Original Article

Intraocular Lens Power Calculation in Silicone Oil Filled Eye: IOL Master Versus A-MODE Acoustic Biometry

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Purpose: To compare accuracy of intraocular lens (IOL) master and A-mode acoustic biometry in patients undergoing phacoemulsification with intraocular lens implant and removal of silicone oil.

Study Design: Prospective non randomized case series.

Place and Duration of Study: Al-Ehsan Eye Hospital Lahore / Jinnah Hospital, Lahore.

Material and Methods: This study was conducted on 30 patients with cataract and history of silicone oil in that eye as a consequence of previous vitreo-retinal surgery. Pre and post operative axial length (AXL) measurements were made using IOL master and conventional A-mode acoustic biometry. Accuracy and reliability of these techniques were compared by comparing post operative axial lengths and refractive errors.

Results: Mean AXL measured with IOL master preoperatively was 23.62+/-0.36 mm. Readings noted by IOL master one month after SO removal showed a mean of 23.58+/-0.29 mm. There was no statistically significant difference (p-value 0.463). The pre and post operative AXL measured by conventional acoustic A-scan showed statistically significant difference (p-value 0.004). Preoperative AXL was 23.34+/-0.58 mm and post operative AXL was 23.97+/-0.71 mm. Post operative refractive error in IOL master group was 0.70+/-0.32 diopter sphere (DS) whereas that of acoustic A scan group was 1.55+/-0.98 DS. This difference was statistically significant (p-value 0.038) at eight weeks interval.

Conclusion: IOL master is superior and more accurate for calculating AXL and post operative refractive error in SO filled eyes when compared to A-mode acoustic biometry.

Keywords: IOL Master, silicone oil, axial length, phacoemulsification.

Cataract formation is one of the most frequent sequel after an uneventful pars plana vitrectomy (PPV) with/without silicone oil (SO) endotamponade[1]. Cataract after PPV is formed due high oxygen tension in vitreous cavity during surgery and exposure of crystalline lens to oxygen stress precipitates nuclear sclerosis[2]. If SO is used as an endotamponade after PPV in a patient with crystalline lens, then it leads to interruption of normal metabolic environment of lens. Also direct contact of SO with lens may be responsible in accelerated cataract formation[3,4]. Although may surgeons have reverted to the use of gas as a preferred endo-tamponade agent, SO still holds a pivotal position when it comes to scenarios like proliferative vitreoretinopathy (PVR), giant retinal tears, trauma, and severe proliferative diabetic retinopathy, chronic uveitis with hypotony, retinal detachment due to a macular hole in highly

myopic eye, colobomatous retinal detachment etc[5-7].

Due to advancements in microsurgical techniques for PPV and phacoemulsification, most surgeons are inclined to remove the cataract / implant intraocular lens (IOL) at the time of silicon oil removal in one procedure. For that, we need an accurate IOL power calculation in an eye filled with SO. As far as conventional acoustic biometry is concerned, the speed of sound travelling in SO is significantly slower than in vitreous cavity of phakic eyes; thus rendering a falsely longer axial length (AXL) of SO filled eyes if no correction factor is used[8]. Even with the use of correction factors that may be built in the biometer, high levels of accuracy and repeatability are seldom achieved.

Newer biometers utilizing the principle of partial coherence interferometry (PCI) (reflected interference signal from retinal pigment epithelium) are being used as standard tools for AXL measurement in normal eyes with cataracts. These optical biometers are nearly 10 times more accurate and reliable than conventional methods[9]. Recent evidence has suggested that PCI principal is also more reliable and accurate for AXL measurement SO filled eyes as well[10,11].

We conducted this study to evaluate and compare the reliability and accuracy PCI based biometers when compared to conventional acoustic biometers.

MATERIAL AND METHODS

This prospective non randomized clinical study was conducted at a private ophthalmic facility between July 2015 to January 2016. All patient included in this study were well informed about the nature and purpose of this study and informed consent was taken. Hospital ethical committee approved this study. A total of 30 patients who had undergone PPV with SO (RS-OIL silicone oil 1000 cS; AL.CHI.MI.A Srl., Italy) injection for rhegmatogenous retinal detachment (RRD) were included in this study. Patients with recurrent RRD and other factors that may influence the accurate calculation of AXL were not included in this study. At the time of surgery, standard acrylic foldable intraocular lens was implanted in all patients.

All patients had preoperative AXL measurements by PCI method using IOL Master (Version 5; Carl Ziess Meditec Ltd, Germany) and by conventional A-scan ultrasound in SO filled eye mode (Quantel Medical compact; Quantel Medical SA, France).

The IOL power was calculated using standard protocols and applying SRK-T formula. No corneal or scleral sutures were applied at the end of the surgery. Repeat AXL length was measured using the above mentioned 2 techniques at one month after surgery. Refraction was done using standard auto-refractor at 3 months after surgery. One patient had recurrent RRD after removal of SO and was excluded from the study at 2nd month follow-up.

Accuracy of the AXL reading between two techniques was evaluated by comparison of pre and post operative AXL difference and comparison of the same between 2 machines.

Results were analyzed statistically using Chi-square set and Pearson's correlation by software package SPSS 20.0 (SPSS Inc., IL, USA). Results were declared statistically significant if p-value < 0.05.

RESULTS

Out of 30 patients, one patient was excluded from final data analysis due to recurrent RRD. Of 29 patients, 13 were female and 16 were male. Mean age of the patients was 43.4 years with SD =/- 9.3 years. Results are shown in table 1.

Table 1: AXL results of two machines

Machine	Preop AXL in mm	1 mth Post SO removal AXL	P value	Postop Refractive Error DS
IOL Master	23.62+/-0.36	23.58+/-0.29	0.463	0.70+/-0.32
Acoustic A Scan	23.34+/-0.58	23.97+/-0.71	0.004	1.55+/-0.98

The mean AXL measured with IOL master preoperatively was 23.62+/-0.36 mm (range 19.72-26.83 mm). Readings noted by IOL master one month after SO removal showed a mean of 23.58+/-0.29 mm (range 19.90 – 26.12 mm). There was no statistically significant difference (p-value 0.463).

The pre and post operative AXL measured by conventional acoustic A-scan showed a statistically significant difference (p-value 0.004). Preoperative AXL was 23.34+/-0.58 mm and post operative AXL was 23.97+/-0.71 mm.

When compared to post operative AXL measured by acoustic A-scan, the pre operative AXL measured

by IOL master was again significantly different (p-value < 0.003).

Post operative refractive error in IOL master group was 0.70+/-0.32 DS where that of acoustic A scan group was 1.55+/-0.98 DS. The difference between these groups was statistically significant (p-value 0.038).

DISCUSSION

Our study showed that the there is a statistically significant difference in the pre and post operative AXL measured by IOL master and conventional acoustic A scan. Also the post operative refraction was more accurate when IOL master was used to calculate AXL. Although, not many studies have been conducted on this topic, yet almost all the research work done on this topic shows that IOL power measurement done with IOL master is superior to conventional acoustic method especially in cases where eyes were filled with SO. One such observation was made by Kunavisarut and colleagues.[12] He showed that IOL master has superior reliability and repeatability over immersion method of acoustic biometry when calculating AXL and post operative refractive error in eyes planned for phacoemulsification + IOL implant + removal of silicon oil in one procedure. His results showed preoperative mean AXL of 23.91 ± 0.24 mm and 23.71 ± 0.59 mm by IOL master and immersion A-scan, respectively, which demonstrated a statistically significant difference (P = 0.002). Also, the post operative refractive error calculation was shown to be more accurate with IOL master. In subgroup analysis, he showed that a preoperative AXL outside ± 1 SD of the postoperative AXL was associated with an aphakic lens status (P = 0.001 and AXL > 25 mm (P = 0.042) in the immersion group. However, there were no such associations were noted in the IOL master group. Since, we did not include any aphakic preoperative patients in our study, we cannot compare our results in this subgroup analysis. Another study showed that the preoperative AXL measured with IOL master was 0-1.2 mm longer (median 0.3 mm) than that measure after SO removal postoperatively. Our study also showed such a trend that mean preoperative AXL measured with IOL master was 0.04 +/ -0.29 mm than post operative measurements but our difference was statistically insignificant (p-value 0.463). They also concluded that preoperative axial lengths measured by A-scan at 980 m/s tended to be 0-1.5 mm (the median of 0.52 mm) shorter than those obtained after silicone oil removal. Our study also showed a similar trend[13]. Similar trends have also been documented in literature by other researchers that AXL values obtained with the IOL Master after adjustment are more accurate than A-mode ultrasonography in silicone-filled eyes[14]. Another interesting study affirming the superiority of IOL master over A-mode utrasongraphy showed that conventional acoustic method of AXL measurement in SO filled eye yielded less accurate results in terms of post operative refraction when compared to IOL master. But when the author employed same A-mode utrasongraphy intraoperatively after removal of SO and before phacoemulsificatio, then the results were statistically not different when using IOL master[15]. They concluded that when comparing predictability of intraoperative A-scan biometry and IOL Master Biometry, the two techniques showed small predictive postoperative refractive errors without a statistically significant difference in the predictive errors of the two techniques. Such an approach is also advocated by other studies to improvise in such situations where IOL master is not readily available[12,16]. Researchers have also proposed other methods of AXL calculations in eyes with SO. These methods include AXL measurement in contralateral eye (with no history of anisometropia), intraoperative retinoscopy, magnetic resonance imaging (MRI) and preoperative AXL measurement in same eye with macula ON retinal detachment[17-22]. But with the fairly widespread availability of PCI bases technology, these above mentioned techniques have been superseded; although the surgeons should be aware of the other options available in case PCI based machines are not available. Another possibility is a two step operation where SO is removed in stage one and then IOL is implanted in stage 2 where A-mode acoustic biometry can give very predictable results in the absence is SO. The short fall is that patient has to undergo 2 separate procedures with their known risks in mind and visual recovery is considerably delayed.

Our study was conducted under controlled conditions with all the A-mode biometrics performed by a single experienced user; although the chance of deviation still remained and could have influenced the final results. Another shortcoming of this study was that we did not include eyes with very short and very long axial lengths where we could have documented the results of IOL master in externe AXL conditions. The strong point of this study was that same group of patients were tested twice for AXL by two different

methods which further authenticated the superiority of IOL master over conventional A-mode biometry.

CONCLUSION

We safely conclude that IOL master is a safer, superior and more accurate method when calculating AXL and predicting post operative refractive error in eye under going combined procedure of phacoemulsification with IOL implant and removal of silicone oil.

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