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Measurement of Axial Length and Intraocular Lens Power Using IOL Master and A-Scan Biometry

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Abstract:

Aim: to compare between IOL master (optical method) and A-scan (sonographic method) regarding the measurement of axial length and intraocular lens power in patients with cataract.

Method:150 eyes of 125 patients were participated in this prospective study. Axial length measurement was obtained by both non-contact method(IOL master technique CARL ZEIS, Germany) and contact method(A-scan Tommy, Japan).Calculation of IOL power was done by SRK T formula.

Result: the mean age of the participants was 65 years (ranging 41 -78 years) male to female 68:57.Axial length obtained with contact method (mean 23.48mm) ranging (22.32-24.64mm) were lower than those obtained by non-contact method(mean 23.66mm) ranging(22.51-24.93mm) .The difference was statistically significant (p value ≤0.003 using paired t-test).The predicted IOL power was 20.45±2.7 diopter with A scan versus 20.1±2.98 diopter with IOL master ,the difference was statistically significant (p value ≤0.001).Best corrected visual acuity was 6/9 in 126 patients,6/12 in 15 patients and 6/18 in nine patients.

Conclusion: laser interferometry (IOL master) provide more accurate results than conventional applanation Ascan in patients with cataract surgery .

INTRODUCTION:

In the last few decades there was revolutionary technological developments in IOL designs, ocular biometry ,phacoemulsification and IOL calculation formulae.

These achievements had encouraged ophthalmic surgeons to expand the rate of cataract surgeries as well as had increased patients expectations for satisfactory postoperative vision without need for any refractive correction.

To achieve the desired postoperative refraction, accurate calculation of IOL consider the corner stone[1].This depend on several factors including axial length, corneal power measurement, depth of AC (anterior champer) and IOL calculation formula[1,2].

The most important step for accurate calculation of IOL power is the preoperative measurement of ocular axial length(AL)[3].Inaccurate measurement of AL may account for up to 54% deviation from the expected refraction following routine cataract surgery[4], in contrary ,studies found only 8% of postoperative ametropia had result from error in measurement of corneal power[5].

4Axial length of the eye is routinely measured by A scan ultrasonagraphy (with resolution of 200 micrometer).

The most important limitation for this technique is corneal indentation (as the transducer should contact the cornea) which result in underestimation of axial length [6].

An error of (100 micrometer) in axial length measurement lead to 0.28 diopter of postoperative refractive erorr[7].

Modern optical biometry device (IOL master) is a fast non-contact method which consider more prescise and accurate than A scan biometry[8].

For the measurement of axial length ,IOL master employed the method of partial coherence interferometry(PCI) which based on reflection of interference signal of RPE(retinal pigmented epithelium) [9].

Additionally, built in soft ware in this device provide more accurate IOL power calculation and multiple choices for IOL formulae[10].

It has been found that the IOL master is more accurate in patients with high myopia , posterior staphyloma or silicone oil filled globes[11].As the patient will fixate on light source, measurement along the visual axis is confirmed so misalignment error produced by an off-axis posterior staphyloma unlikely happened[12,13].

Unfourtenately ,significant axial opacity will affect the IOL master reading e.g. central corneal scar, brunescent lens, dense posterior subcapsular cataract and vitreous hemorrhage rendering the measurement meaningless[14].

The purpose of this study was to compare axial length and intraocular lens power in patients with different type of cataract using optical method (IOL master) and acoustic method (A scan) and to evaluate clinical outcome of each method.

MATERIALS AND METHODS:

One hundred twenty five patients complained from cataract who visit ophthalmology department at Diwanyia teaching hospital in the period from August to December 2016 were recruited in this prospective study. The study was approved by ethical committee of ophthalmology department, College of Medicine , University of Al-Qadisiyah it followed the principle of declaration of Helsinki.

Inclusion criteria was any patient with age related cataract of any type who scheduled for routine cataract surgery. Exclusion criteria was those with corneal scarring, dense posterior subcapsular cataract ,those with previous corneal surgery, high myopia (more than -6 diopter) or any patient with complication during phacoemulsification surgery that not permit in the bag IOL implantation.

After taking an informed consent from all the participants in this study, IOL measurement was done using IOL

master(noncontact method) .The machine is zeis IOL master 500(V 5.2 carl zeis -Germany) which use the principle of partial coherence interferometry for the measurement of axial length. For keratometric reading ,six points telecentric technique was employed.

With this device three consecutive measurements for axial length and keratometry was performed and the mean of these valid measurements were used for calculation of implanted IOL power. Then, by the same operator A-scan ultrasound was done.

Ultrasound biometry (tommy -japan) was used for the measurement of axial length by applanation method .Sound velocities of 1532 m/s were taken for aqueous and vitreous while for the lens the sound velocity were 1641 m/s. Six axial length measurement were obtained by appalanation ultrasonogaphy and a mean of at least three valid measurement was used as axial length.

All the measurement were taken while the patient is sitting in upright posture and the transducer held in a way so that the ultrasound beam was perpendicular to the globe.

For the calculation of the IOL power ,we used the theoretic IOL power predication formula (SRK/T) aiming for postoperative emmetropia in all eyes.

Follow up visit 1day,3 days ,1 week and 1 month after surgery. Best corrected visual acuity was tested using E-chart and subjective refraction was examined by autorefractokeratometery , tommy .japan).

STATISTICAL ANALYSIS :

Data analysis was performed using SPSS version 23 (2013,Chicago,USA) and Microsoft excel version 2017 .The data was summarized using mean ±SD . Paired t-test was used for comparison of the axial length between the contact and noncontact technique while for the comparison of the postoperative refractive status ,we used the non-paired t-test .

Regression analysis was used for the comparison of the agreement between the two device . P values less than 0.005 were considered as statistically significant.

RESULTS:

A total of (150)eyes from (125) patients were studied by the two technique (68 male and 57 female) .The mean age of the participants was (65)years ranging from (41) to (78). Ninety eyes had nuclear cataract, forty eyes with posterior subcapsular cataract and twenty with cortical cataract. Best corrected visual acuity ranging from counting fingers to 6/18 (0.48 log MAR).

The mean axial length taken by IOL master (non-contact technique) was 23.66 mm ranging (22.51-24.93 mm) longer than axial length taken by A-scan (contact technique) which was 23.48 mm and ranging 22.32 -24.64 mm[table 1and figure1].The predicted IOL power taken by IOL master was ranging from (20.10±2.98D) versus (20.45±2.7 D) with ultrasound method [table1 and figure2].

There was statistically significant difference between both device regarding axial length and IOL power calculation using paired t-test with p value of 0.003 and 0.001 respectively [table 1].All the patients preferred IOL master rather than applanation biometry as it non-contact technique.

Postoperatively, best corrected visual acuity was 6/9 (logMAR0.18)in (126) patients (84%), 6/12(logMAR0.3) in (15) patients (10%) and 6/18 (logMAR0.48) in (9) patients (6%). Spherical equivalent(SE) was ranging from (-0.25 to +0.25 diopter) in one hundered and seven patients , from (-0.5 to +0.5 diopter) in twenty seven patients and from (-0.75 to +0.75 diopter) in sixteen patients [as shown in table 3 and figure 3].

Table 1: Axial length and IOL power using A scan and IOL master technique

Parameter	A-scan	IOL Master	P-value
Axial length	23.48 ±1.16 mm	23.66 ±1.25mm	0.003
IOL power	20.45 ±2.70 D	20.10 ±2.98 D	0.001

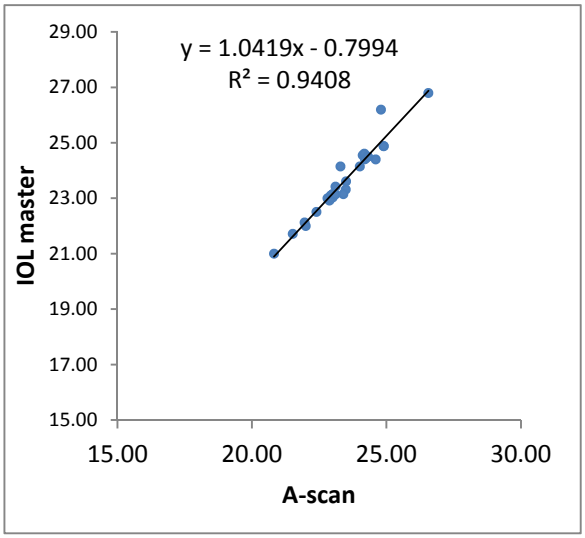

Figure 1: Comparison between IOL master and A-scan in axial length measurement

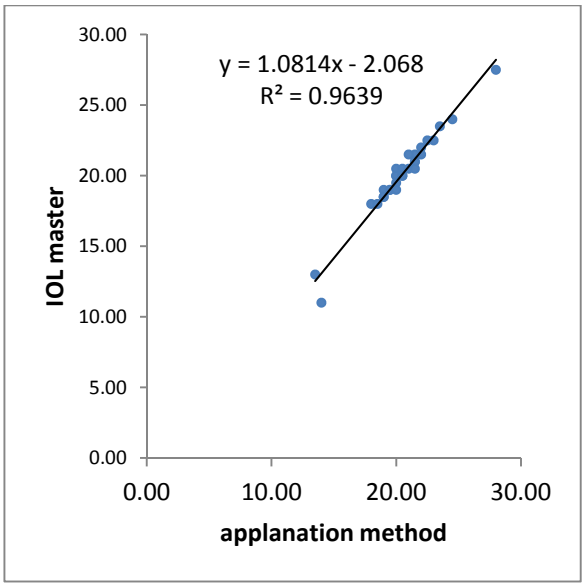

Figure 2: Comparison between IOL master and A-scan in IOL power calculation

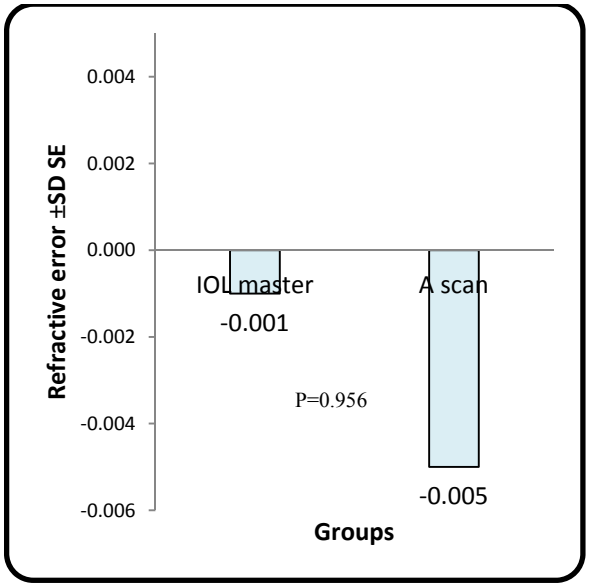

Figure 3: IOL master and A-scan biometry in postoperative spherical equivalent measurement

Table 2: Postoperative spherical equivalent measured by autorefractometer

Postoperative spherical equivalent	Number of patients
+0.75	6
+0.5	12
+0.25	21
0	57
-0.25	29
-0.5	15
-0.75	10

DISCUSSION:

Accurate biometry is essential for satisfactory refractive status following IOL implantation. With the new advancement in IOL design and frequent use of multifocal and toric IOL in recent years ,accurate biometry has become essential to achieve postoperative emmetropia .

Incorrect axial length and K reading measurement consider the most important source of error in biometry[15].

In most ophthalmic practice applanation ultrasonagraphy remain the common method for measurement of ocular axial length[16].

The A scan biometry use contact technique for the measurement of distance from the corneal vertex to the internal limiting membrane (ILM) while the IOL master employed noncontact technique for axial length measurement which measure the distance between anterior corneal surface and retinal pigmented epithelium[17].

In this study, axial length measurement by ultrasonagraphy was shorter than that by IOL master. There are two reasons which explain this disparity in measurement of axial length .First ,the light of IOL master is reflected at RPE while the ultrasound wave is reflected mainly at ILM ,thus there is about 150 micrometer difference which represent the retinal thickness at the fovea[16,17].Second,which is the most important , is the pressure exerted on the eye by the ultrasound probe with the resultant corneal indentation and shortening of axial length.

we found that axial length measured with optical method is longer by an average of (0.18 mm) than that measured by acoustic method .This result agree with that of Gojal et al 2003 who found in his study that axial length measured with A scan is shorter than that measured by laser interferometry by an average of (0.2mm)[18] .

H. Eleftheriadis et al 2017 had found that axial length measured by IOL master is longer than that measured by ultrasound method by an average of (0.4mm)[19] which is more than in our study.

In contrary , Lam et al (2001) found that IOL master gave reading slightly lower than those acquired by ultrasound[20] .Lam et al examined 26 young subject with clear media but in our study the participants were older and had cataract.

Rajan et al (2002) found no significant difference in axial length measurement between contact method and laser interferometry ,but they found postoperative hyperopic shift in postoperative status which agree with our finding[21].

Another factor which had increase the accuracy of IOL master is the alignment of measurement axis with visual axis of the eye ,as laser interferometry relay on optical alignment method in which the patient fixate on light spot ,this will give better alignment of measurement axis with the visual axis compared to ultrasound biometry where misalignment between measured axis and visual axis may occur[22].

In this study the mean predicted IOL power was significantly less using IOL master (20.10 d) in comparison to ultrasonic method (where IOL power is 20.45 d).This result agree with other studies of H. Eleftheriadias and S .Gaballa who found a difference of 0.4 diopter in IOL power calculation using IOL master and A scan biometry[19.23].

It has been found that myopic eye is more vulnerable to measurement error due to long axial length and low scleral rigidity. In eye with posterior pole staphyloma ,IOL master gives more precise result than A-scan because the localization of fovea is more accurate[24].

The process of ocular biometry had been simplified with the use of IOL master .It does not require topical anaesthesia (since it employ noncontact technique) thus preventing corneal abrasion ,transmission of infection and providing comfort for the patients.

Additionally, IOL master is more accurate than US biometry since it measure the ocular axial length along the visual axis (because the patient fixate at the measurement beam),this is very important in eye with posterior pole staphyloma .

In spite of all the mentioned above, IOL master still has many limitations e.g. inability to measure axial length in dense ocular media such as corneal scar, mature cataract or dense posterior subcapsular cataract. Eye with nonoptimal fixation like patient with advanced age related macular degeneration (as the measurement is not along the visual axis) this might result in inaccurate axial length measurement, as well as patients with mobility problem still facing difficulty with IOL master machine.

These drawback ensure the need for US biometry in unlimited numbers of cataract cases facing ophthalmologists every year.

CONCLUSION

IOL master has significant advantage over US biometry in measurement of axial length and determination of IOL power .it is quick and easy to use ,eliminate risk of infection transmission (by applying noncontact technique) However, the limitations of this study are its single center experience and need further researches for refinement of the results also more analysis is needed for eye with high myopia and silicone filled eyes.

REFERENCES:

1 Lam AK, Chan R, Pang PC. The repeatability and accuracy of axial length and anterior chamber depth measurements from the IOLMaster. *Ophthalmic Physiol Opt* 2001;21:477–83.

2 Jansson F, Kock E. Determination of the velocity of ultrasound in the human lens and vitreous. *Acta Ophthalmol*1962;40:420–33.

3 Holladay JT, Prager TC, Chandler TY, *et al*. A three-part system for refining intraocular lens power calculations. *J Cataract Refract Surg* 1988;14:17–24.

4 Doctor K.J. JAYPEE; India: 2009. IOL calculations: when, how and which? Mastering the techniques of IOL power calculations. p. 36–45.

5 Holladay J.T. Ultrasound and optical biometry. Cataract Refract Surg Today Eur. 2009

6 Alpins N.A., Walsh G. accurate biometry and intraocular lens power calculations. In: Agarwal A., editor. Refractive Surgery Nightmares – Conquering Refractive Surgery Catastrophes. Slack Inc; NJ: 2008. p. 581. p. 581–585.8.

7 Hoffer K.J., Shammas H.J., Savini G. Comparison of 2 laser instruments for measuring axial length. J Cataract Refract Surg. 2010;36(4 (April)):644–648. Erratum in J Cataract Refract Surg 2010;36(6 June):1066

8 Hitzenberger CK, Drexler W, Dolezal C, Skorpik F, Juchem M, Fercher AF & Gnad HD (1993): Measurement of the axial length of cataract eyes by laser Doppler interferometry. Invest Ophthalmol Vis Sci 34: 1886– 1893.

9 Kalogeropoulos C, Aspiotis M, Stefaniotou M & Psilas K (1994): Factors influencing the accuracy of the SRK formula in the intraocular less power calculation. Doc Ophthalmol 85: 223–242.

10 Lam AK, Chan R & Pang PC (2001): The repeatability and accuracy of axial length and anterior chamber depth measurements from the IOLMaster. Ophthalmic Physiol Opt 21: 477–483

11 Freudiger H *et al*. Influence of intraocular lenses on ultrasound axial length measurement: *in vitro* and *in vivo* studies. *Am Intraocular Implant Soc J* 1984; 10: 29–34

12 Hoffer KJ. Biometry on 7500 cataractous eyes. *Am J Ophthal* 1980; 90: 360–368

13 Oguchi Y *et al*. Determination of the expected power of the implant lens by ultrasound. *Ophthalmologica* 1975; 171: 281–283 |

14 P. J. Buckhurst, J. S. Wolffsohn, S. Shah, S. A. Naroo, L. N. Davies, and E. J. Berrow, "A new optical low coherence reflectometry device for ocular biometry in cataract patients," British Journal of Ophthalmology, vol. 93, no. 7, pp. 949–953, 2009.

15 M. Bjeloš Rončević, M. Bušić, I. Čima, B. Kuzmanović Elabjer, D. Bosnar, and D. Miletić, "Comparison of optical low-coherence reflectometry and applanation ultrasound biometry on intraocular lens power calculation," Graefe's Archive for Clinical and Experimental Ophthalmology, vol. 249, no. 1, pp. 69–75, 2011.

16 S. Jasvinder, T. F. Khang, K. K. S. Sarinder, V. P. Loo, and V. Subrayan, "Agreement analysis of LENSTAR with other techniques of biometry," Eye, vol. 25, no. 6, pp. 717–724, 2011.

17 Rose LT, Moshegov CN. Comparison of the Zeiss IOLMaster and applanation A-scan ultrasound: biometry for intraocular lens calculation. *Clin Exp Ophthalmol* 2003; 31:121–124.

18 R.Gojyal,R.V North. Comparison of laser interferometery and ultrasound A scan in measurement of axial length.acta ophthalmolgica scandinivai 2003.23;331-335.

19 Elefriadias H. IOL master biometry refractive results of 100 cases.Br j ophthalmol 2017,87,960-963.

20 Lam AK, Pang PC 2001.the repeatability and accuracy of axail length and anterior champer depth using IOL master .ophthalmic phsiol opt 21;477-483.

21 Rajan MS,keilhorn and Bell JA2002 .partial coherence laser interferometry versus conventional us biometry in IOL power calculation. Eye 16;552-556

22 Tehrani M, Krummenauer F, Blom E, et al. Evaluation of the practicality of optical biometry and applanation ultrasound in 253 eyes. *J Cataract Ref Surg* 2003; 29:741–746.

23 Gaballa SH, Allam RS, Abouhussein NB, Raafat KA. IOL master and A-scan biometry in axial length and intraocular lens power measurements. Delta J Ophthalmol 2017;18:13-9

24 Huang J, *et al*. Repeatability and interobserver reproducibility of a new optical biometer based on swept-source optical coherence tomography and comparison with IOLMaster. *Br J Ophthalmol*101, 493-498,