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Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

Refractive outcome after cataract surgery with IOL master 700 optical biometry versus conventional ultrasonographic biometry

B K Gupta[1], **Kanav Gupta**[1], **Kritika Garg**[1], **Isha Gupta**[1,*]

[1]*Dept. of Ophthalmology, N C Medical College & Hospital, Israna, Haryana, India*

ARTICLE INFO

Article history:
Received 10-02-2023
Accepted 15-05-2023
Available online 29-09-2023

Keywords:
IOL master 700
Visual acuity
Emmetropia
Cataract
Phacoemulsification
Optical biometer

ABSTRACT

Purpose: To compare the refractive outcomes after phacoemulsification with an Intra ocular lens (IOL) using IOL master 700 optical biometer versus conventional ultrasonographic biometer.

Materials and Methods: A retrospective analysis of patients who underwent phacoemulsification with intra ocular lens implantation between April 2019 and March 2020 was done. Data of 654 eyes (607 patients) was shortlisted and analyzed. IOL power calculation was done with applanation ultrasonographic biometer and IOL Master 700 optical biometer by dividing patients into 2 groups. SRK/T formula was used in both cases for IOL power calculation. Refractive outcomes were determined at least four weeks after the surgery and the results were recorded. Data analysis was done using Microsoft Excel 2017 and SPSS software.

Results: In group A, applanation ultrasonographic biometer was used, 66.9% of patients were having post-operative refractive power between ±0 to ±0.75D and in group B IOL Master 700 was done 89.8% of patients, were having post-operative refractive power between ±0 to ±0.75D. Thus, refractive outcome was better in Group B eyes (89.80%) as compared to group A eyes (66.90%) and this difference was statistically significant (p value<.001).

Conclusion: Biometry by IOL master 700 improves the refractive outcomes of patients of cataract surgery and is much more accurate than the applanation ultrasonography. It also ensures that the near total emmetropia, post cataract surgery by giving accurate axial length measurements and the better choice of formulas.

1. Introduction

Intra ocular Lens (IOL) implantation using phacoemulsification technique is the gold standard in modern day cataract surgery. In the last few decades, there have been many innovations such as newer designs of Intra ocular lenses, newer models of phacoemulsification machines, newer techniques, and ocular biometry. It has led to a better and a more accurate IOL power prediction formula leading to improvement in the refractive outcomes after cataract surgery. These outcomes depend mainly on the preoperative biometry data, IOL power calculation formulas, and good quality IOL's. The most important step for an accurate calculation of an IOL power is preoperative assessment of the measurement of the axial length (AL) of the eye.[1–3]

A-scan ultrasonography, with a reported longitudinal resolution of approximately 200 μm and an accuracy of approximately 100–150 μm,[4–6] is routinely employed in the measurement of the ocular AL. Ultrasonography measurement requires physical contact of transducer probe with the eye directly (contact method) or through the normal saline filled cup (immersion technique). Due to different amount of pressure exerted on the eyeball, a difference of

* *Corresponding author*.
E-mail address: bkgupta35@gmail.com (I. Gupta).

https://doi.org/10.18231/j.ijceo.2023.079

up to 0.36 mm[7–10] has been reported between immersion and applanation ultrasonography, although latter technique is most widely used. Every 0.1 mm change in the axial length may lead to 0.2 diopters (D) of refractive error post-operatively.[11]

For the best possible refractive outcome post cataract surgery, precise measurement of AL is the need of the hour. In the past several years, an optical imaging technique, and an optical coherence tomography (OCT) has been developed that uses infra-red laser light for high precision and high-resolution biometry and tomography. More than 10 years ago, the IOL Master optical biometer was introduced into clinical practice and there has been a continuous improvement since then.

Commercially available optical biometer equipment IOL Master 700 (Carl Zeiss Germany) is the latest, and advanced, and most precise optical biometer which is based on the principal of Swept Source OCT.

It measures both the anterior and the posterior corneal keratometry, and thus provides the total keratometry value for the optimum results. It detects the unusual eye geometries by showing a longitudinal cut scan through the entire eye from anterior surface of the cornea to the macular pit, thus helping in the detection of poor fixation and giving accurate AL results.

In this study, the refractive outcome post cataract surgery was compared retrospectively between the two biometers namely IOL Master 700 and Conventional Applanation Ultrasonographic biometer.

2. Materials and Methods

The study done was a retrospective study and data of 654 eyes (607 patients) who underwent uncomplicated cataract surgery by Phacoemulsification with IOL implantation between April 2019 to March 2020 were screened and analyzed. There was no associated ocular pathology other than cataract. Eyes with more than 1D of keratometry astigmatism were also excluded from the study.

Patients' data was divided into 2 groups for analysis. In Group A, biometry /IOL calculation was done using the conventional applanation ultrasonographic biometer (Appasamy Appascan Plus) for AL and Tonoref III (Nidek, Japan) for Keratometry. All those patients who underwent cataract surgery during the period from April 2019 to October 2019 were selected in this group. In Group B, biometry /IOL power calculation was done using IOL Master 700 optical biometer. Patients who underwent cataract surgery during the period from November 2019 to March 2020 were selected in this group. During the later period, there were some patients in whom, due to the dense cataract, AL measurement by the IOL master was not possible, so AL measurement was done with conventional applanation ultrasonography. These patients were then also included in group A.

SRK/T formula was used for IOL power calculation in all these cases.

IOL was selected on the basis of the readings of biometer, and the package selected by the patients. The utmost care was taken to calculate the difference of A-Constant while switching between different types of IOL's in case of change of package and thus type of IOL chosen by the patient. In post operative period, patients were called for regular follow up on 1,6,15 & 30th post operative day & later if required.

Most patients came for regular follow ups on the appointment day + 2 days. Patients having any operative complication (posterior capsular rent, vitreous loss) or post operative complications (IOL subluxation, Descemet's detachment) were excluded from this analysis.

Refraction was done on or after 28 days of cataract surgery. Only the spherical equivalent refractive power has been taken into consideration for the present analysis.

Data of final refraction was available for 591 eyes while 63 eyes were either lost to follow up or were excluded due to complications.

Data analysis and statistics was done using Microsoft Excel 2007 and SPSS software.

3. Results

Data of 654 eyes (607 patients) was screened and analyzed. 47 patients got their both eyes operated during this period. Out of these 47, 16 were in group A and 31 were in group B.

Out of 654 surgeries, 346 (52.9%) surgeries were done on male patients while 308 (47.1%) surgeries were performed on female patients. The mean age in our study was 61 years, with the age ranging from 15 years to 90 years.

Maximum surgeries 247 (37.8%) were performed on the patients of age group of 61-70 years, followed by 198 (30.3%) in the age group of 51-60 years. Only 3(0.5%) patients were in the age group of 21-30 years while a single patient (0.2%) was operated at the age of 15 years. (Table 1).

Refraction was prescribed in maximum patients for 31-45 days post operative period i.e., 379 eyes (58%), followed by the period of 16-30 days (actually 28-30 days) i.e., 115 eyes (17.6%). In 71 (10.9%) eyes, refraction was done during the period 46-60 days while in 26(4%) patients, it was done during the period of 61-75 days (Table 2).

Group wise, the final refraction was done in 287 eyes of group A & 304 eyes of group B. Refraction could not be done in 63 out of 654 (9.6%) operated eyes as they were either excluded from study due to various reasons or lost to follow up. Out of these, 30 eyes were from group A and 33 eyes were from group B (Table 3). In group A, 192 eyes (66.9%), were having post operative refractive power between ±0 to ±0.75D, 79(27.5%) eyes had post operative refraction between ±1.0 to ±1.75D while the rest 16 (5.6%) had post-operative refraction between ±2.0 to ±2.75D.

In group B, 273 eyes (89.8%), were having post-operative refractive power between ±0 to ±0.75D, 24(7.9%) eyes had post-operative refraction ±1.0 to ±1.75D while the remaining 7 (2.3%) eyes had a post-operative refraction between ±2.0 to ±2.75D. Thus, refractive outcome was better in Group B eyes (89.80%) as compared to group A eye (66.90%) and this difference is statistically significant (p value <0.001) (Table 4).

Table 1: Age sex distribution

Age	Male	Female	Total	Percentage (%)
11-20	1	0	1	0.2
21-30	3	0	3	0.5
31-40	12	4	16	2.4
41-50	46	48	94	14.4
51-60	98	100	198	30.3
61-70	136	111	247	37.8
71-80	41	39	80	12.2
81-90	9	6	15	2.3
Total	346	308	654	
Percentage (%)	52.9	47.1		

Table 2: Post operative refraction done on (days)

Days	Eyes	Percentage (%)
Lost to Follow-up	63	9.6
16-30	115	17.6
31-45	379	58.0
46-60	71	10.9
61-75	26	4.0
Total	654	

Table 3: Post operative Group wise follow up

Post-operative Refractive Power	Group A	Percentage (%)	Group B	Percentage (%)
Followed	287	90.5	304	90.2
No Follow up	30	9.5	33	9.8
Total	317		337	

Table 4: Post operative refractive power

Post operative Refractive Power	Group A	Percentage (%)	Group B	Percentage (%)
±0-±75 Dioptres	192	66.9	273	89.8
±1-±175 Dioptres	79	27.5	24	7.9
±2-±275 Dioptres	16	5.6	7	2.3
Total	287	90.5	304	90.2

p<0.001

4. Discussion

Satisfactory refractive results after IOL implantation depend on optimal biometry.[12–16] Accurate AL, anterior chamber depth and keratometry readings are essential for all biometric formulas to calculate the IOL power required for the desired results. The most common preventable sources of error are incorrect AL measurements and keratometry readings.[17,18]

Applanation ultrasonography remains the preferred method of measuring the ocular AL in most of the ophthalmic practices.[19] IOL-Master was the first optical biometer available for commercial usage and its accuracy and repeatability made it the gold standard of biometry for many years.[20–22]

Accuracy in IOL power calculation is more with IOL Master as compared to the conventional Applanation Ultrasonography. One of the reasons for this could be the differences in the measurement of axial length between the two machines. This difference in the axial length is due to the pressure exerted in the eye by the ultrasound probe which results in corneal indentation and shortening of axial length which is not the case with IOL Master. Second reason is that the ultrasonic waves are reflected mainly at the internal limiting membrane whereas the light of IOL master reflects from retinal pigment epithelium (RPE) thus resulting in the difference that corresponds to the retinal thickness of the fovea which is around 130 μm.[23]

The employment of optical AL instead of ultrasound AL has significantly improved the refractive results of cataract surgery.[24]

In our study, the maximum percentage (89.8%) of emmetropia or near emmetropia have been achieved in group B eyes in whom biometry and IOL power calculation was done with IOL Master 700 as compared to group A (66.9%) in whom applanation ultrasonography was used. The difference between the two is also statistically significant (p value <0.001).

Needless to say, that IOL Master is a simple, easier and more precise process of biometry. In addition to accurate measurement of AL due to measurement along the visual axis, no corneal indentation; it has more advantages such as non-contact technique thus no chances of infection, no need of local anesthetic drops, no chances of corneal abrasions. Moreover, IOL Master provides all biometric parameters and various formulas for IOL power calculation at a single place hence minimizing the time consumption for the calculation. It takes only 45 seconds for complete measurements and IOL power calculation of both eyes. Further, the learning curve is very small.

Still, applanation biometry is required where IOL Master fails in about 8-10% of cases[24–26] for example in cases of mature/ hyper mature cataract, dense Posterior sub capsular cataracts, eccentric fixation and patients with parkinsonism and other mobility disorders.

The reason, why final refraction was not done in 63 eyes, could be patients were from out station, and they got it from local optician, patients' visual requirement was moderate, and they were satisfied with unaided vision, patients were satisfied with old glasses, patients stayed safe at home due to novel Corona Virus Disease (COVID-19) Lockdown or those who were excluded due to complications.

5. Conclusion

In conclusion, biometry by IOL Master 700 was found to be more accurate for IOL power calculation as compared to applanation ultrasonography. It has significantly improved the refractive outcome of cataract patients in the selected cases. Although there are cases in our scenario where IOL master biometry is not possible, hence availability of ultrasonographic biometer for proper measurement of AL is essential as backup.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Author biography

B K Gupta, Professor and HOD https://orcid.org/0000-0002-4067-9252

Kanav Gupta, Associate Professor https://orcid.org/0000-0003-4119-4756

Kritika Garg, PG Student

Isha Gupta, Professor https://orcid.org/0000-0002-7088-2606

Cite this article: Gupta BK, Gupta K, Garg K, Gupta I. Refractive outcome after cataract surgery with IOL master 700 optical biometry versus conventional ultrasonographic biometry. *Indian J Clin Exp Ophthalmol* 2023;9(3):418-421.