Original Article

Biometric Findings in Patients Undergoing Cataract Surgery; Gender Comparison

Khawaja Khalid Shoaib, Tariq Shakoor

Pak J Ophthalmol 2018, Vol. 34, No. 4

See end of article for authors affiliations

Correspondence to:
Khawaja Khalid Shoaib
FCPS, FRCS, MCPS HPE
Health Bridge Hospital, Ghazi road, near Bhatta Chowk, DHA, Lahore
E-mail: kkshoaib@hotmail.com

Purpose: To report normal biometric findings in patients undergoing cataract surgery and make comparison of these values between males and females.

Study Design: Cross sectional, descriptive.

Place and Duration of Study: Data collected in Armed Forces Institute of Ophthalmology (AFIO) Rawalpindi during 2016 was analyzed.

Material and Methods: A total of 752 biometeries were done in patients undergoing cataract operation. Axial length (AL), Keratometry readings (K1 and K2), Anterior chamber depth (ACD) and Posterior chamber intraocular lens power (PC IOL) of the patients were assessed to find mean, standard deviation, minimum value and maximum value. Statistical analysis was done in SPSS 20. Comparison of these values for males and females was done by Independent Samples t Test.

Results: Age ranged from 16 years to 105 years (Mean 63.05 ± 10.52). Male were 412 (54.79%) and female were 340 (45.2%). Mean AL was 23.22 ± 1.08 mm. Mean K1 was 42.87 ± 1.98 D. Mean K2 was 43.96 ± 1.8 D. 4.55. Mean ACD was 3.2397 ± .40 and mean PC IOL was 21.2 ± 2.35. Significant differences were observed in all the parameters when the findings for males and females were compared.

Conclusion: Pakistani female cataract patients have smaller axial length and anterior chamber depth but higher corneal curvature when compared to their male counterparts.

Keywords: Axial length of eye, Keratometry, Intraocular lens.

Cataract surgery is one of the most commonly done operations in the world. Posterior Chamber Intraocular lens implantation (PC IOL) at the time of cataract surgery is routinely done nowadays and biometry is used to calculate the required power of the IOL. Biometry includes measurement of many parameters and the most important are axial length (AL), corneal curvature (Keartometry or K reading) and anterior chamber depth (ACD). Axial length is the anteroposterior diameter of the eye measured at center of the cornea. K readings are measured with keratometers and represent horizontal and vertical curvature of the cornea. Presence of corneal astigmatism reflected by difference of K readings in different corneal meridian alerts eye surgeon to think of corrective methods before starting surgery. Good biometry improves post cataract surgery refractive status and this is now the aim of cataract surgery. We can achieve in more than 90% cases within ± 1 D of target refraction[1]. Thus measurement of axial length and corneal curvature are very important issues. Axial length is measured with different techniques[2,3,4,5,6]. Ultrasound biometers being most economical are still the predominant source of biometry in Pakistan. Cycloplegia[7,8,9] and trabeculectomy[10] have been associated with effect on ACD, AL and K readings. One should be cautious, not to take biometric findings after mydriasis/cycloplegia. Similarly findings after trabeculectomy operations cannot be taken as of normal population. There is

scarcity of good studies (involving large sample size) regarding age, axial length, corneal curvature and power of intraocular lens undergoing cataract surgery in Pakistani males and females. Keeping in mind all the above mentioned facts we conducted this study to find the normal biometric findings in Pakistani population.

MATERIAL AND METHODS

A total of 752 biometeries were done in patients undergoing cataract operation in Armed Forces Institute of Ophthalmology (AFIO) Rawalpindi from 1st January 2016 to 31st Dec 2016. This study was approved by the Ethics Committee of AFIO and followed the tenets of the Declaration of Helsinki. All the cases for cataract operations were included in the study. Patients who had history of any form of eye surgery were excluded from the study.All the data was collected by TS. Keratometery was done with autorefrectometere RF 2 (Canon - Japan). AL was measured with Axis IIultrasound A mode Biometer (Quantel Medical -France). SRK-T formula was used to calculate PC IOL power. A constant was taken as 118.0. Axial length (AL), Keratometry readings (K1 and K2), anterior chamber depth (ACD) and PC IOL power of the patients were assessed to find mean, standard deviation, minimum value and maximum value in males and females. Findings were noted when the pupil was not dilated (without cycloplegia). Statistical analysis was done in SPSS 20.p-value of < 0.05 was taken as significant.Comparison of the values for males and females was done by Independent Samples T Test.

RESULTS

Age ranged from 16 years to 105 years (Mean 63.05 ± 10.52). Males were 412 (54.79%) and females were 340 (45.2%). Mean AL was 23.22 ± 1.08 mm (Table 1). Mean K1 was 42.87 + 1.98 D (Table 1). Mean K2 was 43.96 ± 1.8 D. 4.55. Mean ACD was 3.2397 ± .40 and mean PC IOL was 21.2 ± 2.35 (Table 1 and 2). Significant differences were observed in all the parameters when the findings for males and females were compared (Table 3).

Table 1: Descriptive Statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	742	16	105	63.05	10.520
Axial Length (mm)	677	20.04	28.83	23.2160	1.08738
K1(D)	705	23.66	48.75	42.8680	1.97796
K2 (D)	705	37.75	51.75	43.9611	1.80413
AC Depth (mm)	352	2.11	4.55	3.2397	.40445
PC IOL Power (D)	723	6.00	31.00	21.2055	2.35320

Table 2: Group Statistics.

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Age	Male	407	65.13	11.129	.552
	Female	335	60.52	9.123	.498
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Axial Length (mm)	Male	368	23.4744	1.04453	.05445
	Female	309	22.9082	1.05841	.06021
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Anterior Chamber Depth (mm)	Male	175	3.3122	.42181	.03189
	Female	177	3.1680	.37408	.02812
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
K1 (D)	Male	384	42.3846	2.11665	.10802
	Female	321	43.4463	1.62140	.09050
	Gender	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
K2 (D)	Male	384	43.4987	1.74641	.08912
	Female	321	44.5142	1.71667	.09581

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Posterior Chamber Intra Ocular Lens Power (D)	Male	393	20.8219	2.10595	.10623
	Female	330	21.6624	2.54616	.14016

Table 3: Comparison between mean values of male and female patients.

	Male	Female	P value (sig)
Age	65.13	60.52	.000
Axial length	23.47	22.91	.000
Ant chamber depth	3.3122	3.1680	.001
K1	42.3846	43.4463	.001
K2	43.4987	44.5142	.000
Post chamber IOL Power	20.82	21.66	.000

DISCUSSION

Age at the time of cataract operation varies from country to country e.g. in southern Chinese[11]mean age was 70.4 years ± 10.5 about 7 years older than our patients.

Similarly different readings of axial length 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, ACD and mean K (Km) were 23.5mm, 3.32mm and 43.52 D respectively[12]. In this study AL and ACD are higher but K is lower than our values. Their findings are comparable to another European study (Portugal) where mean AL, Km, and ACD have been 23.87 ± 1.55 mm (19.8–31.92 mm), 43.91 ± 1.71 D (40.61–51.14 D), and 3.25 ± 0.44 mm (2.04–5.28 mm), respectively[13].

Coming to Chinese studies, one study revealedAL, ACD, and mean K value of 24.07 ± 2.14 mm, 3.01 ± 0.57 mm and 44.13 ± 1.63 D respectively.[11]All of these findings are slightly higher (except ACD) than our findings.In Beijing study mean axial length was 23.25 ± 1.14 mm (range: 18.96-30.88 mm)[14]which is slightly less but close to our finding. Taiwan, China findings were mean AL of 24.75 ± 2.71 mm, and the mean K value of 43.48 ± 1.66 D[15]. AL in this study is higher than ours but K is almost same. Chinese in Singapore had AL and ACD of 23.23 +/- 1.17 mm and 2.90 +/- 0.44 mm respectively[16] and their AL was slightly higher and ACD was slightly less than our readings. AL was 23.13 +/- 1.15 mm in Mongolian adults aged 40 years or more which is slightly less than ours[17].

Average corneal curvature in Nigerians was found to be 42.98 ± 1.19 D[18]. It is very close to our finding. Central rural India finding of mean axial length was 22.6+/-0.91 mm (range, 18.22-34.20 mm)[19]. It is less than our finding. Findings from Nepal for AL, K1 and K2 are 22.96 + 0.95, 43.64 + 1.45, 44.29 + 1.47 respectively[20]. So their AL is smaller while corneal curvature is comparable to ours.

Pakistani studies on this topic include following. In Hyderabad AL, K1 and K2 was found to be 22.96 ± 1.04, 44.00 ± 1.83, 44.78 ± 1.88 respectively[21]. These readings are less than our readings. In a study from Gomal University the range of axial length was 19.50 to 28.0mm[22]. 581 (58.1%) patients were having axial length 22-23.50mm. Ten (1.0%) had axial length > 26 mm and 6 (0.6%) 25 D. The minimum K1 and K2 readings noted were 37.0 D, while the maximum readings were 48.0D. The minimum power calculated as 10.0 D, while the maximum one was 33.0 D. This study divided all the parameters in different subsets but did not give mean and standard deviation. Thus though the findings are close to our findings it is difficult to compare the two. Our findings are in agreement with the trend observed[21] that our eyes are shorter than European eyes and comparable to Chinese eyes. However our study differed that Indian eyes are shorter and not comparable.

Regarding differences between males and females,in older male Chinese AL was 23.38 mm (22.83, 24.00) and ACD was 2.75 mm (2.53, 3.00) while for females AL was 22.83 mm (22.32, 23.46) and ACD was 2.61 mm (2.42, 2.84)[23]. AL and ACD findings in this study for both males and females is close to our findings (though slightly less) and confirm our finding that female findings are lower than male readings. Los Angeles study also found that females had significantly shorter AL and shallower ACD than males[24]. In Rajasthan, India AL in emmetrope males 40 to 60 year of age, was 22.33 mm and in females 22.99 mm[25]. These readings are less than readings in our

males and more than our female readings. This study is different because findings in both sexes have been subdivided according to refractive state and mean of total population studied is not available. Limitation of our study is that a few readings were missing in the analyzed data while strength of the study is a relatively large sample size.

CONCLUSION

Axial length in Pakistani patients is less than that of Europeans but more than our Asian neighbors like India and Nepal. Chinese findings are more or less the same as ours. Pakistani female cataract patients have smaller axial length and anterior chamber depth but higher corneal curvature and they undergo operation at younger age as compared to their male counterparts.

Authors Affiliation

Dr. Khawaja Khalid Shoaib
FCPS, FRCS, MCPS HPE
Health Bridge Hospital, Ghazi road, near Bhatta Chowk, DHA, Lahore.

Dr. Tariq Shakoor
MCPS, FCPS
Rahbar Medical & Dental College, Lahore.

Role of Authors

Khawaja Khalid Shoaib
Study Design, Data Collection & Manuscript writing.

Dr. Tariq Shakoor
Data collection, Manuscript writing, critical analysis

Conflict of Interest: None.

REFERENCES

1. **Sheard R.** Optimising biometry for best outcomes in cataract surgery. Eye (Lond). 2014 Feb; 28 (2): 118-25. Doi: 10.1038/eye.2013.248. Epub 2013 Dec 6.
2. **Verkicharla PK, Mallen EA, Atchison DA.** Repeatability and comparison of peripheral eye lengths with two instruments. Optom Vis Sci. 2013 Mar; 90 (3): 215-22. Doi: 10.1097/OPX.0b013e318282ccc4.
3. **Grulkowski I, Liu JJ, Zhang JY, Potsaid B, Jayaraman V, Cable AE, Duker JS, Fujimoto JG.** Reproducibility of a long-range swept-source optical coherence tomography ocular biometry system and comparison with clinical biometers. Ophthalmology, 2013 Nov; 120 (11): 2184-90. Doi: 10.1016/j.ophtha.2013.04.007. Epub 2013 Jun 4.
4. **Huang J, Savini G, Li J, Lu W, Wu F, Wang J, Li Y, Feng Y, Wang Q.** Evaluation of a new optical biometry device for measurements of ocular components and its comparison with IOL Master. Br J Ophthalmol. 2014 Sep; 98 (9): 1277-81. Doi: 10.1136/bjophthalmol-2014-305150. Epub 2014 May 2.
5. **Kunert KS, Peter M, Blum M, Haigis W, Sekundo W, Schütze J, Büehren T.** Repeatability and agreement in optical biometry of a new swept-source optical coherence tomography-based biometer versus partial coherence interferometry and optical low-coherence reflectometry.J Cataract Refract Surg. 2016 Jan; 42 (1): 76-83. Doi: 10.1016/j.jcrs.2015.07.039.
6. **Abu El Einen KG, Shalaby MH, El Shiwy HT.** Immersion B-guided versus contact A-mode biometry for accurate measurement of axial length and intraocular lens power calculation in siliconized eyes. Retina. 2011 Feb; 31 (2): 262-5. Doi: 10.1097/IAE.0b013e3181e17f39.
7. **Huang J, McAlinden C, Su B, Pesudovs K, Feng Y, Hua Y, Yang F, Pan C, Zhou H, Wang Q.** The effect of cycloplegia on the lenstar and the IOL Master biometry. Optom Vis Sci. 2012 Dec; 89 (12): 1691-6. Doi: 10.1097/OPX.0b013e3182772f4f.
8. **Chang SW, Lo AY, Su PF.** Anterior Segment Biometry Changes with Cycloplegia in Myopic Adults. Optom Vis Sci. 2016 Jan; 93 (1): 12-8. Doi: 10.1097/OPX.0000000000000748.
9. **Sarwar S, Rasool G, Sadiq MA, Khan AA, Dogar S, Lateef Q, Safdar M.** Ultrasound contact biometry with and without pupil dilation. Ophthalmology Pakistan: Vol. 5 issue 1. 2015; 12-17.
10. **Alvani A, Pakravan M, Esfandiari H, Yaseri M, Yazdani S, Ghahari E.** Biometric Changes after Trabeculectomy with Contact and Non-contact Biometry. Optom Vis Sci. 2016 Feb; 93 (2): 136-40. Doi: 10.1097/OPX.0000000000000781.
11. **Cui Y, Meng Q, Guo H, Zeng J, Zhang H, Zhang G, Huang Y, Lan J.** Biometry and corneal astigmatism in cataract surgery candidates from Southern China. J Cataract Refract Surg. 2014 Oct; 40 (10): 1661-9. Doi: 10.1016/j.jcrs.2014.01.039. Epub 2014 Aug 20.
12. **Mackey DA, Sherwin JC, Kearns LS, Ma Y, Kelly J, Chu BS, Macmillan R, Barbour JM, Wilkinson CH, Matovinovic E, Cox HC, Bellis C, Lea RA, Quinlan S, Griffiths LR, Hewitt AW.** The Norfolk Island Eye Study (NIES): rationale, methodology and distribution of ocular biometry (biometry of the bounty).Twin Res Hum Genet. 2011 Feb; 14 (1): 42-52. Doi: 10.1375/twin.14.1.42.
13. **Ferreira TB, Hoffer KJ, Ribeiro F, Ribeiro P, O'Neill JG.** Ocular biometric measurements in cataract surgery candidates in Portugal. PLoS One, 2017 Oct. 5; 12 (10): e0184837. Doi: 10.1371/journal.pone.0184837. eCollection 2017.

14. **Yin G, Wang XY, Yang H, Xu L, Jonas JB.** The Beijing eye study group. Ocular axial length and its associations in Chinese: the Beijing eye study. PLoS ONE, 2012; 7: e43172.
15. **Wang JK, Chang SW.** Optical biometry intraocular lens power calculation using different formulas in patie nts with different axial lengths.Int J Ophthalmol. 2013 Apr 18; 6 (2): 150-4. Doi: 10.3980/j.issn.2222-3959.2013.02.08. Print 2013.
16. **Wong TY, Foster PJ, Ng TP, Tielsch JM, Johnson GJ, Seah SK.** Variations in ocular biometry in an adult Chinese population in Singapore: the TanjongPagar Survey. Invest Ophthalmol Vis Sci. 2001 Jan; 42 (1): 73-80.
17. **Wickremasinghe S, Foster PJ, Uranchimeg D, Lee PS, Devereux JG, Alsbirk PH, Machin D, Johnson GJ, Baasanhu J.** Ocular biometry and refraction in Mongolian adults. Invest Ophthalmol Vis Sci. 2004 Mar; 45 (3): 776-83.
18. **Foster PJ, Broadway DC, Hayat S, Luben R, Dalzell N, Bingham S, Wareham NJ, Khaw KT.** Refractive error, axial length and anterior chamber depth of the eye in British adults: the EPIC-Norfolk Eye Study. Br J Ophthalmol 2010; 94: 827-830.
19. **Nangia V, Jonas JB, Sinha A, Matin A, Kulkarni M, Panda-Jonas S.** Ocular axial length and its associations in an adult population of central rural India: the Central India Eye and Medical Study.Ophthalmology, 2010 Jul; 117 (7): 1360-6. Doi: 10.1016/j.ophtha.2009.11.040. Epub 2010 Apr 2.
20. **Shrestha S, Kaini KR, Basnet B.** Gender differences in ocular biometry among cataract patients of western nepal. American Journal of Public Health Research, 2015; 3 (4A): 31-34. Doi:10.12691/ajphr-3-4A-6.
21. **Nizamani NB, Surhio SA, Memon S, Talpur KI.** Axial length variability in cataract surgery.J Coll Physicians Surg Pak. 2014 Dec; 24 (12): 918-21.
Doi: 12.2014/JCPSP.918921.
22. **Saleem M, Khan SB, Khattak MA, Muhammad L.** Analysis of intra ocular lens power estimation in patients admitted for cataract surgery. Gomal Journal of Medical Sciences. Jan – Jun 2009 Vol. 7, No. 1: 22-26.
23. **He M, Huang W, Li Y, Zheng Y, Yin Q, Foster PJ.** Refractive error and biometry in older Chinese adults: the Liwan eye study. Invest Ophthalmol Vis Sci. 2009 Nov; 50 (11): 5130-6. Doi: 10.1167/iovs.09-3455. Epub 2009 Jun 24.
24. **Shufelt C, Fraser-Bell S, Ying-Lai M, Torres M, Varma R.** Los Angeles Latino Eye Study Group. Refractive error, ocular biometry, and lens opalescence in an adult population: the Los Angeles Latino Eye Study. Invest Ophthalmol Vis Sci. 2005 Dec; 46 (12): 4450-60.
25. **Bhardwaj V, Rajeshbhai GP.** Axial length, anterior chamber depth-a study in different age groups and refractive errors. J Clin Diagn Res. 2013 Oct; 7 (10): 2211-2. Doi: 10.7860/JCDR/2013/7015.3473. Epub 2013 Oct 5.