



A COMPARISON BETWEEN WHITE TO WHITE MEASUREMENTS OBTAINED USING MANUAL CALIPERS AND OPTICAL BIOMETER

Ophthalmology

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ABSTRACT

PURPOSE: To compare White To White (WTW) measurements obtained using manual calipers and optical biometer

MATERIALS AND METHODS: Preoperative horizontal WTW measurements in 10 eyes of 05 patients who opted for phakic IOL were recorded using both manual calipers and optical biometer (NIDEK AL SCAN). Phakic IOL were designed based on WTW readings taken by manual calipers. Postoperatively, AS OCT has been performed to measure the vault of the Phakic IOL. Independent T test was used to analyse the results.

RESULTS: Mean WTW measurement using calipers and optical biometer was 11.70±0.15 and 12.13±0.25mm respectively. P value was significant (0.00)

CONCLUSION: WTW measurements recorded by using manual calipers were reliable. Optical biometer overestimates the WTW measurements compared to calipers

KEYWORDS

White to white measurements, optical biometer, phakic IOL, vault size, Vernier calipers

INTRODUCTION:

Measurement of horizontal corneal diameter, known as white-to-white (WTW) distance, is important for a refractive surgeon. Very accurate estimation of WTW is also crucial in choosing the proper size of a pIOL. The most important way to avoid phakic intraocular lens (pIOL) induced complications, such as pupillary block and cataract formation, is to achieve the proper distance between the back pIOL surface and the anterior crystalline lens pole. This distance, called vault, is dependent on the chosen pIOL diameter. At present, the diameter of the pIOL is determined based on the principle of partial coherence interferometry, anterior segment optical coherence tomography and ultrasound biomicroscopy. However, different modalities give slightly different readings, which adds to the perplexity of choosing an accurate WTW.[1] In one study, IOL Master, a device that works on the principle of partial coherence interferometry is regarded as having the highest reliability in measuring corneal diameter as compared to other methods.[2]

The Purpose of this study is to compare WTW measurements obtained using manual vernier calipers with those obtained using Optical Biometer AL Scan(NIDEK CO.,LTD).In addition, we checked if manual calipers are still a reliable source for measurement of WTW by choosing pIOL diameters based on caliper measurements and observing the vault of pIOL as seen on AS-OCT.

METHODOLOGY:

OPTICAL BIOMETER AL SCAN (NIDEK CO., LTD), a device similar to IOL MASTER works on the principle of partial coherence interferometry offers the ease of obtaining keratometry values, anterior chamber depth and axial length measurements in a single setting. WTW is measured based on a digital photographic image that it acquires.

A caliper often similar to a drafting compass is a device used to measure the dimension of an object or the distance between 2 points on a plane. Modern calipers are calibrated against a standard of length to provide absolute measures that are displayed on analog (e.g., mechanical caliper) or digital scales. [3,4]

STUDY DESIGN: A cross sectional analytical study

SETTING: Tertiary Eye Care, Andhra Pradesh

DURATION OF STUDY: February 2018-May 2018

INCLUSION CRITERIA:

Patients with age between 21-30 years
Patients with clear crystalline lens

EXCLUSION CRITERIA:

Patients with history of glaucoma
Patients with corneal, iris or pupil anomaly
Patients with history of trauma
Patients with history of uveitis
Patients with ACD less than 2.5mm

This study included 10 eyes of 5 patients who opted for Phakic IOL implants. Informed consent was obtained from all participants. The study was conducted in tertiary eye care centre after requisite ethical clearance from institutional review board.

For optical coherence biometry, the Optical Biometry AL Scan (NIDEK CO., LTD) was used. Corneal power was assessed using a built-in automated keratometer. Axial length measurement was taken using the principle of partial coherence interferometry. At least 6 measurements were taken. The computed average of 3 selected measurements with the highest signal-to-noise ratio was taken. Horizontal WTW values were recorded. The scan was performed by an experienced ophthalmic technician.

Manual caliper measurements were performed by the operating surgeon who adjusted the calipers under the microscope, pre operatively by placing each tip on the limbus (180 and 360) just beyond the clear corneal margins. This was done under topical anesthesia.

Diameters of the Phakic IOL were chosen according to manufacturer's nomograms based on the WTW measurements obtained through calipers and ACD obtained from AL SCAN. All the Phakic IOL's used were designed for posterior chamber implantation.

All the patients underwent pIOL implantation under topical anaesthesia performed by single surgeon.

One week postoperatively, AS OCT has been performed to measure the vault of the Phakic IOL. The central separation between the anterior lens surface and the posterior pIOL surface (vault) was assessed using optical coherence tomography (Zeiss Visante AS-OCT). The separation was measured perpendicular to the lens apex or at the narrowest space between the 2 surfaces. All vault measures were taken

under the same lighting conditions and with cycloplegia to avoid the potential influence of accommodation-induced changes in the position of the anterior surface of the crystalline lens or the pIOL, which could affect the estimation of the amount of vault. In previous studies[5,6]] the eyes were divided into groups based on the vault value. Ideal vault was defined as 250 to 750 mm, excessive vault as more than 750 mm, and insufficient vault as less than 250 mm.

Statistical analysis of data was performed using SPSS software (version 22.0). To determine if there was difference between mean diameters obtained with calipers versus AL scan, independent t-test comparison was used. P-values of less than 0.05 were considered significant. Agreement of techniques was assessed using the interclass correlation coefficient and Bland Altman plot.

RESULTS:

This study included 10 eyes of 5 patients who opted for Phakic IOL refractive surgery. Table 1 shows WTW measurements of both Optical Biometer and manual calipers. The mean WTW using Optical Biometer AL scan was 12.13 ± 0.25 , ranging from 11.7 to 12.5. The mean WTW using callipers was 11.68 ± 0.15 , ranging from 11.5 to 11.9 (table 2). The diameters measured using Optical Biometer AL scan were significantly more than that measured using manual callipers (p value 0.00). Analysis using Pearson coefficient and interclass correlation coefficient (table 2) showed that there was no correlation between WTW measured using the two machines.

Table 1: WTW measured using AL SCAN and manual calipers(in mm)

EYE STUDIED	CALIPERS	OPTICAL BIOMETER
1	11.5	11.9
2	11.5	12.2
3	11.7	12.5
4	11.7	12.4
5	11.5	12.1
6	11.5	12.3
7	11.9	11.8
8	11.9	11.7
9	11.75	12.2
10	11.75	12.2

Table 2:

	Optical biometer	Caliper
Mean + SD	12.13 ± 0.25	11.7 ± 0.15
Correlation	-0.55	
ICC	.107 (p=0.85)	

(SD=standard deviation, Correlation=Pearson correlation coefficient and ICC=Interclass correlation coefficient)

Table 3: Vault size 1 week postoperatively on AS-OCT in μ m

EYE STUDIED	AS-OCT POST OP
1	576
2	612
3	443
4	438
5	482
6	480
7	514
8	505
9	471
10	483

When AS-OCT vault size assessment was performed 1 week postoperatively, the results ranged from 438 to 612 with an average value of 500.4 μ m

DISCUSSION:

In view of increasing popularity of newer generations of phakic IOL's, the need for precise measurement of WTW horizontal corneal

diameter has regrown. One of the most important ways to avoid phakic IOL-induced complications, such as pupillary block and cataract formation, is to achieve the proper distance between the back surface of the IOL and the anterior pole of the crystalline lens [7]. This distance, known as vaulting, is highly dependent on the chosen phakic IOL diameter. Kamiya et al.[8] found patient age and WTW to be the most significant factors affecting vault.

In a study by Tina H Chen and Robert Osher,[9] WTW measurements provided by IOL master were smaller than that by calipers. The current study found WTW using AL SCAN to be 11.7 to 12.5 with a mean of 12.13 ± 0.25 . This was significantly more than WTW measured using manual calipers ranging from 11.5 to 11.9 with a mean of 11.68 ± 0.15 . This could be explained by the different measurement techniques between the two instruments. Moreover, neither instrument is free from defects, preventing exact measurement, as pointed out. Manual placement of calipers depend on the operator and is a highly subjective end point. Also in a study by Dinc et al, authors emphasized the interdevice differences in IOL MASTER [10].

The ideal postoperative vault must create space over the whole anterior crystalline lens surface, with the recommended amount of vault equal to 1.0 to 1.5 central corneal thicknesses on slitlamp examination[11], which corresponds approximately to a value between 400 μ m to 600 μ m[12]. For this to be achieved, the appropriate pIOL must be selected. Underestimating the pIOL diameter is frequently associated with poor vault (250 μ m) immediately after surgery. This increases the risk for cataract development, which is caused by pIOL-crystalline lens contact or by disturbances in aqueous flow, which interferes with lens nutrition and thus results in metabolic disturbances to the crystalline lens. On the other hand, excessive vault (>750 μ m) can cause angle closure, pupillary block glaucoma, or pigmentary dispersion glaucoma and is often associated with an oversized pIOL. In this study when sizing of Phakic IOL's were chosen based on the WTW measurements obtained through calipers and post operatively an AS-OCT vault assessment was done and in all the eyes the vaults were within normal size range. [6,7]

Because of the haptics of the posterior chamber pIOL rest in the sulcus, the ideal overall diameter of the phakic IOL depends on the ciliary sulcus diameter. Thus, it is desirable to obtain a direct measurement of the sulcus-to-sulcus length using newer technologies. Regardless of the accuracy of the WTW measurement, recent studies found no anatomic correlation between external measurement and internal sulcus-to-sulcus diameter. Therefore, WTW distance alone may not predict angle or sulcus size. So most of the manufacturers determine the diameter of pIOL by adding an additional 0.5 mm to 1.00 mm to the WTW measurement depending on the depth of the anterior chamber.

LIMITATION:

Small sample size
Short postoperative follow up

There could be inter operator variability where as it is not seen in automated methods. [2]

CONCLUSION:

The current study has shown that WTW horizontal corneal diameter as measured using OPTICAL BIOMETER and manual calipers is not identical. Optical Biometer AL SCAN (Nidek) overestimates WTW compared to manual calipers.

As the pIOL's chosen were based on WTW measurements obtained using calipers and the vault sizes based on postoperative AS-OCT assessment are within the normal range and not poor (<250 μ m) or excessive (>750 μ m), [7] WTW measurements provided by manual calipers are reliable for choosing the diameter of pIOL. Manufacturer's nomograms still depend on manual WTW measurement using calipers.

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