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Biometry Reading in Al-Kindy Teaching Hospital, Ultrasonic Versus Optical Axial Length and IOL Power Distribution

A research project submitted to the Family & Community Medicine department, Al-Kindy College of Medicine as a partial fulfillment of Research Module Year III

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ
دَرَجَاتٍ ۚ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ

(سورة المجادلة: 11)

صدق الله العظيم

Acknowledgment

We would like to thank and express our gratitude to supervisor Dr. Ali Abdulkareem who advised us on this study and gave us general directions on how to conduct it and finish this work. Also, we would like to thank the Family and Community medicine department in Al-Kindy College of medicine for giving us the opportunity and allowing this study to happen.

Dedication

This project is dedicated to the professors in the Family and Community medicine department, to our supervisor in the ophthalmology department Dr. Ali Abdulkareem and our beloved parents who helped and guided us throughout the project and have never failed to give us the support that we need to successfully complete this project work. Allah bless them. Finally, we dedicate it to all patients participating in the study

Abstract

Background: over the last decade, IOL power calculations have become a focal point of cataract surgery, considering this surgery as a refractive surgery, to reduce glass dependence.

Aims of the study: to compare the sensitivity and specificity of optical biometry and applanation ultrasonic biometry in the measurement the power of a retrospective of comparative study.

Methods: a retrospective comparative study, comparing optical with ultrasonic biometry in lens power measurement of 151 eyes from 80 patients. Admitted to Al-Kindy teaching hospital to perform cataract extraction and IOL implantation. The following date collected from Al-Kindy teaching hospital was classify to axial length and IOL target measured by optical versus ultrasonic groups, and classified the axial length of the same patient, one measured by optical device and another measured by ultrasonic device. All these classifications were done pre-operative surgery. Collected data introduced into google sheet and then converted Microsoft Excel sheet and loaded into Statistical Package for Social Sciences (SPSS) V26 statistical program.

Results: there were statistically significant (p value <0.001) in the difference between optical biometry and ultrasonic applanation biometry, the optical device is longer than ultrasonic device in about (=1.31mm), and the difference in the same patient on measured by optical device and another measured by ultrasonic device was (0.48mm). The mean standard of axial length in Al-Kindy was about (23.69mm), and the mean standard power of intraocular lens was about (21.55 D). The percentage of eyes was measured by optical biometry about (82%) and the percentage of eyes was measured by ultrasonic biometry about (18%).

Conclusion: in Al-Kindy hospital the axial length measures by ultrasonic biometry is shorter than it measures by optical biometry significantly, that give error in choosing intraocular lens power. The mean standard power of intraocular lens in Al-Kindy teaching hospital was about (21.55 D).

Keywords: Optical biometry, ultrasonic biometry, axial length and IOL power

Introduction

Ultrasound technology has been almost always used in ophthalmology. Since it has been described, cataract surgeons adopted ultrasound to measure the axial length of the eye for IOL power calculation. we can calculate either by contact applanation biometry (ultrasonic biometry), or by non-contact automated modality (optical biometry).

Basic parameters needed. The first, axial length of the eye (AL) is the distance between the anterior surface of the cornea and the fovea. Second, Central corneal power (Ks), another important factor, is a thin spherical lens with a fixed anterior to posterior corneal curvature ratio.

Currently the axial length measures by two methods. First, the most correct method is optical biometry by using optical infrared light non-contact automated modality. Second, by contact applanation biometry, this technique requires contact with an ultrasound probe on the center of the cornea (Ultrasonic biometry). Immersion ultrasonic biometry is also a non-contact method like optical biometry, using A-scan or ultrasound which is approach to optical biometry, but used widely in practice.

In general, optical biometry has been shown to be more accurate than contact applanation ultrasonic biometry in several studies, they found that the axial lengths measured by optical biometry were (0.47mm) longer than those measured by the applanation ultrasonic biometry.[{2}]

The normal range of axial length is between (22.5-24.5 mm), mean of axial length is estimated to be (23.48mm), standard deviation is about (1.154mm).[{23}]

Aims of the study

1. To compare the sensitivity and specificity of optical biometry and applanation ultrasonic biometry in measurement the power of a retrospective of comparative study.

2. To know the frequency of intraocular lens power use in Al-Kindy teaching hospital.

Methodology

A retrospective comparative study, comparing optical with ultrasonic biometry in lens power measurement of 151 eyes from 80 patients. Admitted to Al-Kindy teaching hospital to perform cataract extraction and IOL implantation, from the date (2022/12/13) to the date (2023/1/10). These patients underwent cataract surgery from several doctors in Al-Kindy teaching hospital.

The measurement of the power of the lens with optical biometry device (ALADDIN, volt 100-240v , power 150va ,FREQ 50/60 Hz, Italy), and for patients who did not obtain the axial length of the eye for them by the optical biometry device, the axial length was taken by ultrasonic biometry device (TOMY CORPORATION ,volt 100-120v /220-240v ,power 35/42va , FREQ 50/60 Hz,Al100) the measurement was taken after drops (Tetracaine) were placed in the eyes that cannot be obtained in the optical biometry and the patient was directed to look forward to the wall ,then the applanation ultrasonic biometry measured three times and take the average of these measurements, finally these measurements were added to the optical biometry device.

The following data collected from Al-Kindy teaching hospital was classify to axial length and IOL target that measured by optical versus ultrasonic groups, and classified the axial length of the same patient, one measured by optical device and another measured by ultrasonic device. All these classifications were done pre-operative surgery.

Intraocular is a lens implanted in the eye usually as part of a treatment for cataract or for correcting other vision problems. most of ophthalmologist in Al-Kindy Teaching Hospital uses Rayner lens, because it is high quality (brand name) and pre-loaded.

The collected data was introduced into google sheet and then converted to Microsoft Excel sheet and loaded into Statistical Package for Social Sciences (SPSS) V26 statistical program. Descriptive statistics were presented using tables (means ± SDs, frequencies and percentages). Pearson's Chi-square test, paired sample t-test, ANCOVA (Analysis of covariance) statistical tests were used to find out a significance of association between optical biometry and ultrasonic applanation biometry. $P < 0.05$ was considered statistically significant.

Results

A total number of 151 eyes from 80 patients, admitted Al-Kindy Teaching Hospital was included in this study. The total number of males was (n=38) patients which means (47.5%), and the total number of females was (n=42) which means (52.5%). The percentage of eyes was measured by optical biometry about (82%) and the percentage of eyes was measured by ultrasonic biometry about (18%).

Table (1): Distribution of patients by their demographic characteristics

Variable		Frequency	Percentage
Age	<40 years	22	27.5%
	>40 years	58	72.5%
	Total	80	100.0%
Gender	Female	42	52.5%
	Male	38	47.5%
	Total	80	100.0%

Table (1) shows the age more than (40 years old) participated (72.5%) and the age less than (40 years old) participated (27.5%) of the total. Regarding gender more female participated (52.5%) than male (47.5%).

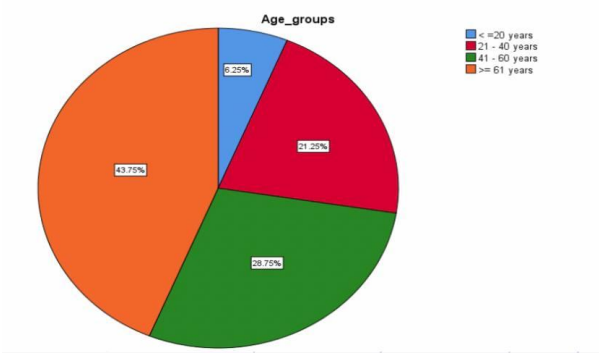

Figure (1)

Table (2) and Chart (1): patients' axial length distribution and frequency (total)

	Mean	Minimum	Maximum	Std. Deviation
Axial length	**23.69**	**21.81**	**32.75**	**1.57**

Table (2) shows the means, minimum value, maximum value and standard deviation of the total axial length for 80 patients.

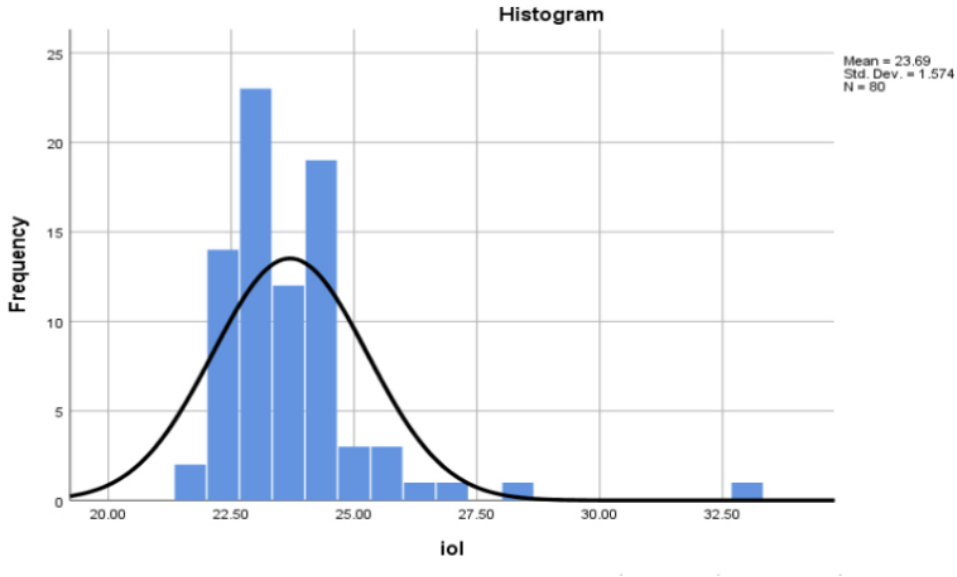

Chart (1) shows the frequency of the total axial length Regardless that the axial length was measured by optical biometry or applanation ultrasonic biometry, for the right and left eye.

Table (3) and chart (2): Intraocular lens distribution and frequency (total)

	Mean	Minimum	Maximum	Std. Deviation
IOL @target	21.55	16.63	26.44	2.19

Table (3) shows the mean value, minimum value, maximum value and standard deviation of the total intraocular lens for 67 patients.

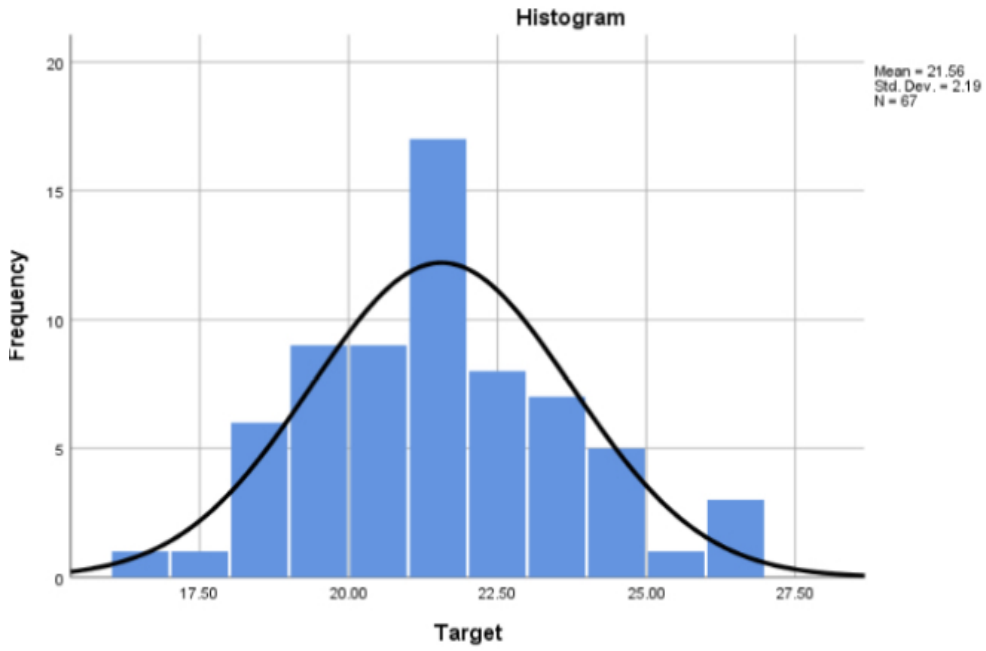

Chart (2) shows the frequency of the total intraocular lens @target, Regardless the right or left eye was measured by optical biometry or applanation ultrasonic biometry.

Table (4), chart (3) and chart (4) distribution and frequency between the total(right/left) axial length measured by optical biometry and total(right/left) axial length measured by ultrasonic biometry.

	Mean	Minimum	Maximum	Std. Deviation	P value
Optical axial length	23.89	21.86	32.97	1.62	< 0.001
Ultrasonic axial length	22.58	21.76	24.22	0.75	< 0.001

Table (4) shows that the difference in the axial length which is measured by two different devices, the first device is the optical biometry and the second device is the applanation ultrasonic biometry, the result from this table is that the optical biometry longer than applanation ultrasonic biometry as much as (=1.31mm), this difference because of the pressure of applanation ultrasonic biometry in the eye and the Tetracaine drops that cause contract of the eye.(p vale less than 0.001) mean that, it was highly significant.

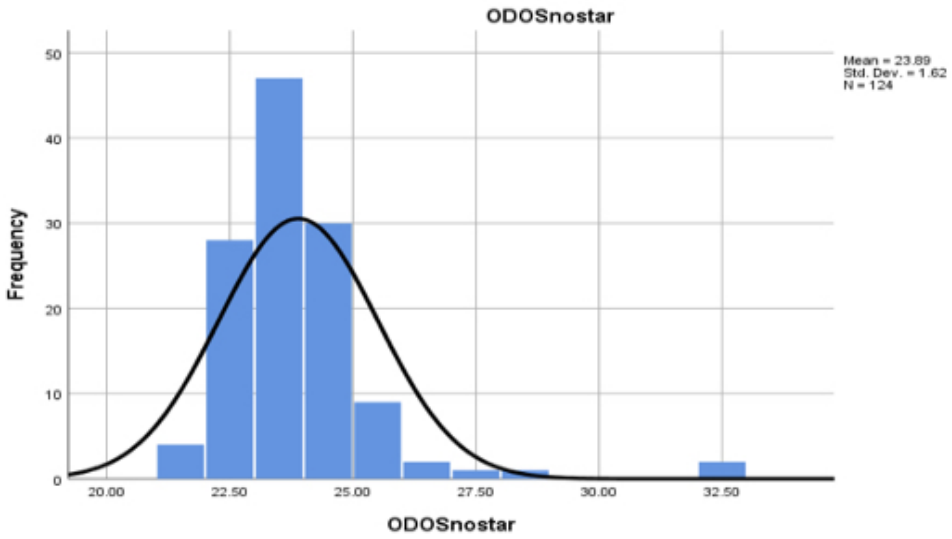

Chart (3) shows the frequency of the axial length that is measure by optical biometry, the means of this method is equal to (23.89mm).

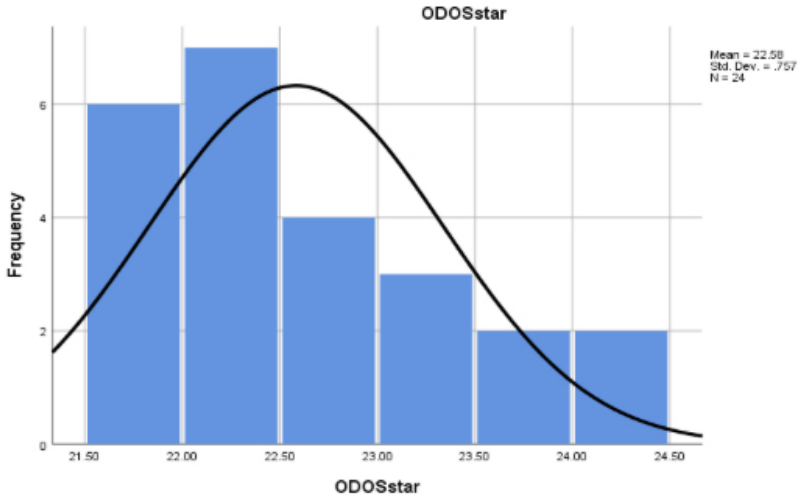

Chart (4) shows the frequency of the axial length that is measure by applanation ultrasonic biometry, the means of this method is less than optical measurements that is equal to(22.58mm).

Table (5), chart (5) and chart (6) distribution and frequency of axial length in the same patient (one eye was measured by optical biometry and the other eye was measured by ultrasonic biometry).

	Mean	Minimum	Maximum	Std. Deviation
Optical axial length	23.24	21.93	24.21	0.73
Ultrasonic axial length	22.76	21.83	24.22	0.79

Table (5) Confirms the difference in the axial length in the same patient, the axial length was measure by optical biometry is longer than ultrasonic biometry as much as(=0.48mm), this difference was caused by the same cause in the table (4), look to result of the table (4).

So, that we take this study to take care of this variation in the axial length when the ophthalmologist does the cataract surgery to implant the correct lens.

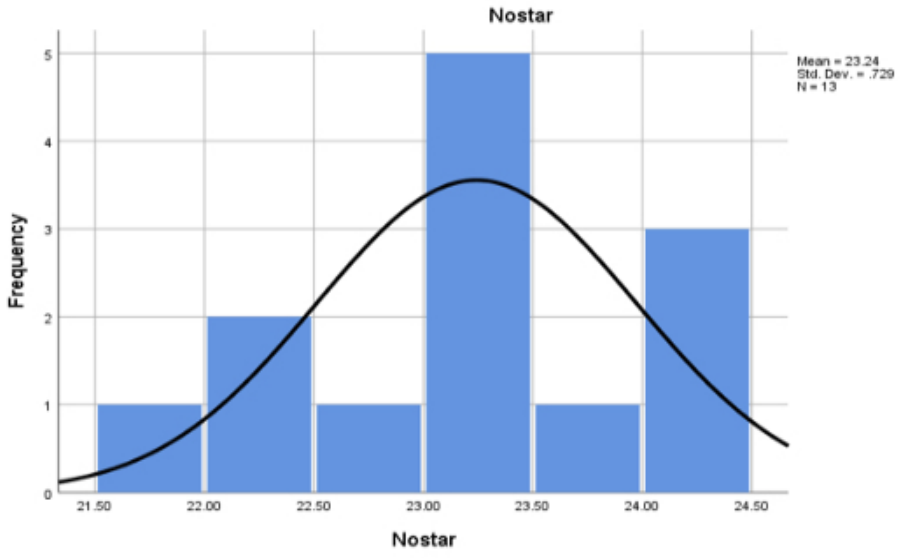

Chart (5) shows the frequency of axial length that is measure by optical biometry, the means of this method is equal to (23.24mm).

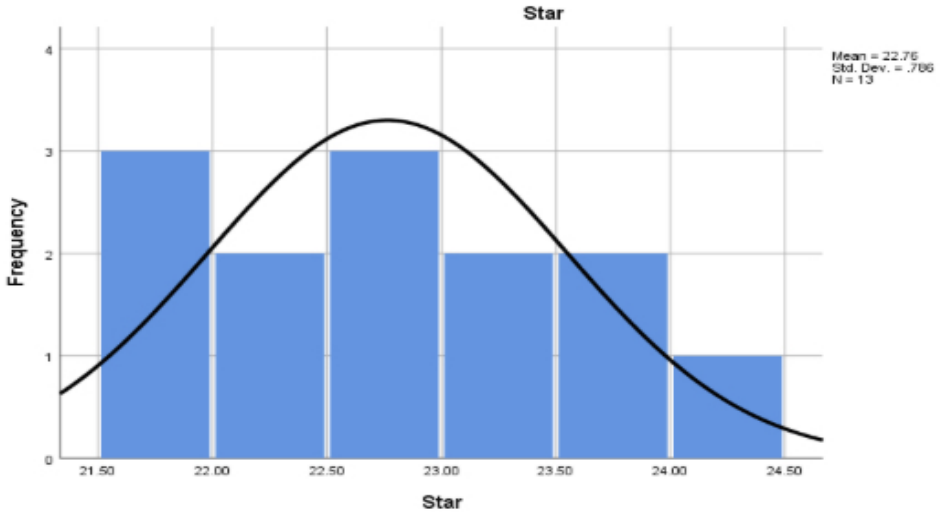

Chart (6) shows the frequency of axial length that is measure by ultrasonic biometry, the means of this method is equal to(22.76mm).

Discussion

The mean of axial length that measured by optical or ultrasonic biometry for 151 eyes from 80 patients in Al-Kindy teaching hospital was (23.69mm), which is same of axial length in many countries around the world, to compare those axial lengths with axial length of Al-Kindy teaching hospital. That was same to study from Dhahran Eye Specialist Hospital in Saudi Arabia, the axial length was (23.55) axial length.[1]

In comparison with South China, Al-Kindy axial length was approach the axial length in Guangzhou in south China, (23.48mm) was the axial length in Yuexiu and Tianhe Districts of Guangzhou. [21] Finally, in comparison with urban, Al-Kindy axial length was approaching the axial length in urban, (23.30mm) was the axial length in Nizhniy Tagil Russia.[22]

The intraocular lens was measured and implanted in Al-Kindy teaching hospital; the mean of intraocular lens was (21.55mm). Intraocular is a lens implanted in the eye usually as part of a treatment for cataract or for correcting other vision problems. most of ophthalmologist in Al-Kindy Teaching Hospital use Rayner lens, because it is high quality (brand name) and pre-loaded.

Effective lens position estimation is currently considered the primary source of the prediction error of IOL power formulas, that influences the refractive outcome of cataract surgery. The definition of the effective lens position can differ depending on the eye model used, with refractive elements that may correspond to either thin or thick lenses.[24]

Conclusion

In Al-Kindy hospital the axial length measures by ultrasonic biometry is shorter than it measures by optical biometry significantly, that give error in choosing intra ocular power. the mean standard power of intraocular lens in Al-Kindy teaching hospital was about (21.55 D).

Limitations of the Study

There were some limitations on our study occurred, short follow up period limited the comparison of the long terms outcomes, Also, some patients who were included at first visit were lost to follow up; and that resulted in less than the intended number of study sample. Also, the number of axial lengths measured by ultrasonic biometry was little.

Recommendation

We recommend another study that measures the axial length by optical biometry to the patients who do the cataract surgery after measured the axial length by ultrasonic biometry and compare pre-operative axial length that measures by ultrasonic biometry with post-operative axial length that measures by optical biometry.

For technicians the accuracy of ultrasonic biometry can be improved by implementing the following: minimizing variability and improving consistency by assigning a single properly calibrated instrument and experienced technician for the work-up, using one of the newer IOL power calculation formulas and personalizing the lens constants for each formula and By understanding the advantages and limitations of current technology and following these guidelines, it is possible to consistently achieve highly accurate results.

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