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Ocular biometry characteristics and Specular count among patients attending eye OPD: Hospital based study:

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Abstract

Background: Cataract is the most common cause of blindness and the second major cause of visual impairment worldwide. Ocular biometric (axial length, anterior chamber depth and lens thickness) values are measured in everyday ophthalmological practice. This is mostly indicated in the preoperative evaluation of cataract surgery.

Aim: To determine the average value of ocular biometric parameters and specular count and to investigate their inter correlation among the patients attending eye OPD.

Methods: A profile of 350 participants was available during the study period and was conducted in Upgraded Department of Ophthalmology, Govt. Medical College Jammu from 1st November 2020 to 31st October 2021. Due approval from Institutional Ethics Committee of Govt. Medical College Jammu was taken prior to initiating the study. Anterior segment examination was done with the help of Slit lamp, detailed fundus examination and intraocular pressure was measured. Biometric parameters like axial length (AL), Anterior chamber depth (ACD), lens thickness (LT), White to white (WTW), corneal diameter (K) and intraocular lens (IOL) power calculation was taken with Topcon (Aladdin HW3.0) optical biometer. Corneal endothelial count, central corneal thickness was measured using Topcon specular microscopy.

Results: The mean axial length in males (23.41±0.82 mm) was longer than females (22.95±0.89mm) and this difference was found to be statistically significant. The mean ACD was more for males (3.41±0.38 mm) than females (3.29±0.39 mm), this difference was found to be statistically significant. The mean lens thickness (LT) of the study participants was (4.01±0.42mm), was more for males (4.03±0.44mm) than females (4±0.49mm) but this difference was not found to be statistically significant. Mean white to white (WTW) corneal diameter was more in males (11.42±48mm) than females (11.17±0.49mm), this difference was found to be statistically significant. Mean endothelial density in males 2440±481 cells/mm² was more than female's 2415±472.5 cells/mm², this difference was not found to be statistically significant.

Conclusion: In conclusion our study revealed that the mean values of most biometric parameters varied across age and sex distribution. Moreover, most of the parameters showed significant age-related changes among the study population.

Keywords: Ocular biometric characteristics, cataract, specular microscopy, demographics.

Introduction:

As reported by the World Health Organization in 2017, cataract is the most common cause of blindness and the second major cause of visual impairment worldwide [1]. Ocular biometry parameters, which are basic elements in planning for cataract surgery, include axial length (AL), anterior chamber depth (ACD), corneal curvature, and white-to-white (WTW) [2]. Accordingly, appropriate implanted intraocular lens (IOL) power selection results in an acceptable uncorrected distance visual acuity, with greater patient satisfaction [3]. Different formulas have been recommended for the calculation of IOL power, all of which require specific biometric data and constants [4].

Ocular biometric (axial length, anterior chamber depth and lens thickness) values are measured in everyday ophthalmological practice. This is mostly indicated in the preoperative evaluation of cataract surgery.

Modern cataract surgery is considered a form of refractive surgery, aimed not only to restore visual clarity, but to provide excellent vision in refractive terms as well even when no intraocular lens (IOL) is implanted. When prescribed, an IOL is given to achieve a certain refractive status for the eye unlike what was obtainable in the past when refractive errors were corrected only after the surgery. This is made possible because of the development of modern, accurate diagnostic and surgical techniques.

The critical step in ocular biometry to attain the desired post-operative refractive outcome requires standardization of techniques to ensure accurate measurements important in providing correct calculation of required IOL power for cataract surgery. [5,6]

A-scan ultrasound is the traditional technique for measuring anterior chamber depth, axial length and lens thickness. It involves passing an ultrasonic beam via a transducer through the eye, and as this is returned after hitting intraocular structures a trace of ocular spikes is displayed on the monitor from the cornea to the orbital fat. [7]Biometry values can be obtained either by contact (applanation), immersion or optical methods. [8]

Corneal deturgescence by endothelial pump is indicated by corneal thickness. [9] Normal central corneal thickness is 540 μm. [10] Central Corneal Thickness evaluates corneal pathologies like keratoconus and corneal dystrophies. [11] It is a key determinant of intraocular pressure and prevents misdiagnosis of glaucoma. [12] Error of 3.4mm of Hg in IOP measurement occurs with 10% difference in central corneal thickness. [13] It evaluates cornea for refractive procedures. [14] It is important in various disorders such as contact lens complications and diabetes mellitus. [15] Various modalities are used for the measurement of corneal thickness. Contact methods include confocal microscopy and ultrasound Pachymetry.[16] Noncontact methods such as topography, optical coherence tomography and specular microscopy are also used. [17] Corneal topography by Scheimpflug camera and scanning slit system provides corneal thickness map. [18] Scheimpflug imaging devices include Tomey, Galilei, Pentacam, and Sirius. [19] Optical biometer like AL-Scan uses diode laser of 830nm and works on scheimpflug principle for central corneal thickness measurement. [20] Specular microscope analyzes corneal endothelial cell count. It is also used for the measurement of corneal thickness. [21] It uses light reflections to differentiate layers of cornea for the measurement of corneal thickness. [22]

Methods

This Prospective, descriptive study was conducted in Upgraded Department of Ophthalmology, Govt. Medical College Jammu from 1st November 2020 to 31st October 2021. Due approval from Institutional Ethics Committee of Govt. Medical College Jammu was taken prior to initiating the study.

INCLUSION CRITERIA

- All patients attending eye OPD >20yrs age

- Either sex
- Willingness to participate

EXCLUSION CRITERIA

- Corneal degenerations and dystrophies
- Pseudo exfoliation syndrome
- Uveitis
- Glaucoma
- Previous history of intraocular surgery or trauma
- Diabetes mellitus
- Mature cataract

The cases were selected from the patients who attended the outpatient department of ophthalmology, GMC Jammu. The purpose and procedure of study was clearly explained and consent was taken from the participants prior to inclusion in the study. Detailed clinical history was taken. Complete general physical examination was carried out. Uncorrected and corrected distance visual acuity of each eye was assessed with the Snellen's Chart. Anterior segment examination was done with the help of Slit lamp, detailed fundus examination and intraocular pressure was measured. Biometric parameters like axial length (AL), Anterior chamber depth (ACD), lens thickness (LT), White to white (WTW), corneal diameter (K)and intraocular lens (IOL) power calculation was taken with Topcon (Aladdin HW3.0) optical biometer. Corneal endothelial count, central corneal thickness was measured using Topcon specular microscopy.

STATISTICAL ANALYSIS:

The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means ± SD. The following statistical tests were applied for the results:

1. The comparison of the variables which were quantitative in nature was analysed using Independent t test.
2. Pearson correlation coefficient was used for correlation of age with various parameters and also correlation of axial length with other parameters.

The data entry was done in then Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 21.0. Statistical significance was set at $P < 0.05$.

Results:

Out of total study participants 350, 221 (63.1%) subjects were males and 129 (36.9%) were femaleswith mean age of the participants was 57.48±13.03 (years).There was no statistical difference in the mean age between the male (58±13.23 years) and females (56.73±13.53 years) among the study population [table 1].

Table 1: Demographic profile of the study population

Variables	NUMBER	PERCENTAGE (%)
20-29	8	2.2
30-39	20	5.7
40-49	52	14.9
50-59	100	28.6
60-69	114	32.6
70-79	38	10.9
>80	18	5.1
M/F	221/129	63.1/36.9

The mean axial length, ACD, lens thickness (LT) , white (WTW) corneal diameter, IOL, ECD, CCT(µm), in males was (23.41±0.82) mm, (3.41±0.38 mm), (4.03±0.44mm) , (11.42+0.48),(21.15±2.29D), (2440±481), (511.22±36.78) as compared to females (22.95±0.89mm), (3.29±0.39 mm), (4±0.49mm) , (11.17±0.49)mm, (21.45± 1.08D), 2415±472.5,(513.50±39.16) with majority of parameters showing statistically significant differences among the study population [table 2].

Table 2: Total mean and gender wise mean of various ocular biometric parameters among the study population

PARAMETERS	TOTAL n=350	MALE n=221	FEMALE n=129	P-VALUE
AGE(Yrs),Mean ±SD	57.48±13.03	58±13.23	56.73±13.53	0.425
AL(mm) ,Mean ±SD	23.25±0.79	23.41±0.82	22.95±0.89	<0.0001
ACD(mm),Mean± SD	3.36±0.36	3.41±0.38	3.29±0.39	0.005
LT(mm),Mean± SD	4.01±0.42	4.03±0.44	4±0.49	0.432
K(D), Mean± SD	43.66±1.62	43.41±1.56	44.09±1.66	0.0001
WTW(mm),Mean ±SD	11.33±0.47	11.42±0.48	11.17±0.49	0.0001
IOL(D),Mean ±SD	21.26±2.29	21.15±2.08	21.45±1.85	0.137
CCT(µm),Mean± SD	512.08±37.24	511.22±36.78	513.50±39.16	0.811
ECD, Mean± SD	2431.24±470	2440±481	2415±472.5	0.651

Positive correlation of axial length was found with white to white diameter (WTW) corneal diameter which was statistically significant, anterior chamber depth (ACD) which was statistically significant, Endothelial cell density (ECD) which was not statistically significant [Fig 1].

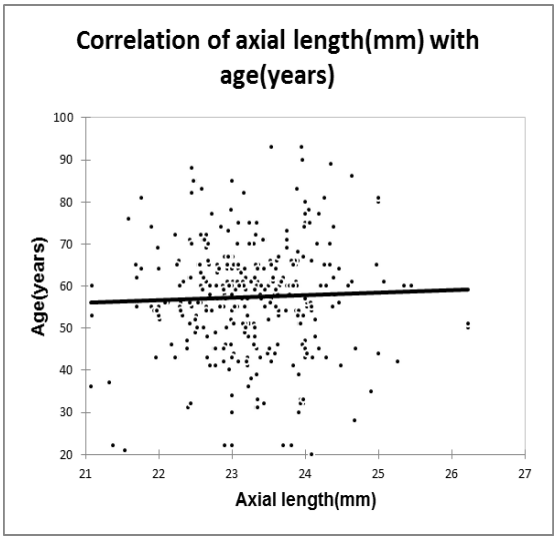

FIGURE 1: Scatter plot of correlation of axial length (mm) with age(years) - shows postive correlation of axial length with age which was not statistically significant (p value-0.512,r=0.035).

Negative correlation of axial length was found with central corneal thickness (CCT) which was not statistically significant, intraocular lens (IOL) power which was statistically significant, mean corneal curvature(K) which was statistically significant, lens thickness (LT) (p=0.035,r=-0.113) which statistically significant [Fig 2].

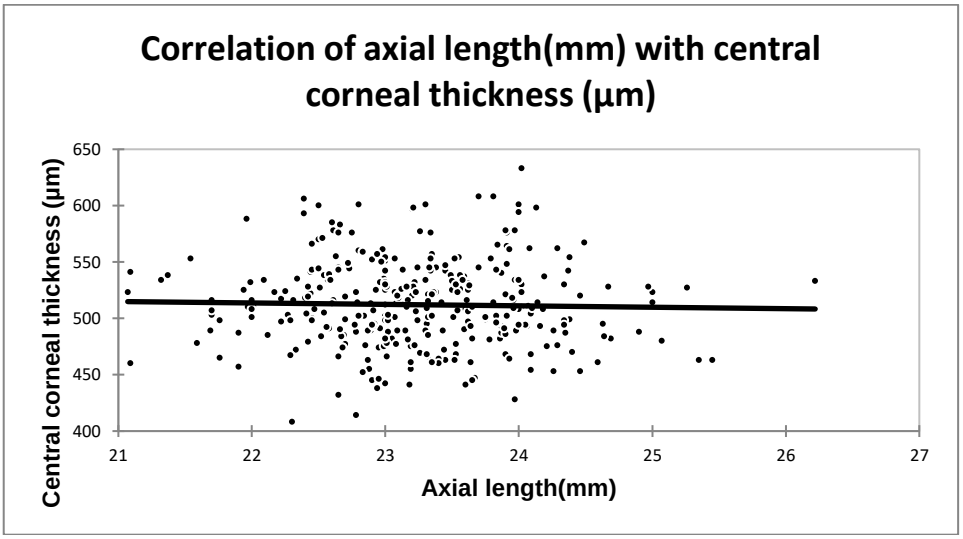

Figure 2:-Scatter plot of correlation of axial length with central corneal thickness (CCT)-shows negative correlation of axial length(mm) with central corneal thickness (µm) which was not statistically significant(p value<0.612,r=-0.0273).

Discussion:

Ocular biometry is basic to cataract surgery, the commonest surgery carried out in Ophthalmology. Precise measurement of ocular biometry values, especially axial length measurement is central to the accurate calculation of intra-ocular lens (IOL) power inserted at surgery. It is not unusual for different categories of staff to be involved in this important measurement. [23] This necessitates the use of the least operator dependent technique which is the optical method by partial coherence laser interferometry whose reading is set to conform to that of immersion technique. [24]

In our study, mean age of the participants was 57.48±13.03 (years).There was no statistical difference in the mean age between males (58±13.23 years) and females (56.73±13.53 years). In a similar study done by Elizah N *et al.*,[25] (2020) on 151 study participants in which the mean age of the study participants was 57.73±14.87 years. The mean age of males and females was 57.31 and 57.16 years, respectively, and their difference was not statistically significant (P = 0.910).NatungT*et al.*,(2019) [26] carried out study on 641 participant, the mean age of study participants was 64±10.81 yrs, there was no statistical significant difference in the mean age between males and females.

The mean axial length (AL) of the study participants was 23.24±0.79mm.The mean axial length (AL) in males (23.41±0.82 mm) was longer than females (22.95±0.89mm) and this difference was statistically significant (p value is 0.001).There is a positive correlation of axial length with age but this correlation was not statistically significant (p value=0.512, r=0.035). Similar study done by Natung T *et al.*, (2019)[26] on 641participants,in which the mean AL was found to be 23.34±1.12mm.The mean axial length in males (23.58±0.99mm) was longer than females (23.07±1.19.57mm),this difference was statistically significant (p value of 0.001).

The mean anterior chamber depth of the study participants was 3.3±0.36 mm. The mean ACD was more for males, 3.41±0.38mm than females, 3.29±0.39 mm, this difference was found to be statistically significant (p value is 0.05).Anterior chamber depth negatively correlate with age and this correlation was statistically significant (p value =0.027, r=-0.119). Similar study done by Lim LS*et al.*, (2019)[27] in which the mean ACD was found to be 3.10mm and found that females have shallower ACD than males. YoonJJ*et al.*,(2016) [28] carried out study in which the mean ACD was 3.20±0.39. The difference in the mean ACD was 0.13(3.18±0.43 mm in men and 3.05±0.41mm in females)and was statistically significant.

The mean LT of the study participants was 4.01±0.42 mm, was more for males(4.03±0.44mm) than female (4.0±0.49mm) and this difference was not found to be statistically significant(p value 0.432).Lens thickness positively correlated with age, this correlation was found to be statistically significant(r=-0.328,p =0.001). Jivarajika R*et al.*,(2007) [29] carried out study in which the mean LT was 4.93±0.56 mm. Lens thickness positively correlated with age. Meng J *et al.*,(2021) [30] carried out study in which the mean LT was 4.51±0.46mm and was greater in elderly, which was statistically significant(p value is 0.001).

The mean corneal curvature(K) value of the study participants was 43.46±1.62D, mean K value in females (43.41±1.56D) was more than males (44.09±1.66D) and this difference was found to be statistically significant (p value is<0.05). No statistical significant Correlation was found between age and mean K. In similar studies by Merriam JC*et al*.,(2005) [31] the mean K was 43.57D.

The mean WTW corneal diameter of the study participants was 11.33±0.4 mm. The difference of mean WTW corneal diameter in males (11.42±48 mm) and females (11.17±0.49mm) was found to be statistically significant (p value <0.05), it was more for males. No statistical significant correlation of mean WTW corneal diameter with age was found. Similar study was done by Fu T*et al*., (2019) [32] in which mean WTW was 11.79±0.38mm. Likewise Natung T *et al.,* (2020) [26] carried out study in which mean WTW corneal diameter was 11.92±0.54 mm, there was a significant difference between mean WTW corneal diameter in males and females. It was more for males who had 11.99±0.53 mm mean WTW corneal diameter and 11.84±0.54 mm for females. The findings of the above mentioned studies corroborates with our study.

The mean IOL power in our study participants was 21.26±2.29D, mean IOL power was more for females (21.45±1.85D) than males (21.15±2.08D) but this difference was not found to be statistically significant (p value is 0.137). Age negatively correlates with intraocular lens (IOL) power, this correlation was found to be statistically significant (p value is <0.001, r=-0.252). Similar study was done by Natung T *et al.*,(2020) [26] in which mean IOL power of study participants was 20.53±2.79 D, mean IOL for males was 19.27±3.27D and for females was 21.72±2.12D.This difference was more in females than males. The findings of above mentioned study corroborates with our study.

The mean endothelial density was 2431.24±470 cells/mm².Mean endothelial density in males (2440±481cells/mm²) was found to be more than females (2415±472.5cells/mm²). This difference was not statistically significant (p value 0.651).There is a negative correlation of ECD with age, this correlation was not found to be statistically significant (p value is 0.206,r=-0.068). Similar study was done by Mohammad-salih PA *et al.*,(2011) [33] carried out study in which, mean endothelial density in the study population was 2648± 310 cell/mm² no statistical significant difference was found, the above findings corroborates with our study.

The mean CCT was 512.08±37.24µm, males have CCT of 511.22±36.78µm which was smaller than females 513.50±39µm, this difference was not found to be statistically significant (p value is 0.811), central corneal thickness negatively correlates with age, this correlation was statistically significant (p <0.001). This was similar to the study done by Kelekele JK*et al.*,(2021) [34] in which the mean central corneal thickness was 54.2 ± 30.7 µm (CCT).In a similar study by Galgauskas S*et al.,* (2013) [35] mean CCT was 544.6±30.5µm. A statistically significant negative correlation was found between CCT and age (*r*=-0.263, *P valueis*<0.05), no statistical significant difference was found between genders.

Negative correlation of axial length was found with central corneal thickness (CCT)which was statistically insignificant (p value is 0.612, r= -0.027), intraocular lens (IOL) power which was statistically significant (p value is <0.001, r=0.586), mean corneal curvature (K) which was statistically significant (p value<0.001,r=-0.224),lens thickness (LT) which statistically significant(p value=0.035,r=-0.113) . similar study was done by Natung T *et al.*,(2020) [26] in which axial length (AL) had statistical significant negative correlation with corneal curvature(K) and statistical significant positive correlation of AL was found with anterior chamber depth(ACD) and white to white (WTW). These findings of above mentioned study corroborates with our study.

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