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Original Research Paper

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Comparison of anterior segment measurements by Sirius Schiempflug Topographer and Tomey Optical Biometer

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ABSTRACT

AIM: The aim of this study was to Compare the anterior segment measurements by Sirius Schiempflug Topographer and Tomey Optical Biometer as precision in ocular biometric measurements have become the need of day.

METHODOLOGY: This Prospective study was conducted in ophthalmology department in eye life hospital. Hundred eyes of 50 patients (25 men and 25 women) with a mean age of 58.06 ± 14.55 years (range, 25 to 76 years) were included in this study. One eye of each subject was randomly chosen (fair coin toss) and measured sequentially, first with the Sirius Schiempflug Topographer and then with OA-2000 Tomey Optical Biometer,along with other complete ophthalmology examination.

RESULTS: In the current study, K1, Axis 1 and Axis 2 showed no statistical significant difference between the measurements of both the instruments. The K2 value obtained by the Tomey device was slightly higher than that produced by the Sirius, but the difference in averages was too small to be clinically relevant. The corneal power measurements (K1, Axis1, K2 and Axis 2) obtained by the Sirius and Tomey optical biometer showed a positive correlation In the present study mean ACD of Sirius and Optical Biometer was 2.88±0.44 (mm) and 3.30±0.37(mm), respectively. both the instruments gave a positive correlation. Parameters, such as K2, ACD, CCT, Pupil size and WTW showed statistically significant differences that may not be clinically significant.

CONCLUSION : Regarding the correlation between devices, all parameters were within acceptable limits and showed excellent correlation, indicating that the devices could be used interchangeably for the parameters assessed

KEYWORDS : Anterior Segment Measurements,sirius Schiempflug,tomey Optical Biometer.

INTRODUCTION

The precision of ocular biometric measurements of the Eye has become increasingly relevant in ophthalmic Practice.Obtaining accurate and repeatable measurements[1,2]. of anterior segment parameters is a mandatory step in achieving the best outcomes in refractive anterior segment surgery.

The corneal power (K) value is entered into any intraocular lens (IOL) formula[3-6] ,while corneal astigmatism measurements are needed when planning toric IOLs implantation.

Accurate ACD measurement plays a critical role in the detection of angle-closure glaucoma (7-9) and in the selection of candidates for phakic intraocular lens (IOL) implantation.[10,11] This measurement is also necessary when calculating the IOL power using certain formulas(12,13) and for the toric IOL cylinder from the IOL to the corneal plane.[14,15]

Corneal thickness measurement allows the evaluation of physiological and pathological variations of the cornea structure [16,17]; it is important to evaluate suitable patients for refractive surgery [18,19]; preoperative pachymetry is mandatory before cross-linking treatment of progressive keratoconus [20]; and individual's central corneal thickness (CCT) provides valuable information about their glaucoma risk [21,22]). Furthermore, as contact lens wear could affect corneal thickness, corneal pachymetry is an important factor in contact lens (CL) practice [23-26].

The white to white (WTW) distance can be used to estimate phakic intraocular lens (IOL) size[27].

The Scheimpflug principle allows documentation of an object that is not parallel to the lens and image planes of a camera, such as the anterior eye segment imaged by slitlamp photography, with the maximally possible depth of focus and minimal image distortion. In the human eye, Scheimpflug cameras provide focused images from the anterior corneal surface to the posterior lens surface.[28]

The Scheimpflug principle was introduced in ophthalmology in the 1960s,[29].

This device measures a range of anterior segment parameters, such as central corneal thickness (CCT), anterior chamber depth (ACD), lens thickness, Keratometry (K), and white-to-white (WTW) corneal diameter. [30-37]

The OA-2000 (Tomey, Nagoya, Japan) is the newest instrument used for optical biometry. It measures ocular biometry by using the principle of low coherence reflectometry (OLCR).

Many studies have reported clinically acceptable repeatability of the automatic measurements obtained with the instrument for most parameters.

To our knowledge, this is the first prospectively designed comparative study of anterior segment parameters using both devices in healthy individuals.

MATERIALS AND METHODOLOGY

This Prospective study was conducted at eye life hospital. Hundred eyes of 50 patients (25 men and 25 women) with a mean age of 58.06 ± 14.55 years (range, 25 to 76 years) were included in this study.
Patients without any history of refractive surgery, with/without cataract, Healthy individuals aged more than 18 years were included.

Patients with corneal pathology or corneal scarring, active inflammation, previous ocular surgery, and concomitant ocular or systemic medication likely to induce changes in anterior segment parameters, Contact lens wearer, high intraocular pressure (higher than 21 mm Hg) Any ocular pathology, Pediatric age group, Prior history of trauma, Congenital anomalies or known case of

psychological disorder and subjects who were not willing to undergo the required test for the study.

All subjects gave informed consent after receiving a full explanation of the nature and intent of the study.All subjects received a full ophthalmologic examination that included visual acuity testing with refraction, slitlamp microscopy, noncontact tonometry, anterior segment parameter measurements using Sirius Schiempflug Topographer (CostruzioneStrumentiOftalmici) and OA-2000 Tomey Optical Biometer and dilated fundus evaluation
One eye of each subject was randomly chosen (fair coin toss) and measured sequentially, first with the Sirius Schiempflug Topographer and then with OA-2000 Tomey Optical Biometer.

Measurements with the Sirius Schiempflug Topographer (CostruzioneStrumentiOftalmici) and OA-2000 Tomey Optical Biometer were performed according to the manufacturer's guidelines. The device was brought into focus, and the patient's undilated eye was aligned along the visual axis by a central fixation light. All measurements were performed, according to the manufacturer guidelines.

Three repeated measurements were taken consecutively and averaged by the same experienced examiner.All measurements were performed in the afternoon between 12 pm and 6 pm. [38]

The following parameters were evaluated in this study

- K1 (Flattest Keratometry)
- Axis 1(Flattest Meridian Axis)
- K2 (Steepest Keratometry)
- Axis 2 (Steepest Meridian Axis)
- ACD (Anterior Chamber Depth)
- CCT (Central Corneal thickness)
- Anterior chamber depth
- White to white

STATISTICAL ANALYSIS

- The Statistical analysis was performed using Microsoft office Excel 2007 and GraphpadInstat Demo 2016. Normality of the data distribution was evaluated using the Kolmogorov-Smirnov test. Wilcoxon matched-pairs signed-ranks test (Non-parametric test) was used to explore statistical differences between mean K1, Axis1, K2, Axis2, ACD, CCT and Pupil size measurements obtained with both instruments. Paired t-test (Parametric test) was used to explore statistical differences between mean WTW measurements obtained with both instruments. A P value less than 0.001 was considered statistically significant.
- In this study, Spearman Correlation Coefficient (r) evaluated relation between Sirius Schiempflug Topographer (CostruzioneStrumentiOftalmici) and OA-2000 Tomey Optical Biometer measures i.e, K1, Axis1, K2, Axis2, ACD, CCT and Pupil size whereas, Pearson's correlation coefficient (r) evaluated relation between Sirius Schiempflug Topographer (CostruzioneStrumentiOftalmici) and OA-2000 Tomey Optical Biometer measures i.e, WTW.

- Bland and Altman plot evaluated r2, the coefficient of determination (gives regression line of goodness of fit) between Sirius Schiempflug Topographer (CostruzioneStrumentiOftalmici) and Tomey Optical Biometer OA-2000 measures i.e, K1, Axis1, K2, Axis2, ACD, CCT, Pupil size and WTW.

RESULTS

Fifty healthy individuals (25 men, 25 women) aged 25 to 76 years (mean: 58.06±14.55 years) were prospectively recruited. The mean spherical equivalent refraction was -0.1475±1.65 diopters (D) (range -4.75 to +4.25 D). The mean best corrected visual acuity for distance and near was 0.062±0.09 (Log MAR) and 0.7575±0.04 (M units), respectively

Table 1. Mean measured values of Sirius Schiempflug Topographer and Tomey Optical Biometer OA-2000

Measure valus	Sirius	Tomey	Mean difference	SEM	P Value
K1 Range	43.80±2.01 (45.81,41.9)	44.00±1.86 (45.86,42.4)	0.20	0.21	0.2179 (p>0.0)
Axis 1 Range	84.76±51.91 (136.67,32.85)	90.63±56.59 (147.22,34.04)	5.87	5.05	0.6983 (p>0.05)
K2 Range	44.58±1.98 (46.56,42.6)	44.91±1.75 (46.66,43.16)	0.33	0.08	< 0.001
Axis 2 Range	90.20±55.26 (145.46,34.94)	92.43±53.18 (145.61,39.25)	-2.23	5.29	0.7977 (p>0.05)
ACD Range	2.88±0.44 (3.32, 2.44)	3.30±0.37 (3.67, 2.93)	-0.42	0.03	< 0.001
CCT Range	539.05±44.43 (583.48,494.62)	518.57±35.42 (553.99,483.15)	20.48	2.78	< 0.001
Pupil Size Range	4.43±2.33 (6.66, 2.1)	5.48±1.89 (7.37, 3.59)	-1.06	0.18	< 0.001
WTW Range	11.44±0.44 (11.88, 11)	11.91±0.42 (12.3311.4)	0.46	0.03	< 0.001

Table 2. Correlation Coefficient (r) of the measured values of Sirius Schiempflug Topographer and Tomey Optical Biometer OA-2000

Measured Values	Correlation Coefficient (r)	P value
K1	0.4096	<0.001
Axis 1	0.5712	<0.001
K2	0.9724	<0.001
Axis 2	0.5148	<0.001
ACD	0.7715	<0.001
CCT	0.8584	<0.001
Pupil Size	0.6491	<0.001
WTW	0.6763	<0.001

DISCUSSION

In the current study, K1, Axis 1 and Axis 2 showed no statistical significant difference between the measurements of both the instruments. The K2 value obtained by the Tomey device was slightly higher than that produced by the Sirius, but the difference in averages was too small to be clinically relevant. The corneal power measurements (K1, Axis1, K2 and Axis 2) obtained by the Sirius and Tomey optical biometer showed a positive correlation. Such good correlation suggests that their measurements could be used interchangeably. In a similar study, Shirayama et al.[39] compared the corneal powers obtained using four different instruments in 20 healthy volunteers and his findings implied that the technique combining a Scheimpflug camera and a Placido disk could obtain valid and accurate corneal power in clinical application.

In the present study mean ACD of Sirius and Optical Biometer was 2.88±0.44 (mm) and 3.30±0.37(mm), respectively. both the instruments gave a positive correlation. Comparatively, similar values of anterior chamber depth were previously obtained by Pentacam, optical coherence tomography (OCT), Sirius and ultrasound biomicroscopy with averages of 2.87±0.4 mm, 2.97±0.31 mm, 2.97±0.29 and 2.90±0.32 mm, respectively.(40,41,42) .

Recently similar study, Cornelius K. Nasser et al. [42] Compared the

measurements of CCT and ACD with Sirius imaging system (CostruzioniStrumentiOftalmici) and Pentacam HR imaging system (Oculus Optikgeräte GmbH) in Forty-five healthy individuals (21 men, 24 women) aged 20 to 61 years (mean: 40.23±10.49 years). The measurements are comparable with the present study.

Central corneal thickness measurements in our study group were also close to previous reported data obtained by Orbscan II [43] with a mean of 537±37 µm in right eyes and also by Pentacam[44] with a mean of 535±33 µm. These data provide important evidence that the measured values in our study reflect the normal distribution of these parameters in healthy eyes.

Pupil Size measurements was also comparable with both the instruments.

Although recent studies have shown that the WTW cannot accurately predict the real sulcus-to-sulcus distance [45], it remains an important biometric parameter for phakic IOL diameter calculation [46]. Because patients are not comfortable due to direct contact measurements by ultrasound biomicroscopy[47], most surgeons rely on noncontact devices.Baumeister et al. [48] compared manual and automated methods to measure the WTW and found that automated devices provide more precise and reliable results.In our study, WTW measurements obtained by the two devices showed a positive correlation suggesting that their measurements could be used interchangeably.

From a practical point of view, when the Sirius is used to calculate IOLs, the use of other devices to obtain the axial length is also required. As such, having the ability to measure the axial length would expand the clinical application of the Sirius and also in future we would be able to compare the Axial Length (AL) measurements between both the instruments. Studies have shown that the Scheimpflug photography feature provided precise and valid measurements for IOL calculation[49].

In this study the measurements were acquired from healthy subjects with normal corneas and unoperated eyes. This population was chosen because the aim of this study was to evaluate and compare anterior ocular segment measurements using Sirius Scheimpflug topographer and the Tomey optical biometry device in normal subjects with good vision and fixation; therefore, the comparison data obtained between the two anterior segment imaging systems cannot be simply applied to eyes with pathological changes, keratoconic, or postoperatively altered corneas. This issue requires further investigation.

CONCLUSION

- This study found that both instruments, devoted to measuring the same parameters, produced little different results for some parameters. Parameters, such as K2, ACD, CCT, Pupil size and WTW showed statistically significant differences that may not be clinically significant. The parameters that did not show a statistically significant difference was K1, Axis 1 and Axis 2.
- Regarding the correlation between devices, all parameters were within acceptable limits and showed excellent correlation, indicating that the devices could be used interchangeably for the parameters assessed.
- The availability and simplicity of use, the ability to obtain the measurements accurately, and the non invasiveness make these instruments potentially useful for ophthalmological practice.

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