COMPARISON OF CENTRAL CORNEAL THICKNESS MEASUREMENTS WITH THE GALILEI DUAL SCHEIMPFLUG ANALYZER AND ULTRASOUND PACHYMETRY

Muhammad Tauseef Dildar, Muhammad Amer Yaqub*, Shahzad Ali, Muhammad Kamran Saeed, Muhammad Asad Farooq*

Combined Military Hospital Quetta/National University of Medical Sciences (NUMS) Pakistan, *Armed Forces Institute of Ophthalmology/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To determine the correlation between mean central corneal thickness taken with Galilei dual Scheimpflug Analyzer and Applanation Ultrasound Pachymetry.
Study Design: Descriptive cross sectional study.
Place and Duration of Study: Armed Forces Institute of Ophthalmology Rawalpindi, from Jul 2013 to Jan 2014.
Material and Methods: Central corneal thickness was measured in 100 eyes of 50 patients. First three readings were taken with Galilei dual Scheimpflug analyzer, with a gap of 1 minute. Then three readings were taken with ultrasound pachymetry after applying topical 0.5% proparacaine (Alcain). The mean of the three readings was used for the analysis.
Results: For right eye the mean central corneal thickness measured by the Galilei dual Scheimpflug analyzer and Ultrasound pachymetry was 544.06µm ± 27.36 and 546.88µm ± 27.71 respectively, and for left eye it was 544.72µm ± 25.47 and 546.52µm ± 26.15 respectively. There was a strong and positive correlation between the two instruments (r=0.969, *p*=0.000 for right eye and r=0.956, *p*=0.000 for left eye).
Conclusions: The pachymetry readings with GSA showed strong and positive correlation with those of US pachymetry. So GSA may be considered as an alternative to US Pachymetry, thus avoiding operator-dependent errors, patient discomfort and other disadvantages.

Keywords: Applanation ultrasound pachymetry, Central corneal thickness, Galilei dual scheimpflug analyzer.

INTRODUCTION

Central corneal thickness (CCT) measurement plays a major role in diagnostic and therapeutic approaches to corneal pathology, for example, in measuring intra ocular pressure (IOP) and in a very commonly performed laser assisted in situ keratomileusis (LASIK)[1].

Applanation ultrasound (US) pachymetry is currently the gold standard[2] method for the measurement of CCT. It is a dry, contact, simple and portable system[3]. However, placement of probe on the corneal center is subjective, thus operator-dependent errors due to off-center placement and indentation are a possibility. In addition, disadvantages like patient discomfort, epithelial damage and risk of infection exist[4]. Recently, other sophisticated and non-contact pachymetry instruments like Galilei dual Scheimpflug analyzer (GSA) have been developed and are gaining popularity. Karimian et al[5] showed no significant difference in CCT measurements by GSA (mean CCT 555.8 ± 29.6µm) and US pachymetry (mean CCT 544.4 ± 33.4µm). Yeter et al[6] showed a high correlation (r=0.86; *p*<0.001) between the measurements obtained with both devices.

The new GSA has no risk of infections and operator dependent errors, and gives additional information of corneal topography and anterior eye segment. Aim of the study is to explore the correlation between the new GSA and previously used US pachymetry in Pakistani (Asian) eyes so that it could be recommended in corneal clinics.

PATIENTS AND METHODS

This descriptive cross sectional study was carried out in Armed Forces Institute of

Correspondence: Dr Muhammad Tauseef Dildar, Eye Dept Combined Military Hospital Quetta Pakistan
Email tmtauseef@gmail.com)
Received: 26 Apr 2016; revised received: 07 Nov 2016; accepted: 09 Nov 2016

Ophthalmology (AFIO) Rawalpindi, after approval from hospital ethical committee from Jul 2013 to Jan 2014, in which 100 eyes of 50 patients were studied. Sample size was calculated using WHO calculator for correlation, keeping confidence interval 95%, level of significance 5% and r=0.86. Patients between 20 to 40 years of age irrespective of gender, with normal cornea (not having corneal pathology) presenting in AFIO outpatient department (OPD), were selected through non-probability consecutive sampling, and further placed in to four age groups (21-25 years, 26-30 years, 31-35 years and 36-40 years). The cases were informed in detail about the study, including the possible side effects associated with the procedure. Detailed ophthalmic history was taken and comprehensive ophthalmic examination was done. Patients with apparent corneal pathology on examination, contact lens wearers, high ametropia of more than -6 or +6 diopters (D), and history of corneal pathology or previous eye surgery were excluded from the study.

This was followed by CCT measurement with the two instruments. CCT was first taken on the GSA (Galilei™ G4 dual Scheimpflug analyzer; Ziemer, Switzerland) by an experienced ophthalmologist as per manufacturer's instructions. Three readings were taken for each eye, with a gap of 1 minute after each reading and the alignment was freshly done each time. The mean of the three readings was used for the analysis. After this cornea was anesthetized with topical 0.5% proparacaine (Alcain) and three readings of the central cornea in primary gaze were taken with US pachymeter (Reichert IOPac Advanced Pachymeter; angled probe) by the same ophthalmologist. The ultrasound pachymeter was calibrated at the beginning of each day according to the manufacturer's instructions. The mean of the three readings was used for the analysis. The same pachymeter was used every time for all the cases. The ultrasound probe was sterilized with spirit swab after measurements were taken from each subject. All readings were taken in a very calm and comfortable environment. To avoid the bias of multiple observers, the measurements were made by the same ophthalmologist. To nullify the effect of diurnal variation, the measurements were made between 9am to 12pm. To avoid the effect of corneal hydration, the measurements were taken under similar conditions for all the patients.

All the data was collected by the researcher and findings were recorded in a specially prepared proforma and analyzed in the statistical package for social science (SPSS) version 14.0. Mean and SD were calculated for quantitative variables. Categorical variables were presented by frequency and percentages. Pearson correlation (+1/-1) was calculated between mean CCT measurements taken with GSA and US pachymeter. Level of significance was taken as $p \leq 0.05$.

Table-I: Central corneal thickness measurements of both eyes.

	CCT of Right Eye		CCT of Left Eye	
	GSA (in μm)	US pachymetry (in μm)	GSA (in μm)	US pachymetry (in μm)
Number of eyes	50	50	50	50
Mean	544.06	546.88	544.72	546.52
Standard Deviation	27.36	27.71	25.47	26.15

Table-II: Differences in mean central corneal thickness and Pearson's correlations for both eyes.

	Right Eye	Left Eye
Difference in mean CCT (in μm)	2.82	1.80
Pearson's Correlation	0.969*	0.956*
Significance (2-tailed)	<0.001	<0.001

*Correlation is significant at the 0.01 level (2-tailed).

RESULTS

One hundred eyes of fifty patients were studied. The age of the patients was between 20 and 40 years. Most of the patients (44%) were between 26 and 30 years of age. Twenty eight patients (56%) were males while 22 (44%) were females. For the right eye the mean CCT measured by the GSA was 544.06µm ± 27.36 standard deviation (SD) and by US pachymetry was 546.88 µm ± 27.71 SD (table-I). Difference in mean CCT measured by both the techniques was 2.82µm for the right eye (table-II).

For the left eye the mean CCT measured by the GSA was 544.72 µm ± 25.47 and by US pachymetry was 546.52µm ± 26.15 (table-I). Difference in mean CCT measured by both the techniques was 1.80µm for the left eye (table-II).

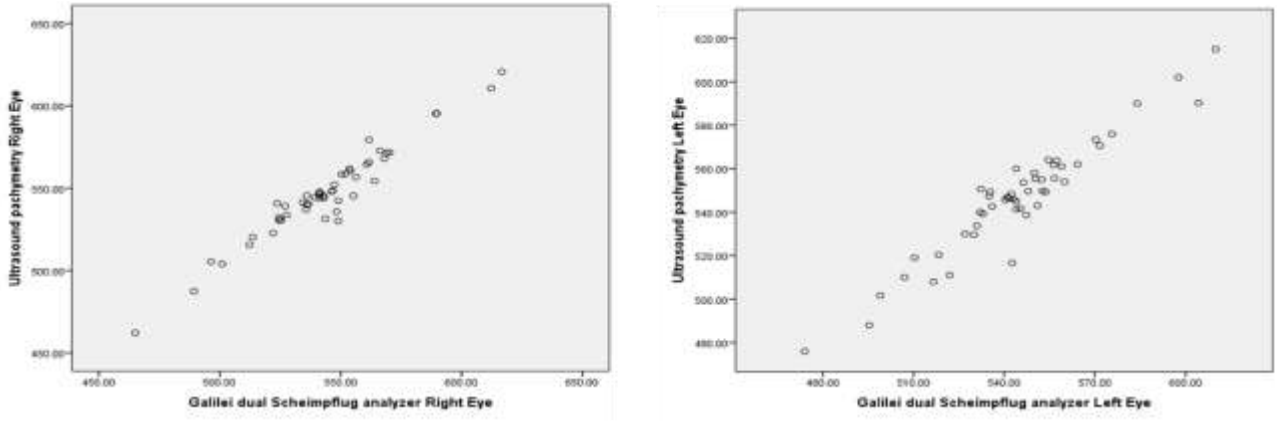

Figure: Scatterplots for both eyes.

In this study, Pearson's r is 0.969 for right eye and 0.956 for left eye, and both Pearson's r values for right and left eyes are positive (table-II). This number is very close to 1, thus showing that there is a strong positive relationship between CCT measured by GSA and US pachymetry. Moreover significance level or *p*-value is 0.000 (table-II), which is well below the 0.05 cut-off value. In our scatterplot (figure), the dots seem to go together to form a straight line that slopes upward from zero, this means that the GSA and US pachymetry have a positive and strong relationship

DISCUSSION

Normal CCT is about 540µm[7]. Comparison of CCT with the GSA and US pachymetry has also been carried out in some studies. Ladi and Shah showed that the mean CCT measured by US pachymeter was 541.83 ± 30.56µm SD and that measured by GSA was 541.27 ± 30.07µm SD. Mean difference between the two methods was 0.55µm. The correlation coefficient was 0.978[4]. These results are comparable to our measurements by the two instruments. Yeter et al conducted a prospective study in 161 myopic eyes of 81 refractive surgery candidates. The mean CCTs obtained by GSA and US Pachymeter were 559.85 ± 30.87 and 560.41 ± 34.45µm respectively, with a high correlation (r=0.86; *p*>001) between the measurements obtained with both devices[6]. They concluded that because of high agreement between these devices, the GSA being a non-contact method may be an alternative to US pachymeter for measurement of CCT. These results are also in accordance with our study. Karimian et al presented an evaluation of corneal pachymetry by Galilei, Orbscan-II and ultrasonic pachymetry, in 184 eyes of 92 healthy subjects. The mean difference of readings measured by US pachymetry with Galilei was 2.3 µm and the correlation coefficient was 0.947[5]. These results are similar to our study and thus further strengthen our study.

To the best of our knowledge, this is the first study using the Galilei dual Scheimpflug analyzer in normal Pakistani Asian eyes. To find out which method ultimately gives us the true CCT in eyes with corneal pathologies a similar study may be required in patients with corneal pathologies.

Limitations of the Study

The study revealed some instrument-dependent limitations. Galilei measurements often had to be repeated because of an incorrect result caused by fixation loss, blinking, or incorrect head position. Moreover, this study was conducted in patients with normal corneas. Therefore, it may not be possible to generalize these findings to patients with corneal pathologies such as keratoconus. To better evaluate the accuracy of the Galilei system, a similar study should be conducted in patients with corneal pathologies.

CONCLUSION

The pachymetry readings with GSA showed strong and positive correlation with those of US pachymetry. So GSA may be considered as an alternative to US Pachymetry, thus avoiding operator-dependent errors, patient discomfort and other disadvantages.

Disclosure

This article is a CPCP approved dissertation based original article.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

REFERENCES

1. Kanski Jack J, Bowling B. Clinical ophthalmology, A systemic approach. 7th ed. Elsevier Saunders; 2011. Chapter 7, Corneal and Refractive Surgery 247-9.
2. Beutelspacher SC, Serbecic N, Scheuerle AF. Assessment of central corneal thickness using OCT, ultrasound, optical low coherence reflectometry and Scheimpflug pachymetry. Eur J Ophthalmol 2011; 21: 132-7.
3. Michael R. Feilmeier. Corneal Pachymetry: Modalities and Instruments, Internet 2009 25 cited 2013. Available at: http://www.ophthalmologyweb.com/Tech-Spotlights/26478 Corneal Pachymetry Modalities and Instruments.
4. Ladi JS, Shah NA. Comparison of central corneal thickness measurements with the Galilei dual Scheimpflug analyzer and Applanation Ultrasound pachymetry. Indian J Ophthalmol 2010; 58: 385-8.
5. Karimian F, Feizi S, Faramarzi A, Doozandeh A, Yaseri M. Evaluation of corneal pachymetry measurements by Galilei dual Scheimpflugcamera. Eur J Ophthalmol 2012; 22 Suppl 7: S33-9.
6. Yeter V, Sönmez B, Beden U. Comparison of central corneal thickness measurements by Galilei Dual-Scheimpflug analyzer and ultrasound pachymeter in myopic eyes. Ophthalmic Surg Lasers Imaging 2012; 43: 128-34.
7. Prasad A, Fry K, Hersh PS. Relationship of age and refraction to central corneal thickness. Cornea 2011; 30: 553-5.