Original Article

Comparison of Accuracy between Ultrasound B Scan and Partial Coherence Interferometry (IOL Master) in IOL (Intraocular Lens) Power Calculation

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ABSTRACT

Objective: To compare the accuracy between partial coherence interferometry and ultrasound B scan in intraocular power calculation.

Study Design: Non-randomized control trail study.

Place and Duration of Study: This study was conducted at the Department of Ophthalmology, Bahwal Vctoria and Civil Hospital, Bahawalpur, from June 2018 to January 2019.

Materials and Methods: IOL power and probable refractive outcome was calculated for each patient by both methods i.e. A-scan ultrasound biometry and IOL master (partial coherence interferometry). IOL power as calculated by IOL master was implanted in-the-bag by the author himself in specified time duration. Preoperative assessment was conducted for each patient, which included, best corrected visual acuity and subjective refraction, slit lamp examination for pupil examination, corneal clarity and cataract type, detailed fundus examination and intraocular pressure measurement. Post operative best corrected visual acuity and uncorrected and slit lamp examinations were performed at 1st day and 1st postoperative month. Mean and standard deviation was calculated for qualitative variables while frequency and percentage was calculated for quantitative variables. Mann-Whitney test was applied and P value less than or equal to 0.05 was considered as statistically significant.

Results: Total of 50 eyes were examined. Ultrasound A scan as well as partial coherence interferometry was performed for all the eyes and IOL power was implanted in accordance with IOL master. Mean absolute error was 0.686±0.493 with A scan while 0.731±0.528 according to IOL master (p=0.656). Mean numerical error was -0.531±0.498 with A scan while -0.612±0.590 with IOL master (p=0.460). Mean axial length was 24.48±3.37 and 24.92±3.54 with ultrasound A scan and IOL master, respectively (p=0.527).

Conclusion: It can be concluded by the results of this study that difference between the two modalities is not statistically significant in terms of refractive outcome.

Key Words: Ultrasound B scan, Partial Coherence Interferometry, Intraocular lens, Power, Axial length, Cataract surgery

Citation of articles: Khan MJH, Faraz MA, Ghafoor A.. Comparison of Accuracy between Ultrasound B Scan and Partial Coherence Interferometry (IOL Master) in IOL (Intraocular Lens) Power Calculation. Med Forum 2019;30(2):108-111.

INTRODUCTION

In ophthalmology cataract surgery is one of the most commonly performed surgery and owing to the recent advancements in this surgery has lead it to become a more of refractive surgery than curative surgery[1].

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Received: January, 2019
Accepted: January, 2019
Printed: February, 2019

Alternative to cataract surgery are no present and the aim of this surgery is to attain as much normal vision as possible. Correct estimation of intraocular lens power is a necessary first step in order to achieve the emmetropia in cataract surgery[2]. In biometry different variables are used which are calculated using the variety of intraocular lens calculation formulae, these include axial length of eye, depth of anterior chamber and average refractive power of cornea[3]. Accuracy of refraction postoperatively in cataract surgery depends on minimal number of errors associated with above mentioned parameters of measurements[4]. A skilled technician, significant duration and optimum contact to the surface of cornea are required to achieve the minimal error. Moreover errors linked to the axial length most significantly affect the post cataract surgery refraction[5]. This accounts for more than fifty percent of deviation from the expected outcome postoperatively.

Axial length is traditionally measured with the help of ultrasound or A-scan it is the most commonly used method[6]. Associated side effects of this technique include the possible indentation of the cornea by coming in contact with the ultrasound probe which might result in shortening of the eye and thus causing incorrect estimation of the axial length and in the end leading to postoperative refraction shift towards myopia [7]. These difficulties are limited now with the introduction of a newer technique which is a non contact optical biometry i.e. laser interferometry. With the help of laser interferometry postoperative intra ocular lens selection has been better and more accurate. Partial coherence interferometry has become a more accurate and better instrument for the measurement of axial length. In this study, we have evaluated eyes posted for cataract surgery in a prospective fashion estimating the IOL power in the same patient with both traditional axial biometry and the IOL master.

MATERIALS AND METHODS

Study was conducted in Department of Ophthalmology, Bahwal Victoria and Civil Hospital, Bahawalpur, from June 2018 to January 2019. It is a non randomized study. Ethical approval was obtained from hospitals ethics committee. Sample size was calculated from the reference study conducted by Aditi Sharma et al [8]. non probability consecutive sampling technique was used. A total number of 50 patients took part in this study. Inclusion was based upon following criteria; all patients in whom calculation of reliable IOL master reading was possible which were based on good SNR. Exclusion was based on the following criterion; low or border line SNR cases, corneal curvature abnormalities, corneal pathologies, corneal opacity, eyes with dense cataract, corneal degeneration and media opacities, keratocunjuctivitis sicca, lens induced glaucoma, any retinal pathology, angle closure glaucoma, any history of trauma to eye, patients with complications at the time of surgery and patients who had history of prior eye surgery, age less than 15. IOL power and probable refractive outcome was calculated for each patient by both methods i.e. A-scan ultrasound biometry and IOL master (partial coherence interferometry). IOL power as calculated by IOL master was implanted in-the-bag by the author himself in specified time duration. Preoperative assessment was conducted for each patient, which included, best corrected visual acuity and subjective refraction, slit lamp examination for pupil examination, corneal clarity and cataract type, detailed fundus examination and intraocular pressure measurement. Post operative best corrected visual acuity and uncorrected and slit lamp examinations were performed at 1st day and 1st postoperative month.

IOL master or coherence interferometry was used according to the standard recommendations in all patients. After that keratometry was done using the manual keratometer and then A-scan contact probe biometry was done using an ultrasound unit. Both procedures were performed by the author himself. With each IOL, SRK T formula was used to determine the IOL power as well as predicted postoperative refraction. In order to obtain geometrical distances, the optical distances calculated by IOL master were divided by the group refractive indices of ocular media. For group refractive indices of aqueous, lens, vitreous and cornea, values of, 1.3454, 1.4065, 1.3440, and 1.3851 were used. A constant group refractive index for all cataract grades was assumed for conversion of optical values into geometrical values of lens thickness. For aqueous humuor and vitreous humuor sound velocity of 1532 meter per second was used while sound velocity of 1642 meter per second was used for the lens. At least ten measurements were taken for each parameter in each eye and mean was calculated. A total axial length was obtained by adding means of measured intraocular distances.

All patients underwent successful phacoemulsification. Follow up was planned at 1st postoperative day and 4 weeks postoperatively. All the data was calculated by the researcher himself. Data thus obtained was subjected to statistical analysis. Statistical analysis was done with the help of computer software SPSS version 23. Mean and standard deviation was calculated for qualitative variables while frequency and percentage was calculated for quantitative variables. Mann-Whitney test was applied and P value less than or equal to 0.05 was considered as statistically significant.

RESULTS

Total of 50 eyes were examined. Ultrasound A scan as well as partial coherence interferometry was performed for all the eyes and IOL power was implanted in accordance with IOL master. Mean absolute error was 0.686±0.493 with A scan while 0.731±0.528 according to IOL master (p=0.656). Mean numerical error was -0.531±0.498 with A scan while -0.612±0.590 with IOL master (p=0.460). Mean axial length was 24.48±3.37 and 24.92±3.54 with ultrasound A scan and IOL master, respectively (p=0.527). MNE was compared according to the cataract type. MNE was -0.534±0.688 and -0.582±0.667 for NS1; -0.457±0.293 and -0.439±0.281 for NS2; -0.488±0.300 and -0.760±0.743 for NS3; and -0.761±0.790 and -0.764±0.672 for NS4, with ultrasound A scan and IOL master, (p-value 0.872, 0.854, 0.215, 0.992) respectively. MNE was also compared according to axial length. For eyes with 20-24 MAL, MAE was -0.479±0.448 and -0.504±0.460 with A scan and IOL master, respectively (p=0.829). For eyes with 25-29 MAL, MAE was -0.506±0.313 and -0.760±0.773with A scan and IOL master, respectively (p=0.320).For eyes with 30 and above MAL, MAE was -0.863±0.898and -0.764±0.672with A scan and IOL master, respectively (p=0.816). Table-I

Table No.I: Comparison of ultrasound A scan vs IOL master

Variable	A scan	IOL master	p-value
Mean absolute error (n=50)	0.686± 0.493	0.731± 0.528	0.656
Mean numerical error(n=50)	-0.531± 0.498	-0.612± 0.590	0.460
Mean axial length(n=50)	24.48± 3.37	24.92± 3.54	0.527
Cataract type of MNE			
NS1 (n=11)	-0.534± 0.688	-0.582± 0.667	0.872
NS2(n=17)	-0.457± 0.293	-0.439± 0.281	0.854
NS3(n=14)	-0.488± 0.300	-0.760± 0.743	0.215
NS4 (n=08)	-0.761± 0.790	-0.764± 0.672	0.992
Axial length of MNE			
20-24 (n1=33, n2=29)	-0.479± 0.448	-0.504 ±0.460	0.829
25-29(n1=11, n2=13)	-0.506± 0.313	-0.760 ±0.773	0.320
30 and above (n1=06, n2=08)	-0.863± 0.898	-0.764 ±0.672	0.816

DISCUSSION

Accurate biometry after lens implantation is the most important factor in order to achieve a successful refractive outcome even more important than the formulas used for calculation of lens power[9]. Accuracy is dependent upon the technique of the technician. Without the use of proper skill the measurements obtained are mostly faulty and unreliable. On the other hand use of partial coherence interferometry requires minimum training and is able to give optimum results better as compared to the best ultrasound technique. In this study these two procedures were compared. Many past studies in different settings have compared these techniques and results of these studies strongly favor the partial coherence interferometry as it gives improved refractive outcome with all available IOL formulas[10].

In a previous study conducted by Julio Narvaez[11] partial coherence interferometry was compared to immersion ultrasound and the results showed similar refractive outcomes with both modalities. In that study they also concluded that ultrasound is irreplaceable especially when it comes to eyes with dense media opacities.

In a study inter-observer and intra-observer variability was estimated with the use of IOL master measurements by Annette et al[12] and they concluded that IOL master or partial coherence interferometry gives very reliable results and it is not observer dependent. On the other hand if comparison of experience variability in biometry is compared, another study showed that technicians with higher experience have lower difference and lower variability in difference between partial coherence interferometry and applanation ultrasound[13]. This is supported by our study as well because author also has very good experience in biometry. A previous study has also shown that applanation ultrasound results in measuring shorter axial lengths because of obvious indentation of corneal surface[14].

In a previous study they have mentioned that ultrasound A-scan although is the most commonly used method for the measurement of the axial length but it has its limitation as ultrasound probe comes into contact with the corneal surface and causes indentation of the surface thus resulting in shorter measurements as compared to the non contact partial coherence interferometry [14,15]. The measurements in their study were 23.35mm (SD 1.81mm) and 23.55mm (SD 1.76 mm) with contact ultrasound and laser interferometry respectively which are comparable to the results of our study.

Simon Raymond et al [16] compared mean absolute error for both techniques and concluded that there was no clinical difference between the two techniques in terms of refractive outcome. The results of our study didn't show any significant difference between the two techniques but laser interferometry was better than ultrasound A-scan in terms of improved accuracy.

R. Goyal et al[15] did a comparison between A-scan and laser interferometry in terms of axial length and their results show that axial length calculated by A-scan had lower values as compared to those calculated by IOL master. On the other hand in this study we adjusted by taking the final spherical equivalent as the deciding factor thus suggesting the accuracy of calculation of axial length. In contrast to them in our study the difference in terms of refractive outcome was not statistically significant whereas only minor difference was noted in postoperative refractive errors.

CONCLUSION

It can be concluded by the results of this study that even though difference between the two modalities is not statistically significant in terms of refractive outcome but IOL master is slightly more accurate as compared to ultrasound B scan. Moreover ultrasound B scan is highly dependent on the experience of the technician.

Author's Contribution:

Concept & Design of Study:	Muhammad Jahan Zaib Khan
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Data Analysis: Abdul Ghafoor
Revisiting Critically: Muhammad Jahan Zaib Khan, Mohammad Asad Faraz
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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