Original Article

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# Measurement of Axial Length in the Calculation of Intraocular Lens Power for Biometry

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**ABSTRACT**

***Background:*** *Intraocular Lenses (IOLS) are permanent artificial lenses that can replace the eye's natural lens to restore both near and distant vision. The aim of the study is to compare the accuracy of a single high quality. A scan measurement with that of the average three acceptable measurements in the calculation of IOL power.*

***Materials and methods:*** *Studied 180 eyes of 180 patients who underwent IOL surgery. All these patients underwent preoperative ocular biometry. Phacosurgery with posterior chamber intra ocular lens (PC IOL) implantation and clinical refraction was done in all patients between 4 to 12 weeks post operatively. The duration of the study was from January 2018 to December 2020 at Chittagong Parkview Hospital Ltd, Chattogram.*

***Results:*** *There was no significant difference between the two study group in measured axial length calculated emmertopic IOL power and the prediction of post operative refraction.*

***Conclusion:*** *The use of single high quality axial length measurement was as accurate as the mean of the three acceptable axial length measurement in the calculation of IOL power.*

**Key woards :** Axial length (AL); Dioptic power (D); Keratometry; Visual acuity.

## Introduction

Biometry is the process of measuring the power of cornea and the axial length of the eye and using the data to determine the ideal intraocular lens power. If this calculationis not performed accurately, the patients maybe left with a significant refractive error post operatively.[1] Accurate measurement of axial length is essential for accurate Intraocular Lens (IOL) power calculation. Although it is a common practice to average several axial length measurement to improve accuracy, it has been suggested that a single high quality A – scan ultrasonographic measurement is adequately accurate owing to the high test- retest reliability of A scan biometry.[2]

The axial length is the distance between the anterior surface of the cornea and the fovea as measured by A scan ultrasonography.[3] A scan is an amplitude modulation ultrasound scan. It provides data on the axial length of the eye. Commonly A scan is done using an applanation probe in contact with the cornea but the immersion method may also be used.[1] An A scan measures the time required for a sound pulse to travel through the ocular media, reflect from the retina and return through the media.[4] The sound beam must be aligned with the visual axis for maximal precision, each reflecting surface is represented by a spike on an oscilloscope display monitor.[5]

There are several biometric formulas that can be used depending on the actual characteristics of the eye. The Hoffer Q, Holladay 1, 11, Hagis and SRK T formula are commonly used. The older SRK 1 and 11 regression formulae are now regarded as obsolute.[1] This study was performed to compare the accuracy of a single high quality, A scan measurement with that of the mean of three acceptable measurements in calculation of IOL power.[2]

## Meterials and methods

This prospective study was done on 180 patients where 108 male and 72 female patients were randomly selected 90 patients for each group at Parkview Hospital Ltd, Chattogram who underwent phacosurgery with PC IOL implantation during the period of January 2018 to December 2020. Age of the patient was from 15 to 85 years range. Ocular disease like corneal opacity, abnormal corneal shape and size, size of the eye ball where axial length < 21.00 and > 26.00 mm were excluded from the study.In children, in short and long axial length, there is seperate formula for IOL power calculations.[6] Short eyes (Axial length) in particular prone to unexpected mean spherical and astigmatic errors . In ocular diseases and long axial length, surgery was complicated. So they are excluded from the study.

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Pre operative ocular keratometry regarding as Dioptic power (D) of every cases were measured with automated keratometer. Axial length of eyeball in mm was measured with contact method. A scan byAxis Nano Ultrasonic A scanner, France single reading for first group and three times for second group. Power of IOLwas calculated by using SRK-T formula (P= A – 2.5 L – 0.9 K). A constant for each IOL were specified by the manufacturer. In this soft lens of Alcon Labratories, USA was used and they suggested 118.7 as their common A constant. Clinical refraction was done after 4 weeks and after 12 weeks post operatively.

**Results**

In single A scan ultrasonography, 90 patients had average Axial Length (AL) of 23.80 mm and in average three A scan ultrasonography, 90 patients had Axial Length (AL) of 23.72 mm.

Emmertropic biometry in single "A scan ultrasonography" showed 8 patients (8.88%) had average Keratometry of 42.80 D, average AL of 23.74 mm and average biometry 20.83 D. 45 patients (50%) had average Keratometry 43.10 D, average AL 23.80 mm and average biometry 20.41 D.16 patients (17.77%) had average Keratometry 43.25 D, average AL 23.90 mm and average biometry 20.16 D.10 patients (11.11%) had average Keratometry 43.55 D, average AL 23.70 mm and average biometry 20.25 D. In patients (12.22%) had average Keratometry 44.10 D, average AL 23.84mm and average biometry 19.41 D.

Emmertropic biometry in average three A scan ultrasonography, showed 8 patients (8.88%) had average Keratometry of 42.90 D, average AL of 23.65 mm and average biometry 20.96 D.42 patients (46.66%) had average Keratometry 43.10 D, average AL 23.72 mm and average biometry 20.61 D. 11 patients (12.22%) had average Keratometry 43.30 D, average AL 23.70 mm and average biometry 20.48 D, 17 patients (18.88%) had average Keratometry 43.60 D, average AL 23.74 mm and average biometry 20.09 D,12 patients (13.33%) had average Keratometry 44.10 D, average AL 23.79mm and average biometry 19.53 D.

4 weeks after surgery, Visual Acuity (VA) was measured. In single "A scan ultrasonography" group VA was 6/6 in 44.44% (40), 6/9 in 35.55% (32) of 6/12 in 20% (18) patients. Visual acuity again done 12 weeks after surgery. Now V/A was 6/6 in 56.66% (51), 6/9 in 25.55% (25) and 6/12 in 17.77% (16) of patients.

In average three 'A scan ultrasonography' group, 4 weeks after surgery, visual acuity was found 6/6 in 45.55% (41), 6/9 in 33.33% (30) and 6/12 was less in 21.11% (19) patients. After 12 weeks, VA in this group was 6/6 in 54.44(49), 6/9 in 30% (27) and 6/12 or less in 13.55% (14) patients among the study population.

**Table I** Distribution of sex (n=180)

| Sex of the patients | No of patients | Percentage |
|---|---|---|
| Male | 108 | 60% |
| Female | 72 | 40% |

Total patients were 180 out of which male were 108(60%) and female were 72(40%).

**Table II** Axial Length (AL) in single A scan ultrasonography (n=90 )

| Axial length in mm | Average | Number of patients | Percentage of patients | Average axial length in mm |
|---|---|---|---|---|
| < 23.00 | 22.90 | 12 | 13.33 % | |
| 23.00- 23.50 | 23.35 | 15 | 16.66% | 23.80 |
| 23.50- 24.00 | 23.65 | 43 | 47.77% | |
| > 24.00 | 25.30 | 20 | 22.22% | |

Table shows in single A scan ultrasonography 90 patients had average AL of 23.80 mm.

**Table III** Axial Length (AL) in average of three A scan ultrasonography (USG) (n =90)

| Axial length in mm | Average | No of patients | Percentage of patients | Average axial length in mm |
|---|---|---|---|---|
| < 23.00 | 22.80 | 15 | 16.66 | |
| 23.00- 23.50 | 23.30 | 16 | 17.77 | 23.72 |
| 23.50- 24.00 | 23.65 | 40 | 44.44 | |
| > 24.00 | 25.15 | 19 | 21.11 | |

Table shows in average three A scan USG, 90 patients had AL of 23.72 mm.

**Table IV** Emmertropic biometry in single A scan ultrasonography (n=90)

| Number of patient | keratometry in Diopter | Average keratometry in Diopter | Average axial length | A constant | Emmertropic biometry in Diopter | Average emmertropic biometry |
|---|---|---|---|---|---|---|
| 8 | <43.00 | 42.80 | 23.74 | | 20.83 | |
| 45 | 43.00-43.20 | 43.10 | 23.80 | | 20.41 | |
| 16 | 43,20- 43.40 | 43.25 | 23.90 | 118.7 | 20.16 | 20.21 |
| 10 | 43.40- 44.00 | 43.55 | 23.70 | | 20.25 | |
| 11 | >44.00 | 44.10 | 23.84 | | 19.41 | |

(According to the Keratometric reading).

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**Table V** Emmertropic biometry in average three A scan ultrasonography (n= 90)

| Number of patient | keratometry in Diopter | Average keratometry in Diopter | Average axial length | A constant | Emmertropic biometry in Diopter | Average emmertropic biometry |
|---|---|---|---|---|---|---|
| 8 | < 43.00 | 42.90 | 23.65 | | 20.96 | |
| 42 | 43.00-43.20 | 43.10 | 23.72 | | 20.61 | |
| 11 | 43.20-43.40 | 43.30 | 23.70 | 118.7 | 20.48 | 20.34 |
| 17 | 43.40-44.00 | 43.60 | 23.74 | | 20.09 | |
| 12 | >44.00 | 44.10 | 23.79 | | 19.53 | |

(According to the Keratometric reading).

## Discussion

In single "A scan ultrasonography" (A) group average axial length was 23.80mm and in multiple (Three) "A scan ultrasonography" (B) group average axial length was 23.72 mm. In South East Asia average axial length is 23.45 to 23.89 mm.[1] A study showed in single A scan ultrasonography group, average axial length of 23.81mm and in multiple (Three) A scan ultrasonography group, average axial length was 23.74mm.[1] A study showed in single A scan ultrasonography group, average axial length 23.78 mm and in multiple (Three) A scan ultrasonography group, average axial length was 23.70mm.[7] They were similar to this study. In single A scan ultrasonography group, average axial length 23.76mm and in multiple (Three) A scan ultrasonography group, average axial length was 23.68 mm was showed in other study.[6]

In single A scan group, average emmertropic biometry was 20.21 D and multriple (Three) A scan ultrasonography group the average emmertropic biometry was 20.34 D. Another study showed that single A scan ultrasonography emmertropic biometry was 20.24 D and in multriple (Three) A scan ultrasonography, the average emmertropic biometry was 20.36 D.[8] Sohir H. Gaballa showed in his study that single A scan ultrasonography, emmertropic biometry was 20.19 D and in multriple (Three) A scan ultrasonography, the average emmertropic biometry was 20.32 D.[9] They are similar to this study. In another study showed that single A scan ultrasonography, emmertropic biometry was 20.25 D and in multiple (Three) A scan ultrasonography, the average emmertropic biometry was 20.40 D.[1] Here emmertropic biometry slightly higher because of big sample size and variations of axial length.

In the A group, after 12 weeks 56.76% patients had 6/6 vision, 25.55% patients had 6/9 vision and 17.77% patients had 6/12 or less vision. Gaballa SH showed in his study, after 12 weeks of IOL implantation 57.80% patients had 6/6 vision.[9] A study showed after 12 weeks of IOL implantation, 58.60% patients had 6/6 vision.[10] Another study showed after 12 weeks of IOL implantation, 60.50% patients had 6/6 vision.[1] In the B group, after 12 weeks, 54.44% patients had visual acuity 6/6, 30% patients had visual acuity 6/9 and 15.55% had 6/12 or less vision. In Gaballa SH showed in their study after 12 weeks of IOL implantation, 55.20% patients had 6/6 vision.[9] Another study showed after 12 weeks of IOL implantation, 56.02% patients had 6/6 vision.[8] In MAH Ismail et al. showed their study that after 12 weeks, 57.33% patients had 6/6 vision.[1]

In this study, slightly less emmertropic biometry in both groups as because there is a variation of axial length and keratometric reading.

## Limitation

Single center study.

## Conclusion

From this study it has been suggested that on the basis of emmertropic power, biometry and post operative visual out come, the result of a single high quality A scan ultrasonographic measurement and that of the average of the three acceptable measurement in the IOL power calculation.

## Disclosure

Both the authors declared no competing interest.

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