Comparison of Central Corneal Thickness (CCT) Measurement Using Ultrasound Pachymeter and Pentacam in Patient with Refractory Errors Referred to the Mehr Ophthalmology Clinic Center in the Tabriz in 2012

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Abstract: Measurement of corneal thickness is an important and necessary factor that plays an important role in diagnostic testing and treatment. Ultrasonic pachymetry which is currently the clinical gold standard method. Pentacam is a new imaging system for anterior eye segment study. The aim of this study was to compare central corneal thickness with ultrasound and pentacam method in patients with refractive errors. In a prospective study that performed in Ophthalmology Department of International Branch, Shiraz University on patients with refractive error, central corneal thickness measurement using ultrasound parchymeter and pentacam in patient with refractive errors referred to the Mehr Ophthalmology Clinic Center in the Tabriz in 2012 evaluated. In this study, researchers evaluated Central Corneal Thickness (CCT) of 105 eyes (only right eye) of 105 patients with myopic astigmatism. About 45 of patients were male and 60 of them were female. Mean age of male patients was 29.53 ± 7.88 and in female patients was 28.80 ± 7.05 year (p = 0.617). Mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was 511.73 ± 36.48 micrometer and mean of Central Corneal Thickness (CCT) measured by pentacam 521.11 ± 35.24 micrometer. Mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was significantly lower than mean of Central Corneal Thickness (CCT) measured by pentacam (p<0.001). Mean difference of 2 studied methods in measurement of Central Corneal Thickness (CCT) was 9.38 ± 6.42 micrometer so that in overall of patients, pentacam measured the Central Corneal Thickness (CCT) 9-10 micron greater than ultrasonic pachymetry. Significant direct liner correlation was found between Central Corneal Thickness (CCT) measured by ultrasonic pachymetry with Central Corneal Thickness (CCT) measured by pentacam (p<0.001).

Key words: Central corneal thickness, ultrasonic pachymetry, pentacam, Mehr, micrometer

INTRODUCTION

Measurement of corneal thickness is an important and necessary factor that plays an important role in diagnostic testing and treatment. Pachymetry or the measurement of the corneal thickness is an integral part of a thorough ophthalmic examination. In refractive surgery, knowledge of the corneal thickness is necessary for choosing the best treatment option and avoiding complications such as corneal ectasia (Hashemi and Mehravaran, 2007). The corneal thickness is also known to affect measurements of the Intraocular Pressure (IOP) and thus, the Central Corneal Thickness (CCT) is taken into consideration in decision-making for glaucoma patients (Phillips et al., 2003; Brandt et al., 2004). Various methods used for of measuring corneal thickness that included ultrasound pachymeter, optical coherence tomography, single schiompflug camera (pentacam) and Dual scheimpflug camera (Galilei) (Al-Mezaine et al., 2008; Hashemi et al., 2011).

Ultrasonic pachymetry is gold standard method for measuring corneal thickness. Although, this method is the gold standard but has some limitations and complications, including eye infection due to direct eye probing, the use of anesthesia before the procedure, perform these operations directly related to the skill of the technician and the thickness of the device can be measured the corneal thickness at one point in time (Huang et al., 2011).

Pentacam an optical scanner which no eye contact and had schemflug camera that looked to eye from 25 different angles and give a 3D scan of the anterior

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segment of the eye (anterior and posterior surface of cornea, anterior chamber, the iris and lens). This method is very fast and need only for 2 sec to analyzing of each eye (Hashemi *et al.*, 2011; Huang *et al.*, 2011).

The pentacam is an anterior segment analysis system which generates 2 and 3 dimensional maps and images of the anterior segment, topography maps of the anterior and posterior corneal surfaces and full corneal thickness maps. Previous studies have demonstrated good agreement of the pentacam with other pachymetry devices, especially the ultrasound and its high repeatability as well as inter-observer reproducibility (Hashemi *et al.*, 20007; Miranda *et al.*, 2009; Kim *et al.*, 2007; Lackner *et al.*, 2005). The aim of this study was to compare central corneal thickness with ultrasound and pentacam method in patients with myopic astigmatism.

MATERIALS AND METHODS

In a prospective study that performed in Ophthalmology Department of International Branch, Shiraz University on patients with myopic astigmatism, central corneal thickness measurement using ultrasound parchymeter and Pentacam in patient with myopic astigmatism referred to the Mehr Ophthalmology Clinic Center in the Tabriz in 2012 evaluated.

In this study, 105 patients that referred to the Mehr Ophthalmology Clinic Center in the Tabriz in 2012s with myopic astigmatism selected and enrolled in to the study and central corneal thickness measurement using ultrasound parchymeter and Pentacam.

The results of Central Corneal Thickness (CCT) was compared and evaluated in all patients. The Pentacam device made by Oculus of Germany and US Device made by NIDK of Japan.

The data were analyzed with the SPSS statistical package (version16; SPSS, Inc, Chicago, IL). Analysis was conducted by paired-samples t-test, independent-samples t-test and pearson correlation. $p<0.05$ was considered significant.

RESULTS

In this study researchers evaluated Central Corneal Thickness (CCT) of 105 eyes (only right eye) of 105 patient's with myopic astigmatism. About 45 of patients were male and 60 of them were female.

Mean age of male patients was 29.53 ± 7.88 and in female patients was 28.80 ± 7.05 year. No significant difference was not found between mean of age in 2 genders of patients ($p = 0.617$).

Mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry in male patients was 509.44 ± 29.51 micrometer and in female patients was 513.45 ± 41.10 micrometer. No significant difference was not found between mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry in 2 genders of patients ($p = 0.580$). Mean of Central Corneal Thickness (CCT) measured by pentacam in male patients was 519.60 ± 29.57 micrometer and in female patients was 522.25 ± 39.16 micrometer. No significant difference was not found between mean of Central Corneal Thickness (CCT) measured by pentacam in two genders of patients ($p = 0.705$).

Mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was 511.73 ± 36.48 micrometer and mean of Central Corneal Thickness (CCT) measured by pentacam 521.11 ± 35.24 micrometer. Mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was significantly lower than mean of Central Corneal Thickness (CCT) measured by pentacam ($p<0.001$).

Mean difference of 2 studied methods in measurement of central corneal thickness (CCT) was 9.38 ± 6.42 micrometer so that in overall of patients, pentacam measured the central corneal thickness (CCT) 9-10 micron greater than ultrasonic pachymetry.

Significant direct liner correlation was found between Central Corneal Thickness (CCT) measured by Ultrasonic pachymetry with Central Corneal Thickness (CCT) measured by pentacam ($p<0.001$).

Distribution of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry between 2 sexes was shown in Fig. 1. Distribution of Central Corneal Thickness (CCT) measured by Pentacam between 2 sexes was shown in Fig. 2. Distribution of Central Corneal Thickness (CCT) between to measurement methods was shown in Fig. 3.
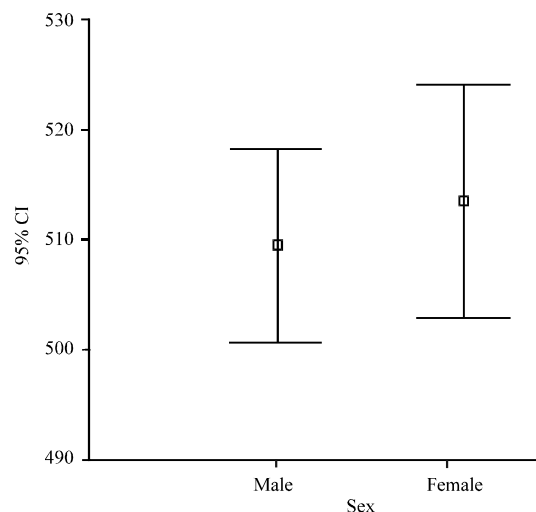

Fig. 1: Distribution of Central Corneal Thickness (CCT) measured by US between 2 sexes
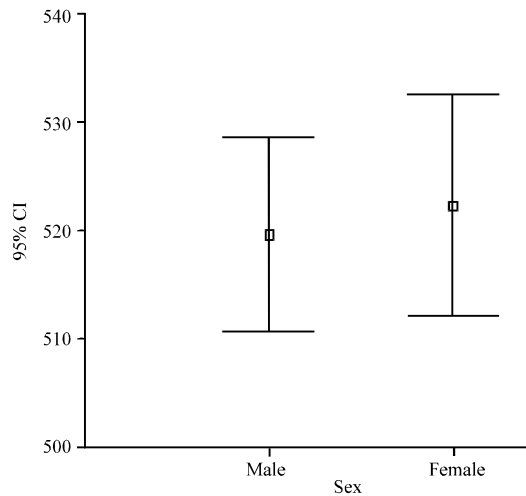
Fig. 2: Distribution of Central Corneal Thickness (CCT) measured by pentacam between 2 sexes

DISCUSSION

Pentacam is a new imaging system for anterior eye segment study. Advances in technology and novel corneal diagnostic and imaging device have created a priority for ophthalmic researchers to assess the efficiency and accuracy of these devices.

In this study, researchers compared the Central Corneal Thickness (CCT) with the ultrasound pachymeter and pentacam in patients with myopic astigmatism.

Previous studies have already shown high repeatability for ultrasound pachymeter and pentacam in measuring the Central Corneal Thickness (CCT) (Hashemi *et al.*, 2007; Kim *et al.*, 2007; Lackner *et al.*, 2005; Barkana *et al.*, 2005) and the findings confirm their results.

Taking the ultrasound technique as the gold standard, in the study, researchers found differences between 2 studied methods ranging from 0.93 μm. However as seen in Fig. 1-3, comparisons between ultrasound and pentacam have yielded different results. Important factors that may contribute to such differences include the studied sample and their corneal characteristics (Hashemi *et al.*, 2007), the dependence of ultrasound pachymetry on the skill of the operator, the inter-observer repeatability (Lackner *et al.*, 2005) and possibly other unknown factors that warrant further studies.

Al-Mezaine *et al.* (2008) demonstrates that the Central Corneal Thickness (CCT) measurements by the pentacam and UP are highly correlated. The pentacam agrees well with UP and is a reliable alternative to UP in Central Corneal Thickness (CCT) measurements.
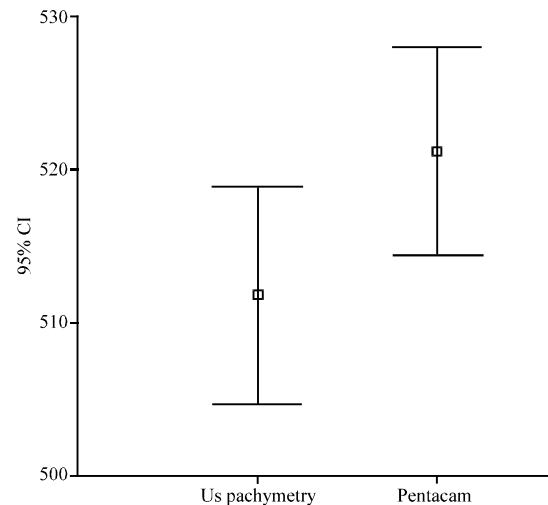

Fig. 3: Distribution of Central Corneal Thickness (CCT) between 2 measurement methods (US via pentacam) g

The assessment of Central Corneal Thickness (CCT) with different modalities shows considerable differences between modalities.

The measurement of central corneal thickness has become increasingly important in ophthalmic practice. For example, refractive surgery is routinely planned according to preoperative measurement of central corneal thickness (American Academy of Ophthalmology, 1999; Price *et al.*, 1999) and accurate determination of intraocular pressure may need to be modified according to central corneal thickness (Doughty and Zaman, 2000; Stodtmeister, 1998; Gordon *et al.*, 2002).

Currently, the most commonly used clinical method to measure central corneal thickness is Ultrasound (US) pachymetry. Recent studies have shown this method to have a high degree of intraoperator, interoperator and interinstrument reproducibility (Miglior *et al.*, 2004; Rainer *et al.*, 2002; Gordon *et al.*, 1990; Marsich and Bullimore, 2000). However, this technique requires corneal-probe contact and so measurement may yield slightly thinner readings as a result of tissue indentation. Ophthalmic biometry should provide rapid, convenient, objective and accurate measurements of ocular dimensions.

In the study of Al-Mezaine *et al.* (2008), the measurement agreement experiment, the mean Central Corneal Thickness (CCT) was 552.4±/37.0 micrometer with oculus pentacam and 544.1±35.4 micrometer with ultrasonic pachymetry. In the study, mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was 511.73±36.48 micrometer and mean of

Central Corneal Thickness (CCT) measured by pentacam 521.11±35.24 micrometer and mean of Central Corneal Thickness (CCT) measured by ultrasonic pachymetry was significantly lower than mean of Central Corneal Thickness (CCT) measured by pentacam (p<0.001).

O'Donnell and Maldonado-Codina (2005)'s study showed that the pentacam instrument provided measurements that were slightly but systematically lower than the measurements provided by ultrasonic pachymetry which is currently the clinical gold standard method. The results coupled with a unique ability to image and analyze the anterior chamber *in vivo*, make the OCULUS pentacam a promising new instrument for anterior eye evaluation (O'Donnell and Maldonado-Codina, 2005). Wu *et al.* (2014) show that pentacam offers similar Central Corneal Thickness (CCT) results to ultrasound pachymetry in normal eyes, thinner corneas after LASIK or PRK procedures.

CONCLUSION

In the study, mean difference of 2 studied methods in measurement of Central Corneal Thickness (CCT) was 9.38±6.42 so that in overall of patients, Pentacam measured the Central Corneal Thickness (CCT) 9-10 micron greater than ultrasonic pachymetry and significant direct liner correlation was found between Central Corneal Thickness (CCT) measured by ultrasonic pachymetry with Central Corneal Thickness (CCT) measured by pentacam (p<0.001).

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