.*

[11].   Wong TY,Foster PJ,Ng TP,Tielsch JM,Johnson GJ,Scah SK. Variations in ocular biometry in an adult Chinese population in Singapore: the Tanjong Pagar Survey.Invest Ophthalmol Vis Sci. *2001; 42: 73–80.*

[12].   Nangia V, Jonas JB,Matin A,Kulkarni M,Sinha A,Gupta R.Body height andocular dianebsions in the adult population in rural Central India.The Central India eye and medical study.*Graefes Arch Clin Exp Ophthalmol.2010; 248:1657-66.*

[13].   KhabazKhoob M,Hashemi H,Yazdani K,Mehravaran S,Yekta A,Fotouhi. A.Keratometry measurements, corneal astigmatism and irregularity in a normal population: the Tehran eye study.*Ophthalmic Physiol Opt.2010; 30:800-5.*

[14].   Quing H,Yongzhi H,Qu L,Wei F. Ocular biometric characteristics of cataract patients in western China.*BMC Ophthalmology.2018;18:99.*

[15].   Cui Y,Meng Q,Guo H,Zeng J,Zhang G,Huang Y,Lan J. Biometry and corneal astigmatism in cataract surgery candidates from southern China.*J Cataract Refarct Surg.2014;40:1661-9.*

[16].   Chen H.Lin H,Lin Z,Chen J,Chen Distribution of axial length, anterior chamber depth, and corneal curvature in an aged population in south China.*BMC Ophthalmol.2016;16:47.*

[17].`   Jonas JB,Nangia V,Sinha,Gupta R.Corneal refractive power and its associations with ocular andgeneral parameters:the central India eye and medical study.*Ophthalmology.2011;118:1805-1.*