ORIGINAL ARTICLE

Comparison of Mean Axial Length Measured by Acoustic Biometry versus Optical Biometry

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ABSTRACT

Purpose: To compare the mean axial length measured by acoustic biometry with optical biometry.

Design: Descriptive observational study.

Place and Duration of Study: Department of Ophthalmology Liaquat National Hospital and Medical College, Karachi from November 2018 to April 2019.

Methods: were 246 patients with visually significant cataract who were recruited in this study by consecutive sampling. Axial lengths were measured by non-contact optical method using Carl Zeiss IOL master. After instillation of local anesthetic, axial lengths were re-measured by contact method with A-Scan probe. All readings were taken by a single observer to avoid data collection bias. Mean and standard deviation was computed for quantitative variable i.e. age, axial length by Applanation ultra sound and axial length by optical biometry. Frequency and percentage was calculated for qualitative variables i.e. gender. Differences of axial length between the Applanation and optical biometry were compared by using pair T-test. Effect modifiers like age and gender were addressed through stratification, post stratification independent test for two groups and ANOVA for more than two groups was applied.

Results: The average age of the patients was 58.09 ± 7.27 years. Mean axial length by optical biometry was 23.744 ± 0.74mm as compared to 22.29 ± 0.76 mm by acoustic method and this difference was statistically significant (P = 0.0005).

Conclusion: Results of axial length with Optical and acoustic biometry are significantly different with p value less than 0.05. However, optical biometers fail in cases of dense media opacities where acoustic biometry in needed.

Key Words: Cataract, Axial length, Applanation ultrasound, Optical Biometry.

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INTRODUCTION

Cataract surgery with intraocular lens (IOL) implantation is one of the most common and frequent surgical procedures performed in ophthalmology.[1] Now-a-days cataract surgery is also considered as a type of refractive surgery.[2] Therefore, appropriate IOL power calculation is a crucial step to achieve the best possible refractive outcomes.[3] Axial length and corneal curvatures are the two important parameters for IOL power calculation, among which axial length is the most important one.[4] At present, biometry is done by two different methods, using distinct principles. One of these is A-scan contact ultrasound, which uses 10 MHZ ultrasonic waves to measure axial length up to vitro-retinal interface only. It uses the echo delay time to measure intraocular distances.[5] For accurate measurement 3 consecutive readings should

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be taken with a difference of 0.02m.[6] Optical biometry (IOL Master)was introduced in 1999 by Carl Zeiss Meditec and uses the principle of partial coherence interferometry (PCI) with a 780nm laser diode infrared light and measures the axial length from tear film to retinal pigment epithelium.[7] Advantages of this recent technology include high precision, its non-contact method and independency of observers bias. It is also useful in pseudophakic and silicone filled eyes. On the other hand, its limitations include media opacities like dense cataract and vitreous hemorrhage where ultrasound biometry is the method of choice.

A study conducted at King Saoud University showed that the mean axial length by IOL master was 23.7mm ± 0.5 as compared to 23.6mm ± 0.6 by acoustic method. This study showed that there was no statistically significant difference in the axial length measured by the two methods.[6]

The purpose of our study was to determine the mean axial length measured by Acoustic versus optical biometer and consequently find out whether there was difference between the two or not. This will help in refining post-operative refractive outcome by calculating the IOL power more accurately. Previous studies also indicate that the research on this subject has been scarce nationally as well internationally.

METHODS

The study was conducted in department of Ophthalmology, Liaquat National Hospital and Medical College, Karachi. It was a cross-sectional study of 6 months duration and was carried out between November 2018 to April 2019. By using open Epi, taking axial length of IOL master = 23.18 ± 0.77[3] axial length by Ultrasound = 22.94 ± 0.75,[3] power of test = 80% and 95% confidence level, sample size was calculated. Mean difference equal to 00.24 – 0.02 and margin of error of 0.0025, the calculated sample size was 246. It was non probability consecutive sampling. Inclusion criteria was age 40 – 80 years, either gender with visually significant cataract (examined by slit lamp examination & the best-corrected visual acuity of < 20/40 or 6/12 vision in the study eye on Snellen's chart). Patients with axial length between 22 – 25mm were included. Patients with axial length less than 22mm and greater than 25mm, dense cataract, history of previous refractive surgery, patients with corneal opacities or scars, corneal edema, keratoconus, keratoglobus, vitreous hemorrhage, retinal detachment or retinitis Pigmentosa and history of ocular trauma were excluded.

After the approval of study, all the consecutive patients fulfilling the inclusion criteria were recruited. Informed verbal consent was taken from all the patients. Procedure was explained to the patients thoroughly. Axial lengths were measured by non-contact optical method using Carl Zeiss IOL master. Then, after instillation of local anesthetic, Proparacaine, axial lengths were measured by contact method using A-Scan probe. To overcome the examiner bias, single researcher performed the measurements. Readings from both devices were compared and analyzed by using SPSS version 21. Mean and standard deviation was computed for quantitative variable i.e. age, axial length by Applanation ultra sound and axial length by optical biometry. Frequency and percentage was calculated for qualitative variables i.e. gender. Differences of axial length between the Applanation and optical biometry were compared by using pair T-test. Effect modifiers like age and gender was addressed through stratification, post-stratification independent test for two groups and ANOVA for more than two groups was applied. P-value less than or equal to 0.05 was taken as significant.

RESULTS

There were 246 patients with visually significant cataract, who were recruited in this study. Most of the patients were 51 to 70 years of age. The average age of the patients was 58.09 ± 7.27 years. There were 112 (45.53%) males and 134 (54.47%) females. There were 102 (41.46%) right and 144 (58.54%) left eyes.

Table 1: *Mean comparison of axial length with age group, gender and technique.*

	Axial Length	P-value
Age Group		
41 – 50 Years	0.14 ± 0.14	.572
50 to 60 Years	0.14 ± 0.19	
60 to 70 Years	0.17 ± 0.22	
> 70 Years	0.09 ± 0.15	
Gender		
Male	0.17 ± 0.25	0.301
Female	0.14 ± 1.4	
Technique		
Applanation ultrasound	22.29 ± 0.76	< 0.0005
Optical Biometry	23.44 ± 0.74	

Independent t-test and ANOVA is applied
*P < 0.05 is considered as significant

Mean axial length by optical biometry was 23.744 ± 0.74mm as compared to 22.29 ± 0.76mm by acoustic method. This difference was statistically significant (Difference = 0.153 ± 0.197; P = 0.0005). Further detail is given in Table 1.

DISCUSSION

With an incidence of 53.7%, cataract remains a significant ophthalmic morbidity where surgical treatment continues to be the definitive treatment and active area of research.[8,9] An increasing number of technologies have been introduced over time to assist in biometric measurement of the eye, further enhancing refractive accuracy and precision as an achievable quality metric. 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. Biometry values can be obtained either by contact (Applanation), immersion or optical methods.

To determine the mean difference in axial length measured by Applanation ultrasound and optical biometry, a total 246 patients of either gender, age 40-80 years with visually significant cataractwere recruited in this study. Most of the patients were 51 to 70 years of age and the average age of the patients was 58.09 ± 7.27 years. Most patients become aware of cataracts after the age of 60. However, cataracts start developing much earlier than that in the form of dysfunctional Lens Syndrome in which the natural lens goes through a normal aging process, which may cause changes in vision from the age of 40. In our study there were 112 (45.53%) male and 134 (54.47%) female.

It has been shown in Australian Blue Mountain Study that females are more associated with senile cataract and the findings of our study follow the same pattern.[10] These findings are suggestive of female gender as a risk factor for cataract.[11]

Optical biometry offers many distinct advantages compared to acoustic biometry. It is a non-contact approach with accuracy and reproducibility in the context of non-severe pathology. When limitations such as dense media opacity, high axial myopia, and/or poor fixation prevent use of optical biometry, acoustic biometry becomes a useful alternative method, as it can be used in cases with significant media opacity.[12,13] The advantage of the Applanation method is the faster measurements in the hands of a skilled operator. However, the disadvantage is the potential for corneal compression that may result in shorter axial length measurements. The disadvantage of the first optical biometery (e.g. IOL Master) in common clinical use, was the inaccurate measurement in cases of media opacities such as corneal scar and vitreous hemorrhage.

In this study, we found statistically significant difference between the results of two methods. (P = 0.0005). However, in a previous study, no statistically significant difference was seen between the two methods for myopic eyes.[14] Similarly Henessy et al,[15] reported that there was longer measurement by contact method as compared to immersion technique. They also suggested that repeating measurements made contact ultrasound biometry comparable to that of immersion with no clinically significant difference in mean axial lengths.

In a recent local study, comparison between axial length measured with non-contact and ultrasound technique showed that there was statistically significant difference ($p < 0.05$) between the two.[16] Inone study, the precision achieved with optical biometry was equal to acoustic biometry.[17]

Another researcher observed significant underestimation of axial length measurement when using the IOL master in eyes with rhegmatogenous retinal detachment with macular involvement, which could affect IOL power selection.[18]

In an Indian study, Applanation biometry with acoustic method showed significantly smaller axial lengths as compared to the optical biometry.[19] In contrast to this, Kaswin, et al, compared the performance of acoustic Scan with IOL- Master 500 in 50 eyes and reported excellent correlation in the axial lengths obtained by the 2 devices when the axial length was in the range of 22 – 27mm.[20]

Limitation of this study is that we did not consider the other factors which affect the biometry, the most important of which is the keratometry. The effect on the final intraocular lens power calculation was also not taken into account. Only a single formula SRK/T

was used. Further research to address these issues is required to bring the results of biometry closer to emmetropia.

CONCLUSION

Results of axial length with Optical and acoustic biometry are significantly different with p value less than 0.05. However, optical biometers fail in cases of dense media opacities where acoustic biometry in needed. Ophthalmologist must keep ultrasound biometry in hand for patients whosebiometry cannot be done with optical device use to density of the cataract.

Ethical Approval

The study was approved by the Institutional review board/ Ethical review board.
(Ref: App 0450-2018-LNH-ERC)

Conflict of Interest

Authors declared no conflict of interest.

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Authors' Designation and Contribution

Munira Shakir; Professor: *Concepts, Manuscript editing, Manuscript review.*

Ronak Afza; Resident: *Design, Literature search, Data acquisition, Manuscript review.*

Mariyam Azam; Resident: *Data acquisition, Data analysis, Manuscript review.*

Sahira Wasim; Resident: *Statistical analysis, Manuscript preparation, v*

Waqas Ali; Resident: *Statistical analysis, Manuscript preparation, Manuscript review.*