Correlation between Ultrasonic Pachymetry and the Scheimpflug Based Pentacam for Assessment of Central Corneal Thickness in Myopic Patients

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Abstract: Purpose: to assess the correlation between central corneal thickness measurements using ultrasonic pachymetry and Scheimpflug based pentacam analyzer in myopic patients. **Materials and Methods:** Forty four myopic patients (88 eyes) were subjected to ultrasonic corneal pachymetry and Scheimpflug based pentacam (Pentacam; Oculus, Wetzlar, Germany) Allegro Oculyzer corneal thickness measurements.. All the measurements were taken by a single operator. Agreement between both instruments was assessed in addition to the interoperator variability. **Results:** The mean of the average central corneal thickness (CCT) measured with pentacam Allegro Oculyzer was 562.72±21.54 µm standard deviation (SD) and US pachymetry was 566.74 ± 21.41µm standard deviation (SD). The correlation coefficient (*r*) between measurements using both instruments was 0.975. There was tendency towards higher measurements with pentacam with a statistically significant difference between both methods ($P < 0.0001$). For the Pentacam the correlation coefficient (*r*) between both observers was 0.975, but there was no statistically significant difference between both observers' measurements. For the US pachymetry measurements the correlation coefficient (*r*) between both observers' was 0.965, but there was no statistically significant difference between both observers' measurements. **Conclusion: C**entral corneal thickness measurements obtained with either the noncontact pentacam or the contact ultrasonic pachymeter are close to each other with tendency of obtaining higher readings with pentacam. Measurements of the CCT with either pentacam or US pachymetry were convenient, with excellent interoperator agreement.

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1. Introduction

Central corneal thickness (CCT) measurements are gaining a significant importance in ophthalmic practice nowaday. Hence its accuracy plays an important role in corneal refractive surgery, especially laser assisted *in situ* keratomileusis (LASIK) which is the most commonly performed corneal procedure currently, CCT allows determination of the amount of stromal ablation which can be safely carried out minimizing the risk of iatrogenic keratectasia.[1] Not only that, but also CCT is also used in glaucoma practice to modify the intraocular pressure reading for accuracy.[2]

Contact Ultrasounic (US) pachymetry is currently one of the most routinely used method for the measurement of CCT with good degree of precision, however, this method seems to have variably high degree of intraoperator and interoperator reproducibility.[3] This variability in measurements might be attributed to the fact that placement of the probe on the corneal center is subjective and operator-dependent errors due to off-center placement with consequent thicker CCT measurements or indentation leading to slightly thinner readings[4,5,6]. Furthermore, in addition to these errors, the risk of epithelial damage and cross-infection exist. That is why there is a growing interest of using the non contact methods especially the Pentacam.[7] High repeatability and reproducibility of measurements with US pachymetry had been verified earlier.[3,8]

Pentacam is a Scheimpflug based system for imaging the cornea and anterior segment of the eye. It is a noncontact instrument which provides quantitative data about anterior and posterior corneal topography, complete corneal pachymetric measurements, lens densitometry and two-dimensional and three-dimensional anterior segment imaging as well.[7,9,10]

The purpose of the current study was to assess the correlation between central corneal thickness measurements using ultrasonic pachymetry and Scheimpflug based pentacam analyzer in myopic patients.

2. Patients and Methods

Forty four patients (88 eyes) were prospectively recruited from those patients presented to the refractive unit in Nile Eye Center. Patients with history of previous eye surgeries or contact lens wearers or ocular disease (other than refractive error) were not included in the current study. All patients were subjected to complete ophthalmic examination including uncorrected visual acuity, and best corrected vision, refraction, detailed slit lamp

examination, and measurement of intraocular pressure and dilated fundus examination. Then the patients were subjected to CCT measurement with two methods, ultrasonic corneal pachymetry and Pentacam Allegro Oculyzer corneal thickness measurements. All the readings on the Pentacam and US pachymeter were taken by two separate well trained technicians.

Patients were assessed twice at the beginning using the Pentacam Allegro Oculyzer (Wavelight, AG, Germany). A gap of 2-5 minutes was given after each reading and the alignment was freshly done each time. This was followed by topical corneal anaesthesia with 0.5% proparacaine and contact US pachymetry (Sonomed, Inc, USA) measurements where two readings were taken with US pachymetry. US pachymetry readings were obtained by aligning the probe on the central cornea as perpendicularly as possible.

A standard technique for Pentacam measurements was followed as per the manufacturers' instructions. The patient was comfortably seated with chin fully placed on the chin rest and forehead against the strap. The patient is allowed to fixate at a target (circle) at the middle of a blue rectangle and was allowed to blink. The operator open the examination program and align a red cross to the center of the pupil in the upper right part of the screen to adjust the horizontal and vertical axis. Then to adjust for the Z axis a red point is allowed to coincide with the red line in the lower bottom part of the examination screen. The patient was asked to blink once, open the eye wide and reading was taken.

Study of variability of measurements between both observers and the level of agreement:

All the data were tested for normality before analysis. In order to assess the pairwise statistical difference between the averages of two operators, and the two instruments as well, the paired *t*-test was adopted. The level of agreement was assessed using the correlation coefficient. For comparison and correlations between both instruments the mean of the two measurements was calculated and used for correlation. The statistical agreement between the two methods was assessed using interclass correlation coefficient. A *P* value of less than 0.05 was considered as statistically significant. All the data were analyzed using the SPSS computer program for Windows (Version 16.0, SPSS, Inc., Chicago, Illinois).

3. Results:

Table-1 summarizes the patients' measurements. In this study 88 eyes of 44 patients whose mean age was 29.66 (5.41 Standard Deviation) were included in the study.

The mean of the average central corneal thickness (CCT) measured with pentacam Allegro Oculyzer was 566.4 ± 21.41 µm standard deviation (SD),and US pachymetry was 562.72±21.54µm standard deviation (SD). The correlation coefficient (*r*) between measurements using both instruments was 0.975 as shown in figure-1. However, there was tendency towards higher CCT measurements with pentacam with a statistically significant difference between both methods (*P*<0.0001). For the Pentacam CCT readings, the correlation coefficient (*r*) between both observers was 0.975 as shown in figure-2, but there was no statistically significant difference between both observers' measurements. For the US pachymetry measurements the correlation coefficient (*r*) between both observers' was 0.965 as shown in figure-3, but there was no statistically significant difference between both observers' measurements.

Also, there was a significant negative correlation between the patients' refraction and both mean CCT measurements with both pentacam in figure-4 (*r=-0.497*), U/S Pachymetry in figure-5 (*r=-0.459*).

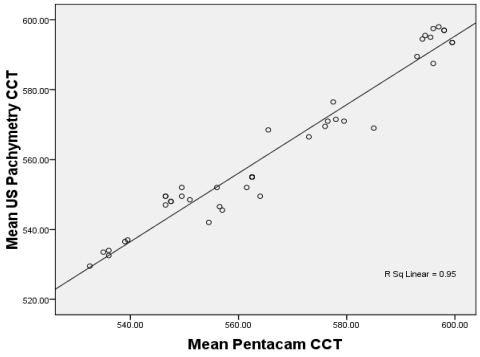

Figure-1: Correlation between the average Pentacam central corneal thickness (CCT) readings and US Pachymetry readings.

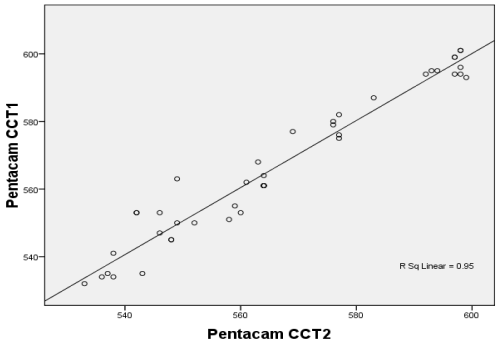

Figure-2: Correlation between the 2 operators' pentacam central corneal thickness (CCT) readings

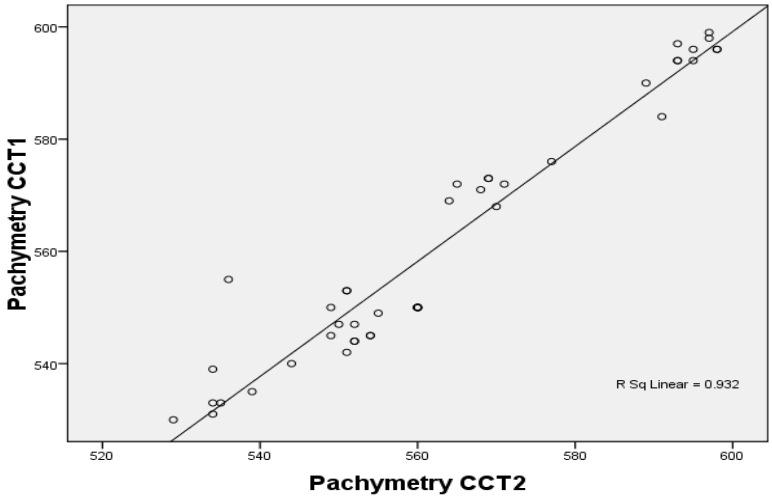

Figure-3: Correlation between the 2 operators' US pacymetry central corneal thickness (CCT) readings

Table 1: Summary of the patients' data and pentacam andUS pachymetry measurements. Penta= Pentacam, Pachy=US Pachymetry

	PreopVA	PostopVA	Refraction	Pachy1	Pachy2	Penta1	Penta2	Pachy Avg.	Penta Avg.
No.	44	44	44	44	44	44	44	44	44
Mean		0.82	-6.52	561.86	563.57	566.93	566.55	562.72	566.74
Std. Deviation		0.20	2.85	22.37	21.09	21.73	21.36	21.54	21.41
Minimum	0.10	0.5	-12.25	530	529	532	533	529.5	532.5
Maximum	0.33	1.0	-2.5	599	598	601	599	598	599.5

4. Discussion:

In this study that included 88 eyes, where the Central corneal thickness (CCT) was assessed. The mean of the average central corneal thickness (CCT) measured with pentacam Allegro Oculyzer was 566.4 ± 21.41 µm standard deviation (SD),and US pachymetry was 562.72±21.54µm standard deviation (SD). It shows a high correlation between Pentacam and US pachymetry measurements with tendency of Pentacam to produce a higher CCT values as compared to US pachymetry readings. This finding is in agreement with two other earlier studies,[11,12] however the amount of overestimation seems to be of little clinical importance (around 4 µm). Our study results showed that the mean CCT in myopic patients was 566.4 ± 21.41 µm, which was different from that in Al-Mezaine, *et al.,*[11] where the CCT was 552.4 ± 37.0 µm in healthy subjects. Actually we do not have an exact explanation for that difference between our study results and Al-Mezaine, *et al.,*except that this variation could be attributed to study population characteristics. Also, in our study the amount of overestimation was around 4 µm as compared to 8.2 µm in Al-Mezaine, *et al.,*[11] Our study results showed a significant negative correlation between the CCT (both instruments) and the degree of myopia which is not in agreement with the study of Al-Mezaine, *et al.,* which showed no significant correlation.[13]

For the Pentacam CCT readings, the correlation coefficient (*r*) between both observers was 0.975 as shown in figure-2, but there was no statistically significant difference between both observers' readings. This was in agreement with the study of Bedei, A., et al and Huang, *et al.,* about repeatability of measurements[14,15].

For the US pachymetry readings, the correlation coefficient (*r*) between both observers was 0.965 as shown in figure-3, but there was no statistically significant difference between both observers' readings. This was in agreement with the high repeatability and reproducibility of measurements with US pachymetry that had been verified earlier by Miglior *et al.,* and Gunvant *et al.,* and others.[3,8,9]

With respect to a difference of 4 µm could exist between both Pentacam and US pachymetry, both of them could be used interchangeably in myopic

patients and that amount of overestimation of CCT with pectacam could be taken into account.

Conclusion:

Central corneal thickness measurements obtained with either the noncontact pentacam or the contact ultrasonic pachymeter are close to each other with tendency of obtaining higher readings with Pentacam. Measurements of the CCT with either pentacam or US pachymetry were convenient, with excellent interoperator agreement, both of them could be used interchangeably in myopic patients.

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