Original Research Article

A comparison of axial length measurement by using applanation A- Scan and IOL master for accuracy of predicting postoperative refraction

Harish R Trivedi [1],*, Bhavik C Zala[2], Nitesh S Pancholi[3]

[1]Dept. of Ophthalmology, Government Medical College, Bhavnagar, Gujarat, India
[2]Jyoti Eye Hospital, Ahmedabad, Gujarat, India
[3]Axis Eye Clinic, Indore, Madhya Pradesh, India

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ABSTRACT

The higher cost of IOL master is an issue in developing countries and hence it cannot be widely used for calculation of IOL power in such countries. Thus, the aim of the current study is to evaluate a cheaper alternative for the calculation of IOL power by comparing the axial length measurement obtained using applanation A-scan with that of IOL Master for accuracy of predicting postoperative refraction.

Materials and Methods: A prospective, randomized, comparative study was done with 100 patients who were posted for cataract surgery. The patients were randomly divided into two groups of 50 patients each using computerized random number method. In Group A (n=50) axial length was measured with applanation A-scan and in Group B (n=50) axial length was measured with IOL Master. Before cataract surgery keratometry reading was taken with auto keratometer and intraocular lens (IOL) power calculation was done using SRK 2 formula in all patients. All patients were operated for cataract surgery by phacoemulsification and foldable intraocular lens were implanted in the bag. Postoperatively, best accepted refraction at 8th week was taken and mean spherical equivalent was calculated.

Results: 100 patients of cataract were subjected for cataract surgery by phacoemulsification.
Corrected spherical equivalent on 8th postoperative week showed:
88% patients in Group A and 96% patients of Group B were within ± 1.00 D.
56% patients of Group A and 76% patients of Group B were within ± 0.50 D.
There was no statistically significant difference (p > 0.05) in axial length and corrected spherical equivalent between the two groups.

Conclusions: There is no extra advantage of IOL Master over applanation A-scan for measuring Axial Length between 21 and 24.50 and predicting post-operative refractive outcome.

1. Introduction

Cataract surgery is the most common surgical procedure in ophthalmology. Refractive outcome of the cataract surgery depends on the power of the intra ocular lens (IOL) to be implanted. Calculation of IOL power mainly depends on preoperative measurement of Axial length (AL) and Keratometry.[1]

Axial length measurement is done with A-scan ultrasound, its probes has a frequency of approximately 10 MHz.with a longitudinal resolution of approximately 200 μm and an accuracy of approximately 100–150 μm.[2] A-scan biometry however requires physical contact of a transducer with the eye either directly (applanation) or through an immersion bath of normal saline (immersion). Differences in the AL between immersion and applanation Ultrasound biometry is reported up to 0.36 mm[3] which may

* Corresponding author.
E-mail address: trivedi_harish@yahoo.co.in (H. R. Trivedi).

be due to various amounts of pressure exerted on the eye by the transducer during applanation biometry, still it is widely used for ocular biometry.

Optical biometry equipment (IOL Master) based on the principle of dual beam Partial coherence tomography. It 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.[4] It uses the cornea as reference surface and measure AL with high precision and accuracy in both normaland cataract eyes.[5,6]

Though applanation A-scan is cheap and easily available, is having disadvantages like: it is contact method, requires anesthetic agent and there are chances of corneal abrasion and infection. Another disadvantage is that it has somewhat steep learning curve than IOL Master. Too much pressure on ultrasound A-scan probe may falsely give shorter axial length and if probe is not put on centre of cornea it can give falsely long or short axial length which will create an error in calculating IOL power and predicting post operative refractive outcome.

IOL Master has advantages that, the technique is non contact, easily performed by ophthalmic or non ophthalmic person and no local anesthetic agent is required. While main disadvantage is that it does not record AL measurement where there are central media opacities present, like central corneal opacity, posterior polar cataract, near mature and mature cataract. These cases require use of A-scan ultrasound for measurement of AL.

Most of the surgeons in developing countries use manual keratometer and applanation A-scan. If there is an error of reading of 1mm in keratometer it will create an error of 6 D, while that of 0.1mm in A-scan will cause an error of 0.28 D in calculating IOL power, so the use of auto keratometer is better choice to avoid error in calculation of IOL power.

The aim of present study is to evaluate refractive errors (mean spherical equivalent) after cataract surgery by comparing the axial length measurement obtained using IOL master and applanation A-scan technique.

2. Materials and Methods

A prospective and comparative study was carried out at Department of Ophthalmology, Sir T. hospital and Government Medical College Bhavnagar after taking permission from Institutional Review Board and written informed consent of each patient. Total 100 cases were studied all of them were cases of cataract with following inclusion and exclusion criteria:

2.1. Inclusion criteria

1. Cataract with grade 1,2,3, dense.

2.2. Exclusion criteria

1. Patients with intra operative complication and post operative inflammation
2. Near Mature cataract
3. Dense Mature cataract (grade 4)
4. Brown cataract
5. One eyed patient
6. Children and patient with psychiatric illness
7. Severe corneal degeneration
8. Corneal opacity
9. Vitreous degeneration and other vitreous pathology
10. Diabetic retinopathy
11. Patient with squint
12. Pregnant women
13. Any other ocular pathology

A detailed history of patients was taken and the patients were subjected to thorough general examination. Ocular examination was done using slit lamp examination and direct and indirect Ophthalmoscopy. Visual acuity examination was done using Snellen's acuity chart. Intra ocular tension was taken with non contact tonometer.

Thereafter these 100 patients were randomly divided into two groups. In Group A patients, axial length was taken with applanation A-sca and in Group B axial length was taken with IOL Master machine, keratometry readings were taken with auto keratometer for both groups and intraocular lens power calculation was done using SRK 2 formula.

In both group cataract extraction was done with phacoemulsification and foldable intraocular lens was implanted in capsular bag. Post operative refraction was measured by using auto-refractometery and retinoscopy. Best corrected visual acuity (BCVA) and pin hole vision were taken on 1st post-operative day, 1st week, 4th week and 8th week of post-operative day. Best accepted refraction of 8th week were considered and spherical equivalent was calculated. For the calculation of spherical equivalent (SE), half of cylinder power was added to spherical power.

Post operative refraction was + 0.00 desired, but availability of IOL power is within ± 0.50 range. So we deducted calculated IOL power from implanted IOL power and for calculation of Corrected spherical equivalent (CSE) we have deducted (d) from spherical equivalent (SE).

Implanted IOL power – calculated IOL power = d

CSE = SE – d

Mean of Axial length and mean of corrected spherical equivalent (CSE) was taken in both groups and statistical analysis was performed with unpaired t test. P value < 0.05 was considered statistical significant.

3. Results

This study was carried out in Sir-T. Hospital, Government Medical College Bhavnagar, Department of Ophthalmology on 100 patients undergoing cataract surgery with the

Table 1: Showing age distribution in Group A and Group B

Age (Years)	No. of Patients	
	Group A	Group B
10-20	1	0
21-30	2	1
31-40	5	3
41-50	10	5
51-60	12	21
>60	20	20

Table 2: Showing sex distribution in Group A and Group B

Sex	No. of Patients	
	Group A	Group B
Male	22	21
Female	28	29

Table 3: Showing axial length measurement in Group A and Group B

Axial Length (mm)	No. of Patients	
	Group A	Group B
21.1-22	7	10
22.1-23	27	14
23.1-24	13	21
>24	3	5

following observations.

According to Table 4, Group A showed 28(56%) patients had Corrected Spherical Equivalent between – 0.5 to + 0.5 and 44(88%) patients had Corrected Spherical Equivalent between - 1.00 to + 1.00. In Group B 38(76%) patients had Corrected Spherical Equivalent between - 0.50 and + 0.50 and 48(96%) the patients had Corrected spherical equivalent between - 1.00 to + 1.00 and 4% patients of Group A had Spherical Equivalent of 0.00 while in case of Group B it was 12%

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According to Table 5, there is no statistical significance of measured mean axial length and mean corrected spherical equivalent between two groups (p > 0.05).

4. Discussion

According to Table 6 comparison of axial length measurements between different studies. In the present study, the mean axial length measured with IOL Master was 22.92, while that of with applanation A-scan is 22.85. There was no statistical significance (p > 0.05) for axial length measurement between IOL Master and applanation A-scan. In Daniel Kessler et al. study showed that mean axial length measured with IOL Master was 23.99, while that of with A-scan was 23.55. In this study they did not mention the statistical value.

According to Table 7 present study data obtained from IOL Master where, 76% of patients had spherical equivalent < 0.50 D, 96% patients had spherical equivalent < 1.00 D and 100% patients had spherical equivalent < 1.50 D, while for applanation A-scan 56% of patients had spherical equivalent < 0.50 D, 88% patients had spherical equivalent < 1.00 D and 98% patients had spherical equivalent < 1.50 D and 100% patients had spherical equivalent < 2.00 D. P value for each group of SE was calculated in present study, which showed no statistical significance (p > 0.05) for SE < 0.50,< 1.00,< 1.50 and < 2.00. Statistical analysis for different SE was not done by any other study given in Table 7.

Comparison of SE between different studies with present study shows that, there are comparable data between Verhulst E et al., H Elftheriadis et al. and present study. While that of Dr. Ashish Gangvar et al study shows somewhat different reading as compared to other three studies.

According to Table 8 present study and Heidarali Moeini et al study result obtained for mean spherical equivalent are not statistically significant, while that of Loreto T Rose et al. and H Elftheriadis et al. study shows results obtained are statistically significant.

In the present study, there is no statistically significant difference (p > 0.05) between the mean axial length measured with IOL Master and applanation A-scan and also mean spherical equivalent between two groups. There are few advantages and disadvantages in both the technique. For measurement of axial length, the pressure over eye ball can be minimized if AL is measured carefully with applanation A scan. We can also use immersion A scan technique to avoid pressure over eye ball and also use Auto keretometry

Table 4: Showing comparison of corrected spherical equivalentin Group A and Group B after 8th week post operative day

Corrected Spherical Equivalent (Diopter)	Group A No. of Patients	Percentage (%)	Group B No. of patients	Percentage (%)
-2.00 to -1.51	1	2	0	0
-1.50 to -1.01	5	10	2	4
-1.00 to -0.51	14	28	10	20
-0.50 to -0.01	17	34	20	40
+0.00	2	4	6	12
+0.01 to +0.50	9	18	12	24
+0.51 to +1.00	2	4	0	0

Table 5: Shows statistical significant of measured mean axial length and mean corrected spherical equivalent between two groups.

Group	Axial Length ± SD (mean)	Corrected Spherical Equivalent (mean) ± SD
Group A (n=50)	22.85 ± 0.850	0.359 ± 0.498
Group B (n=50)	22.92 ± 0.846	0.241 ± 0.419
P value	0.666 (p > 0.05)	0.203(p > 0.05)

Table 6: Showing comparison of mean axial length of different studies

	Present study		Daniel Kessler et al[7]	
	IOL master	A-scan	IOL master	A-scan
Axial length (mean)	22.92	22.85	23.99	23.55
P value	0.666 (> 0.05)		-	

Table 7: Showing comparison of spherical equivalent data between different studies

Spherical equivalent	Present study		P value	Verhulst E et al[8]		Elftheriadis H et al[9]		Dr. Ashish Gangvar et al[10]	
	IOL master	A-scan		IOL master	A-scan	IOL master	A-scan	IOL master	A-scan
< 0.50	76%	56%	0.410	55.30%	40.40%	84%	74%	57%	44%
< 1.00	96%	88%	0.325	89.30%	72.30%	96%	93%	80%	70%
< 1.50	100%	98%	0.305	100%	95.80%	100%	97%	93%	90%
< 2.00	-	100%	0.202	-	97.90%	-	99%	98%	97%
< 2.50	-	-		-	100%	-	100%	100%	100%

Table 8: Comparison of statistical value of spherical equivalent between different studies.

	Present study	Heidarali M et al[11]	Loreto T et al[12]	Elftheriadis H et al[9]
P value	> 0.05	> 0.05	< 0.01	<0.0001
Conclusion	Not significant	Not significant	Significant	Significant

over mannul keratometry for calculation of IOL power for accurate prediction of postoperative refraction.

5. Limitations of the Study

The limitation of the present study is that it only evaluated the difference between applanation A-scan and IOL Master for axial length between 21mm and 24.5mm. Further studies are required for evaluating this difference for axial length less than 21mm and above 24.5mm.

6. Conclusion

The present study concludes that if keratometry is done with autokeratometre and applanation A-scan Technique is used to calculate IOL power than it will give statistically similar results as compared to IOL Master (Axial length in range of 21 – 24.50mm) predicting post-operative refractive outcome. Thus in developing countries, where the higher cost of IOL master is an issue applanation A-scan Technique with auto keratometer can be used instead of IOL master for the calculation of IOL power.

7. Source of Funding

None.

8. Conflict of Interest

The authors declare no conflict of interest.

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Author biography

Harish R Trivedi, Associate Professor ⓘ https://orcid.org/0000-0002-2853-2119

Bhavik C Zala, Eye Surgeon

Nitesh S Pancholi, Eye Surgeon