Original Article

Comparison of Biometry in Phakic and Dense Modes

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Purpose: To compare biometry readings in phakic and dense modes.

Design: Comparative cross sectional, analytical study.

Method: Biometry was done in phakic and dense modes separately, on ultrasound based A-Scan Quantel Medical®, of 68 normal eyes of 34 normal individuals.

Result: Readings were taken in both phakic and dense modes. Mean value of axial length in phakic mode was 23.7832 ± 0.14317 mm and that in dense mode was 23.7888 ± 0.14492 mm. Mean values of anterior chamber depth in phakic mode was 3.6806 ± 0.4398 mm and in dense mode, it was 3.6944 ± 0.4317 mm. Mean values of lens thickness in phakic and dense modes are 4.1485 ± 0.4934 mm and 4.2162 ± 0.5209 mm respectively. Mean values of vitreous length in phakic and dense modes came out to be 15.8490 ± 0.8281 mm and 15.7894 ± 0.7928 mm respectively. In the same way, mean values of calculated intraocular lens (IOL) by phakic mode was 19.4853 ± 0.18295 mm and that in dense mode was 19.5074 ± 0.18548 mm. Wilcoxon Signed Ranked Test was applied as all data was non-parametric. The results showed no significant difference ($p>0.05$) in readings taken in phakic and dense modes.

Conclusion: There is no significant difference between the measurements of anterior chamber, lens thickness, vitreous length, axial length and IOL power values taken either by phakic or by dense mode on ultrasound biometry. As dense mode is more sensitive and quick to perform, it is recommended that dense mode may be used for biometry even in normal conditions.

Keywords: Anterior chamber depth, Auto-keratometer, Axial length, Biometry, Dense mode, Intra ocular lens power, Lens thickness, Phakic mode, Ultrasound A-Scan, Vitreous length. 78.0% (150 patients). Pearson Chi-square test showed statistically significant difference in efficacy of anaesthesia in the groups ($p=0.014$).

Introduction

In the judgment of pathological processes of the eye and to plan surgical interventions accurate data is needed by the eye specialists. In areas like intraocular lens implant or refractive surgery the most important factor is accuracy.

There are several methods which can be used to determine axial length (AL) measurements, such as confocal microscopy, ultrasound biomicroscopy, optical coherence tomography, laser interferometry, and conventional ultrasound biometry and central corneal thickness (CCT). Ultrasound A-scan is mostly used to determine the thickness of the cornea, along with the depth of the anterior chamber and AL.[1] In everyday ophthalmological practice ocular biometric values (lens thickness, anterior chamber depth and axial length) are measured. These investigations are best indicated in the pre-operative evaluation for cataract surgery.[2]

In diabetic patients the major cause of visual impairment is considered to be cataract, as in patients with diabetes mellitus the incidence and progression of cataract is increased. The association of cataract formation with diabetes has been shown in basic research studies and clinical epidemiological research studies as well. As type 1 and type 2 diabetics are increasing worldwide, the incidence of diabetic cataracts steadily increases, even though cataract surgery is considered the most common surgical ophthalmic procedure around the globe.[3]

More than 11 million IOL implantations are done worldwide every year. After nearly 60 years of this procedure, it is considered as the most successful and most frequent surgical intervention in modern medicine. Functional postoperative vision is easily recovered, in the majority of patients. Continuous advancements in measurement methods and surgical techniques are the reason of safety and success of this procedure. Many factors such as, the keratometry reading and axial length, can affect the IOL power.

To detect and document macular disease is one of the challenges we face before cataract surgery. Often, this is performed at the slit lamp only by fundoscopy, which might miss minor pathologic changes and also doesn't allow for documentation. To allow a detailed morphologic analysis of the macula and its documentation, axial resolutions up to 10 mm are required which are offered by optical coherence tomography (OCT) scans, which takes time and, due to which, they are not done routinely.

The IOL Master 700® is a new optical biometry instrument. It measures lens thickness (LT), anterior chamber depth (ACD), axial length (AL), and central corneal thickness (CCT) as well as the corneal radii and white-to-white distance required to calculate the refractive power of intraocular lens (IOL). A-scan is generally used to measure axial length of eyeball. Commercially, Optical biometry based on A-scan technology was launched by Carl Zeiss, for the first time in 1999 along with the introduction of the IOLMaster. In the meantime, many devices of this technology were developed by various manufacturers. Aladdin (Topcon)®, Galilei G6 (Ziemer)®, The Lenstar LS 900 (Haag-Streit)®, AL-Scan (Nidek)®, and OA-2000 (Tomey)® are being used worldwide.[4,6-8]

In ocular biometry, for attaining the desired post-operative refractive outcome, the critical step requires standardization of techniques that ensure accurate measurements which are important in providing correct calculated IOL power for cataract surgery.

A-scan ultrasound is the most common technique to measure axial length, anterior chamber depth, and lens thickness. In it, an ultrasonic beam via a transducer is passed through the eye, and as it returns after hitting intraocular structures a trace of ocular spikes from the cornea to the orbital fat is displayed on the monitor. Biometry values can be obtained either by immersion, contact (applanation), or optical methods. The most commonly used method is contact/applanation technique in which an ultrasound probe is placed on the central cornea; this slightly flattens the surface thus leading to various degrees of corneal compressions which may cause errors in the readings.[2,9,10] To overcome this, a saline filled scleral (Prager) shell can be used between the probe and the eye; it is relatively observer independent and is termed immersion A-scan biometry.

Another method includes non-contact technique which is optical method, which is done by partial coherence interferometry (PCI) that can be highly reproduced. As it is observer-independent, it is potentially more accurate. The optical and immersion methods give results that are highly comparative. Optical method is not able to obtain axial length measurements in many eyes which is its main disadvantage, such as those with nystagmus, posterior sub-capsular cataracts, dense cataract, unstable lids, vision worse than 6/60, etc., in which cases, some other method of biometry is applicable. Unfortunately, our population has cataracts which are already dense at the time of surgery and which makes the optical method less applicable in our environment.[2]

The density of the medium through which sound passes determines its velocity. The eye is composed of both solids and liquids; so an important principle which need to be understood, is that "Sound travels faster through solids than through liquids". In A-scan biometry, the passage of sound includes the solid cornea, the liquid aqueous, the solid lens, the liquid vitreous,, choroid, sclera, the solid retina and then orbital tissue; hence, it continuously changes velocity.[13]

In a comparative review to evaluate the consistency and relationship between PalmScan™ versus another A-mode ultrasound gadget, AL and ACD were shorter. We recorded the Anterior chamber depth (ACD), lens thickness (LT), and axial length (AL) acquired with two A-mode ultrasounds (Eye cubed and PalmScan A2000) utilizing an immersion method. In a similar audit with review the reliability of the estimations got with the PalmScan, when differentiated and another systematized A-mode ultrasound device, and relationship and consistency between the two strategical measurements was assessed with a two-sample t-test. Understanding between the two devices was surveyed with 95% confidence interval and Bland-Altman plots. 70 eyes of 70 patients were enlisted in this review. The measurements with the Eye Cubed™ were compared with the measurements taken by the PalmScan™. The difference was not statistically significant with respect to AL ($p < 0.4$) but rather huge in regards to ACD ($p < 0.001$). The most noteworthy assention between the two gadgets was acquired during LT estimation. Despite being shorter, the palm-scan measurements were not statistically significant ($p < 0.2$). Taken with both devices, the values of AL and LT are in the limits of agreement but are not identical. The magnitude of the ocular dimensions has no impact on the agreement (but only between range of 3.5 mm to 5.7 mm of LT and 20 mm to 27 mm of AL). While calculating IOL a correction of about 0.5 D is considerable. However due to huge fluctuation of the results, the authors suggest watchfulness in using this conversion factor, and to adjust intraocular lens' power based upon the surgeon's personal experience. Another review was led on examination on patients with iris-fixated phakic intraocular lens comparing preoperative and postoperative ocular biometry. This study included ArtiflexpIOL implants numbered 36 and Artisan numbered 40. Partial coherence interferometry (IOL Master) was measured preoperatively and also after 3 months of pIOL implantation and axial length (AL) along Anterior chamber depth (ACD) were measured by applanation ultrasonography (A-scan). ACD measurements after Artiflex or Artisan pIOL implantation were lesser as compare to the measurements taken preoperatively. Specifically, the difference among the values after Artisan pIOL implantation was -0.08±0.08 mm by IOL Master and -1.07±0.17 mm by A-scan. The difference after ArtiflexpIOL implantation was -0.05±0.07 mm by IOL Master and -1.31±0.15 mm by A-scan. After Artisan pIOL implantation, contrasts in AL estimations by A- scan were insignificant (distinction: -0.03±0.15 mm), while postoperative AL estimations by IOL Master were fundamentally longer than preoperative estimations (distinction: 0.12±0.07 mm). After ArtiflexpIOL implantation, AL measurements by both IOL Master and A-scan were fundamentally longer as compared to preoperative measurements (variation: 0.07±0.10 mm by IOL Master and 0.09±0.16 mm by A-scan). In the Artiflex group, variations in AL measurements by A-scan correlated with the central thickness of the ArtiflexpIOL. AL and ACD measurements were impacted by iris-fixated phakic IOL implantation.[14]

Materials and Methods

It was Comparative, cross sectional analytical study. Biometry was done in phakic and dense modes separately, on ultrasound based A-Scan Quantel Medical®, of 68 normal eyes of 34 normal individuals. Data was analyzed in SPSS software version 20 and Wilcoxon signed rank test was used as data was not normally distributed.

Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Ave-K	.117	68	.021	.955	68	.015
PM-AL	.220	68	.000	.821	68	.000
PM-IOL	.134	68	.004	.967	68	.070
PM-ACD	.084	68	.200[*]	.982	68	.456
PM-LT	.141	68	.002	.937	68	.002
PM-VL	.142	68	.002	.906	68	.000
DM-AL	.221	68	.000	.818	68	.000
DM-IOL	.141	68	.002	.968	68	.079
DM-ACD	.137	68	.003	.967	68	.066
DM-LT	.152	68	.000	.936	68	.002
DM-VL	.153	68	.000	.924	68	.001

Applying the Kolmogorov- Smirnov and Shapiro-Wilk tests, it was found out that our data was not normally distributed. So non parametric test (Wilcoxon Signed Rank Test) were used

Descriptive Statistics (n=68)							
	Range	Min	Max	Mean	Std. Error	Std. Dev	Variance
Age	40	20	60	27.74	1.295	10.677	113.989
Ave-K	1.52	7.14	8.66	7.7682	.04821	.39756	.158
PM-AL	6.40	22.32	28.72	23.7832	.14317	1.18061	1.394
PM-IOL	6.50	16.00	22.50	19.4853	.18295	1.50861	2.276
PM-ACD	1.82	2.78	4.60	3.6806	.04398	.36270	.132
PM-LT	2.55	3.15	5.70	4.1485	.04934	.40688	.166
PM-VL	3.48	14.68	18.16	15.8490	.08281	.68285	.466
DM-AL	6.51	22.32	28.83	23.7888	.14492	1.19504	1.428
DM-IOL	6.50	16.00	22.50	19.5074	.18548	1.52954	2.339
DM-ACD	1.70	2.81	4.51	3.6944	.04317	.35603	.127
DM-LT	2.53	3.23	5.76	4.2162	.05209	.42957	.185
DM-VL	3.16	14.49	17.65	15.7894	.07928	.65375	.427

The mean value of Axial Length in phakic mode was 23.7832 ± 0.14317 mm and that in dense mode 23.7888 ± 0.14492 mm. Mean Values of Anterior chamber depth in phakic mode was 3.6806 ± 0.4398 mm and in dense mode was 3.6944 ± 0.4317 mm. Mean values of Lens thickness in Phakic and Dense modes are 4.1485 ± 0.4934 mm and 4.2162 ± 0.5209 mm respectively. Mean Values of Vitreous Length in phakic and dense modes was 15.8490 ± 0.8281 mm and 15.7894 ± 0.7928 mm respectively. In the same way, Mean Values of Intra ocular lens this in phakic mode was 19.4853 ± 0.18295 mm and that in dense mode was 19.5074 ± 0.18548 mm.

Wilcoxon Signed Rank Test

	DM-AL - PM-AL	DM-ACD - PM-ACD	DM-LT - PM-LT	DM-VL - PM-VL	DM-IOL - PM-IOL
Z	-.159[b]	-.313[c]	-1.701[c]	-2.548[b]	-1.134[c]
Asymp. Sig. (2-tailed)	0.874	0.755	0.089	0.071	0.257

DM = Dense Mode, PM = Phakic Mode, AL = Axial length, ACD = Anterior chamber depth, LT = Lens thickness, VL = Vitreous length, IOL = intraocular lens

Applying Wilcoxon Signed Rank Test it was revealed that $p>0.05$ for all the statistics that were included in our investigation. Therefore, this study shows that there is no significant difference in all measurements taken in phakic and dense modes.

Disscussion

There is no doubt that the eyes are great blessing of God. There are many factors affecting the loss of vision including cataract. For cataract surgery biometry is performed to calculate the intra ocular lens power calculation. Axial length and corneal curvature (keratometry reading) is the main factors affecting IOL calculation. Corneal curvature and formulas are also very important factors that affect IOL power calculations. Moreover, different modes are designed according to the type of the IOL, such as whether the eye is having natural lens (phakic mode), dense cataract (Dense mode), silicon mode, PMMA or Acrylic modes etc. While performing biometry, mode is chosen according to the type of the IOL of the eye.This study compares two different modes to measure IOL power, phakic and dense modes. The study included 68 eyes of 34 individuals (gender independent). The age of participants was 20 years or more. The mean values of phakic and dense modes biometry were compared after performing biometry in both the eyes. There was no statistical significant difference between the mean of phakic and dense modes. As dense mode is more sensitive and quick to perform, it is, therefore, recommended that dense mode can equally be used for biometry even in normal conditions. To find out the difference between the two eyes, the study showed that there is no significant difference between them.

Conclusion

There is no significant difference between the measurements of anterior chamber, lens thickness, vitreous length, axial length and IOL power values taken either by phakic or by dense mode on ultrasound biometry. They show same results in both these modes. As dense mode is more sensitive and quick to perform, it is recommended that dense mode can equally be used for biometry even in normal conditions.

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