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# ACCURACY OF OPTICAL BIOMETER AND A-SCAN FOR THE POWER CALCULATION OF INTRAOCULAR LENSES.

Ophthalmology

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## ABSTRACT

**Objective:** The aim of this study is to investigate the accuracy of optical biometer and a-scan for the power calculation of intraocular lenses at SMS Medical college ,jaipur .

**Materials and Methods:** We examined consecutive cataractous eyes with the optical biometer as well as with the acoustic biometry and keratometry. In all eyes, the intraocular lens to be implanted was chosen by means of the SRK/T formula, based on the measurements conducted with our standard method. The achieved postoperative refraction is obtained, at least 4 weeks after surgery, by the treating ophthalmologists. The results were compared and analyzed statistically .

**Results:** We examined 86 out of which 36 female and 42 were male. Comparison of eye lengths as well as of the keratometric measurements showed good correspondence between the obtained measurements by both methods, acoustic biometry yielding significantly ($P < 0.001$) different axial lengths than the optical biometer, and the keratometry yielding significantly ($P < 0.001$) different mean corneal refraction power than the IOL Master. The accuracy of the refraction obtained postoperatively compared to the preoperative aim was better with optical biometer compared to acoustic method.

**Conclusions:** The predicted systemic differences in measurement results could be verified. Significant improvement in accuracy of our postoperative refraction prediction was achieved using IOL master. The other advantages of the optical biometer are the substantial gain in time, as well as the fact that performance of the measurements may be delegated. Only shortcoming was the use of optical biometer in mature cataract.

## KEYWORDS

A scan biometry, optical biometer, IOL power calculation, keratometry

## INTRODUCTION

Cataract surgery is most commonly performed surgical procedure. In the last five decades, innovations such as ocular biometry, phacoemulsification, and intraocular lens (IOL) power prediction formulas have improved considerably the refractive outcome of cataract surgery. The overall accuracy depends on such factors like preoperative biometric data axial length (AL), anterior chamber depth (ACD), lens thickness, keratometric index (K), IOL power calculation formulas and IOL power quality control by the manufacturer.

Studies based on preoperative and postoperative ultrasound biometry show that 54% of errors in predicted refraction after IOL implantation can be attributed to AL measurement errors, 8% to corneal power measurement errors, 38% to incorrect estimation of postoperative ACD. Thus the most important step for an accurate calculation of the IOL power is the preoperative measurement of the ocular axial length (AL). [1] A-scan ultrasonography, with a reported longitudinal resolution of approximately 200 µm and an accuracy of approximately 100-150 µm, [2],[3],[4] is routinely employed in the measurement of the ocular AL, which requires physical contact of a transducer with topical anesthesia. Ultrasound biometry AL measurement errors have been demonstrated to be responsible for postoperative refractive error of 0.28 diopters (D) resulting from an AL shortening of 0.1 mm. [1],[5],[6] The AL when measured by applanation A-scan ultrasound because of the indentation of the globe and off-axis measurement of the AL by the transducer causes erroneous AL detection and an undesired postoperative refractive outcome.

An optical imaging technique, optical coherence tomography (OCT), has been developed that uses infrared laser light for biometry and tomography. [7],[8],[9],[10],[11],[12],[13],[14],[15],[16],[17] A dual beam version of the OCT, partial coherence interferometry (PCI), which is insensitive to longitudinal eye movements, as it uses the cornea as reference surface, has been demonstrated to measure with high precision and accuracy the AL of normal and cataractous eyes. [18] A commercially available optical biometry equipment, IOL master (Carl Zeiss Jena, Germany) uses infrared light ($\lambda$ = 780 nm) of short coherence for the measurement of the optical AL, which is converted to geometric AL by using a group refractive index. [18],[19] Furthermore, it measures the corneal curvature, the anterior chamber depth, and the corneal diameter and it calculates the optimum IOL power by the acquired biometry data, employing several IOL power calculation formulas built into its computer software.

In our study, AL, keratometry and IOL measurements obtained by the optical biometer were compared to those of the ultrasound in a cohort of 156 consecutive patients who underwent cataract surgery. The postoperative refractive accuracy was determined and compared to that of ultrasonography.

## MATERIAL AND METHODS

**Study Design:** Prospective cohort study.

**Selection criteria:** 78 eyes of 78 consecutive patients undergoing phacoemulsification with primary IOL implantation were included in this study.

**Exclusion criteria:** All patients with dense media opacities like mature cataracts, dense PSC, posterior polar cataracts in which optical biometer couldn't be performed were excluded. Also patients who had complicated course of surgery or who didn't turn up for follow up were excluded from study.

Preoperatively, Snellen visual acuity was assessed and all patients underwent a cycloplegics refraction, IOP measurement, slit lamp examination for studying morphology of cataract and fundus examination by indirect ophthalmoscopy.

All patients underwent axial length and keratometry measurements with the optical biometer. AL measurements were also taken by applanation ultrasound and keratometry measurements by manual keratometer (Bausch and Lamb) by single experienced ophthalmic personnel for all patients. The intraocular lens power calculated by the SRK/T formula. The A constants in each SRK-T formula were individualized for the IOL that was chosen by the surgeon.

After informed consent, all patients underwent cataract surgery by clear corneal phacoemulsification with "Stop and Chop" technique with foldable in-the-bag IOL implantation by the same experienced surgeon.

A standard postoperative topical antibiotic and steroid regime was administered. Patients were examined on 1st postop, 7th day and then 1 month after surgery.

The primary outcome measure of the study was postoperative spherical refractive correction. Final refraction was noted at 1 month with all cylinders transposed to minus. Results were statistically analyzed .

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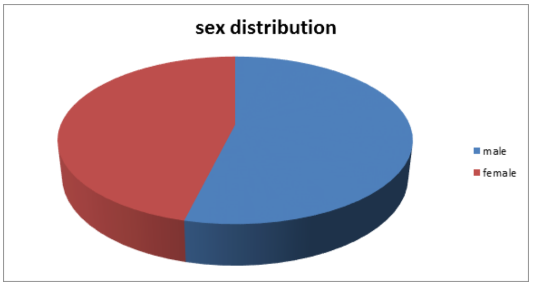
## Results

One hundred and fifty six eyes of 78patients were recruited in this study among which 42 were male (53.84%) and 36 were female (46.15%) patients in which maximum patients fall in the age group of 50-70 median with std. deviation of 104,66.66% [figure1].

**figure1**




### Postoperative Visual and Refractive Results

Out of 78 patients, 35 were implanted IOL calculated by optical biometer and 22 by ultrasound. 21 were implanted IOL which were in between these two.

For optical biometer patients 23 (65.71%) had postop spherical refraction in range of −0.50 to +0.50 and 12 (34.28%) were outside this range [Table 1]

For ultrasound, patients count was 19 (43.2%) and 25 (56.8), respectively [Table 1].

**Table 1: Achievement of postop emmetropia and ametropia in percentages in IOLM, Intermediate and USG categories**

| State of eye | Optical biometer | | Intermediate | | A-scan | |
|---|---|---|---|---|---|---|
| | nominal | percentage | nominal | percentage | nominal | percentage |
| Emmetropia | 23 | 65.71 | 12 | 57.14 | 9 | 40.90 |
| Ametropia | 12 | 34.28 | 9 | 42.85 | 13 | 59.09 |
| Total | 35 | 100 | 21 | 100 | 22 | 100 |

For intermediate group it was 23 (57.5%) and 17 (42.5%), respectively, which was statistically significant (P = 0.00) [Table 1].

For IOL power comparison, there was significant statistical difference (P = 0.00) between IOLM and ultrasound [Table 2].

**Table 2: Showing over all lens power difference amongst optical and acoustic biometry**

| Power difference | Numbers |
|---|---|
| 0.00 to0.5 | 32 |
| 0.6-1.00 | 30 |
| >1 | 16 |

We also studied k1, k2 average k, axial length and IOL power for all groups which was found significantly different with all variables between two methods. ($P$ = 0.00 for K1, K2, avg K and AL) .

## DISCUSSION

Applanation ultrasonography remains the preferred method of measuring the ocular axial length in most ophthalmic practices. [19] The PCI-based prototypes and the optical have been demonstrated to measure very accurately the AL with precision comparable to or even better than that of immersion biometry. [6],[16],[18],[19],[20],[21],[22],[23],[24],[25]

The employment of the optical AL instead of ultrasound AL has improved significantly the refractive results of cataract surgery. [23] In this cohort, the mean absolute prediction error of optimized IOL Master biometry was significantly smaller ($P$ < 0.0001) than that of optimized ultrasound. In our study an improvement in the refractive outcome of 23% [Table 2] was noticed.

Using an investigational prototype, Drexler *et al.*[25] reported an improvement of about 30% when the SRK II formula was used and Rajan *et al.*[20] reported a 16% improvement on retrospective IOL power calculations using the IOL Master. [21],[22],[23]

Contrary to our study, Gantenbein, C., H. M. Lang, *et al.* [26],[27] found high precision and reproducibility with both methods postoperatively compared to the preoperative aim ($P$ < 0.001). There was no statistical difference in the mean absolute error between the two groups.

Nevertheless, despite the improvement of refractive outcome, outliers still exist. This may be due to various cataract characteristics, as the IOL Master utilizes the same group refractive index for all cataract grades.

The weakness of our study was small sample size. The strengths of our study is prospective design; secondly all the patients were studied and analyzed both with IOL Master and A scan ultrasound and the use of IOLM power in some and A scan power in other cases and also intermediate power in remaining cases. Packer *et al.*[6] employing the Holladay II formula, which uses further parameters for the determination of the IOL position in the eye, have reported 100% being within 1 D from intended refraction, whereas we have 95.8 and 92.1%, respectively, with IOL Master and A scan ultrasound with SRKT formula.

However, the advent of the IOL Master has not rendered ultrasonic biometry obsolete as a significant number of eyes still require ultrasound biometry, which is still essential in every ophthalmic practice. Although this number depends on the referral patterns of the practice, it is estimated that it is approximately 8-10%. [6],[20],[23] Dense ocular media-that is, corneal scarring, mature or posterior sub capsular cataracts, prevent acquisition of optical AL measurements. Moreover, eyes with non-optimal fixation as in cases of age-related macular degeneration may result in inaccurate AL measurements as the measurements are not on the visual axis. Positioning also of patients with mobility problems on the IOL Master machine may occasionally be a problem. Another limitation of the IOL Master is its inability to measure the lens thickness, which is required for the Holladay II formula.

## CONCLUSION

Optical Biometry was found to be more accurate in the measurement of the ocular axial length than applanation ultrasonography. It has improved significantly the refractive results of cataract surgery in this carefully selected cohort. However it has number of limitations, the presence of outliers indicates the need for further improvements in the ocular biometry and IOL power prediction methods.

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