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A COMPARATIVE STUDY OF BIOMETRIC VALUES OF LASER INTERFEROMETRY VS CONVENTIONAL ULTRASONIC BIOMETRY IN EYES UNDERGOING CATARACT SURGERY

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ABSTRACT Shift of paradigm of the cataract surgery from a visual rehabilitative procedure to a refraction procedure, presents a constant pressure on the surgeon to achieve pre-set refraction target. This is more so valuable in premium category of IOLs which are now been frequently opted by surgeons as well as the patients. The role of Pre- operative IOL calculation is therefore equally important as the surgery itself. The choice of IOL calculation methods therefore is required to be precise and predictably accurate. The present study compares the Laser Interferometry (IOL master) and ultrasonic Biometry for IOL calculation to establish predictable accuracy of the preceding method in achieving emetropia. In the study conventional ultrasonic biometry could achieve post- operative emetropia in only 1/3rd of the patients whereas with Optical biometry it was achieved in 2/3rd of the cases thereby substantiating it as a method of choice for universal employment for IOL calculations.

KEYWORDS : Laser interferometry, Ultrasonic Biomerty, SRK-T

INTRODUCTION

High patient expectations for precise postoperative refractive outcome following cataract surgery have spurred improvements in biometry and intraocular (IOL) lens power calculation. To meet increased patient expectations, proper patient selection, optimized 'A' constant, accurate assessment of keratometry and axial length (AXL) with application of appropriate biometric formula is essential. Any error in this biometric measurement and calculation leads to significant residual refractive error and highly dissatisfied patient.

Non-contact optical laser-based devices, such as IOL Master (Zeiss Meditec AG, Germany), compare favourably with conventional ultrasonic biometric techniques except in eyes with dense media opacities [1,2]. Measurements obtained by the IOL Master are affected by the density of cataract due to changes in the refractive index of the lens nucleus but its accuracy is less affected than conventional ultrasonic biometry[3].

The IOL Master provides an accurate axial length assessment and IOL power calculation based on the third generation formulas. It is quick, easy to use and provides a non-contact technique with no risk of infection or corneal abrasion[4]; this is particularly useful just prior to surgery. Biometry performed using IOL Master also produces a more predictable refractive outcome than immersion ultrasound[5].

Several studies have been conducted to compare the optical biometry versus conventional ultrasonic biometry with regard to the post-operative refractive outcomes [6,7]. However, not many studies have directly compared the K values, Axial Length (AXL), Anterior Chamber Depth (ACD) and IOL power calculated using a third generation formula (SRK/T formula) pre-operatively between the two prevalent techniques.

MATERIALS AND METHODS

A total of 200 eyes of patients with senile cataract scheduled to undergo cataract surgery at a tertiary care hospital in eastern India and willing to participate were inducted in the study. Best corrected visual acuity was estimated and complete ophthalmic examination was done.

Selected patients were then subjected to biometry. Biometric parameters ($K_{horizontal}$, $K_{vertical}$, axial length of the eyeball, anterior chamber depth) and IOL power calculation using SRK/T formula were performed. All eyes underwent estimation of these parameters with the non-contact IOL master (Zeiss IOL Master with Advanced Technology Software Version 5.4). The estimations were subsequently repeated in the same patients and same eyes with Bausch & Lomb keratometer and ultrasonic A-scan biometry using Appascan AME – 01A – Scan. The power chosen for IOL implantation was for emmetropia.

Eyes were subjected to phacoemulsification surgery under peribulbar anaesthesia with implantation of standard foldable intra- ocular lens. The power of IOL implanted was the one derived by IOL master. Foldable PCIOL of Bausch & Lomb (Akreos Adapt-AO) was implanted**.** Wound was closed with corneal hydration. Consecutive cataract patients who underwent surgery by the same surgeon using the same surgical technique were taken up for study. Selected cases were followed up and glasses were prescribed at the end of 6th post-operative week.

The final refractive error was compared with the IOL powers derived pre-operatively by Conventional Biometry method (Group A) and IOL master (Group B). Patients requiring zero spherical correction or those requiring upto ± 0.5D of correction for a best corrected visual acuity of 6/9 or better were considered to be emmetropic. The differences were tabulated and subjected to statistical analysis using Microsoft excel software and SSPS version 11.0.1. A p value of < 0.05 was taken as significant.

Following eyes were excluded from the study:

1. Eyes with poor fixation secondary to macular or retinal disorders
2. Eyes with anterior segment disorders like tear film abnormalities, corneal pathologies and mature cataracts.
3. Eyes which have had intra- operative or post- operative complications and when sutures have been applied after phacoemulsification surgery.

RESULTS

More than half of the patients (64.5%) had nuclear sclerosis grade 2. 32.5% patients had nuclear sclerosis grade 3 and only 3% had nuclear sclerosis grade 1.

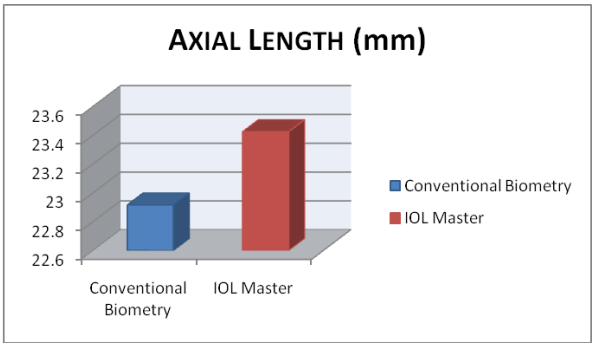
There is a notable difference between the $K_{horizontal}$ and $K_{Vertical}$ (K) values, axial length and anterior chamber depth (ACD) as measured by conventional keratometry and IOL Master with the difference being statistically significant [Table 1, Figure 1].

Table 1: Comparison of Keratometeric values, Axial Length & AC Depth

	Conventional Biometry (A)	IOL Master (B)	Statistical significance of difference between the means
$K_{horizontal}$ (D)	45.14 (↑)	43.55 (↓)	Significant
$K_{vertical}$ (D)	43.70 (↓)	44.68 (↑)	Significant
Axial length (mm)	22.92 (↓)	23.43 (↑)	Significant
Anterior Chamber Depth (mm)	2.80 (↓)	3.05 (↑)	Significant

Values of three out of the four parameters were higher when measured by the IOL Master than the values measured by Conventional Biometry. Since the conventional biometry recorded higher $K_{horizontal}$ values and lower values of $K_{vertical}$ and vice versa for IOL Master, the effect of the variability of K-readings on IOL power calculation was did not affect the average K value and hence did not affect the final readings. The average K reading was +44.42 D by conventional biometry and +44.09 D by IOL master. SRK/T formula was used to calculate the IOL power which did not take into account the anterior chamber depth for IOL power calculation, therefore the effect of anterior chamber depth on IOL power calculation could not be deduced. So, effectively, the only variation is the axial length values as measured by both the methods that affected the calculation of IOL power. This implies that the essential difference between the conventional biometry and IOL is the measurement of axial length.

Figure 1: Axial Length comparison between IOL Master & A Scan



In 25% of cases there was no requirement of spherical correction for emmetropic visual acuity at 6th post-operative week. A refractive error of ±0.5D was taken as emmetropia. The number of cases that corrected to 6/9 or better with ±0.5D was 46%. With implantation of IOL of power as calculated by IOL Master, a total of 71% cases achieved emmetropia at 6 weeks post-operatively.

With IOL Master, 90% of the patients had post- operative refractive error of less than ±1.0D; had IOL implantation been done with aid of ultrasonic Biometry, only 55% would have had post- operative correction of less than ±1.0D, though 45% would have had post-operative refractive correction exceeding ±1.5D [Table 2].

Table 2: Post- operative comparison of refraction after IOL Implantation

Post- operative Correction (at 06 weeks)	IOL Master Cases/ %	Conventional Biometry (Ultrasound)	
		Difference of IOL power from that measured by IOL Master	Number of cases
No spherical correction	50 (25%)	No difference ± 0.5D ±_1D ±1.5D ≥ 2D	11 6 9 11 13
±0.5 D Correction	92 (46%)	No difference ±0.5D ±1D ±1.5D ≥ 2D	18 18 22 14 20
±0.75D Correction	48 (24%)	No difference ±0.5D ±1D ±1.5D ≥ 2D	13 6 10 7 12
Greater than ±1.0D Correction	10 (5%)	No difference ±1.5D ≥ 2D	3 2 5

DISCUSSION

Value of axial length measured by IOL Master was significantly more than that measured by conventional biometry and this difference was statistically significant in our study. A recent study concluded that there was a difference in axial length measurement between IOL Master and ultrasonic biometry. A 0.1 mm error in AXL measurement could result in a ± 0.25 to 0.75 Diopter difference in IOL power that could be clinically significant [8,9].

The percentage of eyes with a difference in the IOL powers calculated by the IOL Master and conventional biometry was 78% in the zero spherical correction sub-group and 80.4% in ±0.5D sub-group, which is significant. The commonest difference in the IOL powers between the two groups was ±1.5D in the zero spherical sub-group (22%) and ±1.0D in ±0.5D sub group (23.9%). This means that at least $^1/_5^{th}$ of the cases had a difference of 1.0 – 1.5D when the power was calculated by conventional biometry compared to that by calculated by IOL Master [Table 2].

This must be because the IOL master utilises a non-touch technique and in the conventional method a certain amount of pressure gets applied, resulting in calculation of a shorter axial length. The relatively similar differences are seen in ACD measurements [10,11]. This leads to the assumption that Ultrasonic examination is more dependent upon the operator.

In only 37.3% of the eyes the IOL powers calculated by the Conventional ultrasonic method was such that post-operatively the patients would have required ±0.5D or less of spherical correction to achieve 6/9 or better vision as compared to 71% of eyes who had achieved the same with IOL Master. The findings of this study are in corroboration with various studies which have shown the IOL Master to be ten times more precise as brought out by O. Findl *et al*[12].

In conclusion, the IOL Master has made the process of ocular biometry more accurate. By performing using conventional biometry, we could have achieved post- operative emetropia in only 1/3rd of the patients but with Optical biometry we have achieved this in 2/3rd of the patients. It allows accurate axial length measurement and determination of IOL power for cataract surgery because it measures the ocular axial length along the visual axis, as the patient fixates at the measurement beam. During ultrasound biometry a misalignment between the measured axis and the visual axis and indentation by the operator may result in erroneous axial length measurements.

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Conflicts of interest: None

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