I.O.L. Master 700 Optical Biometry versus Conventional Ultrasound Biometry (Immersion Technique) in Intra Ocular Lens Power Calculation in High Myopia Patients

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ABSTRACT

BACKGROUND

IOL implantation has turned into a very significant part of modern-day cataract surgery. IOL implantation no longer only sub serves the purpose of better visual rehabilitation but is currently considered as a form of refractive surgery. Accurately predicted post-operative visual outcome has become the necessity of present times. In this regard, precise pre-operative biometric measurement is an essential pre-requisite. The aim of the study was to compare the accuracy of optical biometry and conventional ultrasound measurement of the preoperative intra-ocular lens power calculation formula (SRK/T) of highly myopic eye.

METHODS

This study included 58 eyes of 50 patients [(10 cases of bilateral and 48 cases of unilateral cataract) (20 female (45%) and 30 male (55%)] with extreme myopia and axial lengths ≥25.0 mm with cataract as the only ocular pathology. Patients were divided in two groups. Group 1 (the optical biometry group) included 25 patients and group 2 (the A-scan ultrasound group) included 25 patients. Those eyes were included in the present study which had visually significant lenticular opacity. Eyes which were not suitable for phacoemulsification and primary in-the-bag posterior chamber IOL insertion were excluded for minimizing the confounding factors, all patients were operated by the same surgeon and implantation of single piece soft hydrophobic aspheric acrylic IOL from the same manufacturer was done. (power range ±12.0. D to ±16.0 D).

RESULTS

This study was carried out on 58 Eyes of 50 high myopia patients who had initially presented with visually significant cataract. Patients were randomly divided into two groups: First Group (Group 1 included 30 eyes all of which underwent Optical Biometry using a single machine from the same manufacturer (Zeiss 700 IOL master) and Second Group (Group 2) included 28 eyes all of which underwent conventional A Scan Ultrasound Biometry using a single machine from the same manufacturer (Sonomed PAC SCAN 300 AP). The proportion of eyes with post-operative spherical equivalent of ≤±0.5 D, ≤±0.75 D and ≤±1 D in the conventional ultrasound biometry group were significantly lower when compared with corresponding proportions in the IOL Master group ($p<0.00$) respectively.

CONCLUSIONS

Optical Biometry using partial coherence interferometry gives significantly better pre-operative IOL power prediction as compared to conventional ultrasound-based biometry in high myopia patients.

KEYWORDS

High Myopia, Optical Biometry, Ultrasound Biometry

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BACKGROUND

Surgical removal of cataract is the most common surgical procedure performed in ophthalmic clinical practice. The surgical procedure involves not only removal of the cataractous crystalline lens but also proper in-the-bag implantation of IOL of appropriate dioptric power to ensure clear and sharp post-operative vision without glasses. There is a growing popularity and interest among patients with significant refractive errors in various refractive surgical procedures like laser assisted in situ keratomileusis (LASIK) and phakic intraocular lens implantation. However, cataract surgery provided a wider ambit of refractive error correction which is safer and with much more predictability. This idea has helped emerge the concept of "refractive cataract surgery". IOL power calculation is most important part for postoperative Visual outcome after successful cataract surgery. Factors affecting the end result of biometry are axial length (AL) anterior chamber depth (ACD), Keratometric index (K), lens thickness, IOL power calculation formula and IOL power quality control by manufacturer. Most important factor is axial length.

Globally High Myopia being one of the most prevalent refractive error, has been associated with high risk of other ocular diseases. Post-operative suboptimal refractive outcome is not very uncommon in patients with axial myopia having axial length of more than 25 mm. Pathological Myopia patients with posterior staphyloma are quite prone to have wrong axial length measurement and subsequently incorrect biometric calculations. Patients can retain residual myopic status after cataract surgery or further worse they may turn hyperopic. This causes unanticipated post-operative visual complaint by the patient. It also leads to difficult post-operative visual rehabilitation.

IOL master 7000, was the first optical biometer to incorporate Swept Source - OCT technology. Biometry with total keratometry measures the posterior corneal surface keratometry also.[1,2] It can also reduce the risk of refractive surprise by detecting foveal pit irregularities. One limitation of IOL Master was its inability to measure AL reliability in the presence of opaque media such as corneal opacity and dense cataract. The AL measured by ultrasound A scan by immersion technique can lead to error due to off axis measurement of the AL by the transducer, cause error in AL measurement and refractive surprise after cataract surgery.[3,4]

The present study intended to compare the efficacy of conventional ultrasound based biometric calculation with that of the optically measured biometry in patients having high myopia by corroborating the post-operative refractive outcome after phacoemulsification.

METHODS

58 eyes of 50 high Myopic patients (20 female and 33 male) were included in study. Surgery performed was only phacoemulsification cataract surgery. It was prospective randomized clinical study. Biometry was performed by IOL master 700 (25 patients) or ultrasound A scan biometry immersion technique (25 patients) between 2018 January to 2018 December. After obtaining consent, all patients were subjected to detailed history taking and full clinical examination, especially eye examination. Cases were recruited from outpatient clinics. This study was carried out during a time period from January 2018 to December 2018. The eyes were divided into two groups (A and B). Group A underwent the optical biometry by IOL MASTER 7000. Group B underwent the ultrasound biometry immersion technique (Ascan guided biometry) using SRK-T formula.

Inclusion Criteria

1. Eye with myopic axial length >25 mm.
2. Spherical equivalent (SE) > -6D.
3. Uncomplicated phacoemulsification done with posterior chamber IOL implantation.
4. Eyes with Significant cataract suitable for phacoemulsification and primary in bag implantation of posterior chamber IOL.

Exclusion Criteria

1. Corneal astigmatism more than 3 diopter.
2. Corneal opacities, irregularities, scarring, dystrophy, ectasia or any corneal surgery.
3. Subluxated lens or weak Zonules.
4. Retinal pathology like, - detachment, scar or diabetic retinopathy.
5. Posterior capsule tear, vitreous loss.
6. Post-operative complication, uveitis, TASS.
7. Amblyopia, Glaucoma, Optic neuropathy, Age related macular degeneration, Macular oedema, Uncontrolled Diabetes with ocular manifestation.

Pre-operative history, best corrected visual acuity, keratometry by auto keratometer was taken. Dilated fundus examination, cataract grading and USG B-scan for dense cataract and OCT macular scan was performed to exclude posterior segment diseases wherever required clinically. Two groups were selected one ultrasound groups with ultrasound (Ocuscan, Alcon Corporation) and second IOL master 700 group selected. Patients selected by simple random sampling between two groups. 25 patients were selected in each group. The intraocular lens power calculation was done based on SRK-T formula. Temporal incision, phacoemulsification was done for all cases. IOL used was only Acrys of aspheric natural yellow (SN60WF) IQ, which is a hydrophobic, acrylic, foldable IOL to rule out any manufacturer related IOL power defect. Optical biometry was performed with the patient seated at the IOL Master and asked to fixate on the fixation target. An ultrasound biometry (immersion technique) was performed after instillation of one drop of proparacaine hydrochloride 0.5% on the lower conjunctiva as per standard protocol.

Postoperative assessment included visual acuity and postoperative SE evaluation for 1 month. Post-operative patients were examined day-1, day-3, 1 week and 4 weeks after surgery. Post-operative spherical power was calculated 4 weeks after surgery.

RESULTS

58 eyes of 50 patients (30 males and 20 females), of whom 25 patients underwent biometry with ultrasound by immersion technique and 25 patients underwent optical biometry (IOL Master 700) were selected for the study. Mean age of patient was 69.2 (SD-3.54) years (range 51-82 year). The pre-operative mean axial length was 27.10 ±2.01 mm in optical group (range: 25.55 - 29.83) and 25.94 ±1.57 mm in ultrasound groups (range: 25.01 - 29.12). The IOL power ranged from +12 D± 2 D in IOL master group and ±14 D ± 2D in ultrasound group. Post-operative spherical equivalent was calculated, and overall refractive outcome was in the range of ± 1.25 D in both the groups. However, only 24% eyes had ≤±0.25 D in conventional Ultrasound biometry group as compared to 46% in IOL master group (P<0.00). Similarly, the proportion of eyes with post-operative spherical equivalent of ≤±0.5 D, ≤±0.75 D and ≤±1 D in the conventional ultrasound biometry group were significantly lower when compared with corresponding proportions in the IOL Master group (p<0.00) respectively.

Spherical Equivalent	≤ ± 0.25 D	≤ ± 0.5 D	≤ ± 0.75 D	≤ ± 1 D	≤ ± 1.25 D
IOL Master	46%	66%	82%	98%	100%
Ultrasound	24%	54%	68%	89%	100%
P Value (by Chi Square)	<0.00	0.03	<0.00	0.04	1

Table 1. Percentage of Eyes with Post-Operative Spherical Equivalents at 4 Weeks among the Two Groups

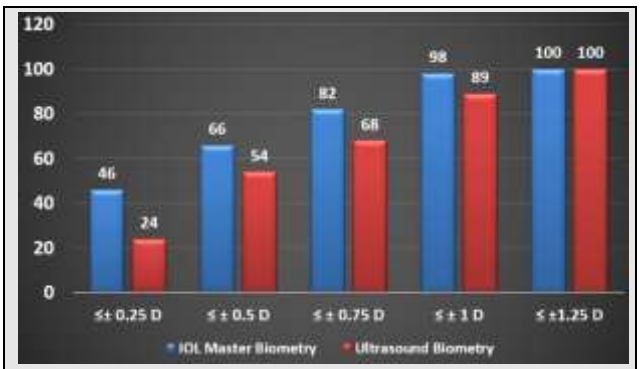

Figure 1. Percentage of Eyes with Post-Operative Spherical Equivalents at 4 Weeks among the Two Groups

DISCUSSION

Now a days, cataract surgery is synonymous with refractive surgery. Invent of modern multifocal, trifocal, extended depth IOL requires accurate biometry to get be best result. IOL master use non-contact technique, more accurate, reliable and appropriate for same day surgery. It measures AL more accurately because it measures along visual axis minimizing chance of misalignment between measured axis and visual axis. Various IOL power calculation formulas in long AL eyes were described. IOL power calculated using SRK/T, - Hoffer Q and holiday 1 formulas predicated comparable outcome.[2]

Previous studies have shown that applanation method of axial length measurement in ultrasound biometry has the risk of producing erroneous result due to compression of the globe while measuring. On the contrary, immersion technique of ultrasound biometry has a steeper learning curve is cumbersome to perform. In comparison, axial length measurement with optical biometry using partial coherence interferometry gives much more precise IOL power calculation with significantly less probability of facing any post-operative refractive surprise. Moreover, optical biometers use non-contact techniques with very high inter observer reproducibility and accuracy.[5]

The IOL master provides all biometric parameters and various formulas for IOL power calculation. The system uses dual-beam partial coherence interferometry, which improves the refractive results in cataract surgery patients.[6] The disadvantages of the first optical biometer (e.g. IOL master).In common clinical use was the inaccurate measurement in cases of media opacities such as corneal scar and dense vitreous haemorrhage, but newer versions of the IOL master and other optical biometers (e.g. AL-scan; NIDEK Co. Gemagori, Japan and Lenstar, Haag- Streit Group, Koeniz, Switzerland) may be more powerful.[7]

In another study, found that SRK-T and Holladay formula are equally well.[4] Wang et al reported the use, of IOL master with the SRK/T formula gives the most precise refraction outcome (MAE. O.52 D) in eye with an AL between 25.0 mm and 28 mm.[3] But the cost of IOL master 700 is too high and limited its use in normal ophthalmic practice. With well-trained ophthalmic assistant ultrasound biometry also gives acceptable outcome.

The accuracy of different IOL power calculation formulas have been examined and compared with each other in eyes with long axial length by several researchers in peer reviewed journals in recent past. The SRK 2 formula have been found to produce inaccurate biometric calculations in patients with axial myopia. Disparate results of IOL power calculations have been obtained in eyes with long axial length by third generation regression formulas. Comparable refractive outcomes in 89 eyes with an AL longer than 24.5 mm have been shown by using SRKT, Hoffer Q and Holladay 1 formulas in a previous study conducted by Chen et al.[6] Similarly in another study conducted by Jin et al have reported that IOL power calculated using SRK/T and Holladay formulas showed equal results.[8] In a separate study done by Wang et al, it was reported that using SRK/T formula with data obtained from IOL master produced the most precise refractive outcome in eyes with axial length varying between 25 mm to 28 mm.[3]

In a study conducted by Farahat et al comparison of the accuracy of optical biometry and applanation ultrasound measurement of the preoperative intraocular lens (IOL) power calculation formulas Haigis, SRK/T, and Hoffer Q was

done among patients with high myopia. The authors reported that Haigis regression formula with data obtained by optical biometers using partial coherence interferometry give significantly better results as compared to applanation ultrasound based measurements in the cohort of high myopia.[9] Similarly in the study conducted by Bang et al, it was shown that Haggis formula was the most accurate in predicting postoperative refractive error comparing with the Hoffer Q, Holladay 1, Holladay 2, and SRK/T for 53 eyes with AL more than 27 mm.[10] The superiority of results obtained by Haigis formula has been upholded in literatures published by Aristodemou eta al[11] and MacLaren et al[12] in cohorts of eyes with axial length atleast more than 26.5 mm. Zaldivar et al have postulated that the superior performance of Haigis formula in claculationg IOL power in high myopia patients may be attributed to the inclusion og anterior chamber depth parameter measured by optical biometers.[13]

CONCLUSIONS

In patients with high myopia, optical biometry by IOL master 700 gives significantly better refractive outcome specially for premium segment IOL patients than ultrasound biometry. However, it needs to be highlighted that ultrasound based biometers are still cost effective in the developing part of the world and optical biometers are not suitable in patients with very advanced cataract. This study needs to be followed up with multicenter prospective analysis with larger sample size and lesser confounding elements to have a further insight in the matter.

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