Original Article

Comparison Between Central Corneal Thickness Measurements Obtained with Orbscan II Topographer and Ultrasonic Pachymeter

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Purpose: To compare the central corneal thickness measurements obtained with Orbscan II scanning slit topographer and ultrasonic pachymeter in eyes undergoing corneal refractive surgery.

Material and Methods: This non-interventional, observational comparative study was conducted in Hashmanis Eye Hospital Karachi. A total of 108 eyes evaluated for central corneal thickness measurement with Orbscan II scanning slit topographer and ultrasonic pachymeter that had undergone corneal refractive surgeries (LASIK, LASEK, PRK). The average age of the patients was 29.85 years.

Result: The mean central corneal thickness (CCT) was 537.44µm standard deviation (SD) ±27.31µm standard error mean (SEM) ±2.63µm with Orbscan II scanning slit topographer and mean CCT 542.04 µm SD ±26.35µm and SEM ±2.54µm with ultrasonic pachymeter (P = 0.007).

Conclusion: The mean Central corneal thickness (CCT) from both devices was found not statistically significantly different from each other.

Pachymetry is defined as measurement of corneal thickness and instrument used to measure corneal thickness is referred to as a pachymeter[1]. Normal central corneal thickness is 490-560 µm and corneal thickness is greatest at limbus[2].

Measurement of thickness of cornea is very important for keratorefractive surgeries to avoid surgical complications[3]. Corneal thickness is also an important factor to evaluate corneal barrier and endothelial pump function and in the diagnosis of corneal diseases[4-6]. Ultrasonic pachymetry is currently the most commonly used technique to evaluate corneal thickness. Recently, other sophisticated non-contact pachymetry instruments have been developed. The Orbscan II scanning slit topography (Bausch and Lomb, Rochester, NY, USA) has multiple functions in the assessment of the cornea, including its thickness profile, anterior and posterior topography, elevation, and anterior chamber depth. The usefulness of this system has been reported previously[7]. Pachymetry values obtained with Orbscan II topographer may differentiate early keratoconus and advanced keratoconus from keratoconus suspects and normal controls[8].

In ultrasound pachymetry an ultrasound probe applanates the cornea and measures corneal thickness when it is perpendicular to the posterior surface[9]. It requires a direct contact of the probe on to the cornea, which may increase the risk of infection and corneal epithelial damage. In addition, its accuracy is dependent on the perpendicularity of the probe application to the cornea and on precise probe

placement on the corneal center[10]. Orbscan pachymetry measures corneal thickness like manual ultrasound pachymetry but it is more repeatable, simpler to perform, non-invasive and returns a map of corneal thickness rather than a point measurement. It combines a slit scanning system and a Placido disk (with 40 rings) to measure the anterior elevation and curvature of the cornea and the posterior elevation and curvature of cornea, it offers a full corneal pachymetry map with white to white measurements. Orbscan pachymetry is able to acquire over 9000 data points in 1.5 seconds and measure anterior chamber depth, angle kappa, pupil diameter, simulated keratometry readings and the thinnest corneal pachymetry reading[11].

In this study, we compared central corneal thickness measurements in prekeratorefractive surgery eyes such as Laser in-situ keratomileusis (LASIK), Laser sub-epithelial keratomileusis (LASEK) and Photorefractive keratectomy (PRK) obtained with Orbscan II scanning slit topographer (Bausch and Lomb, Rochester, NY, USA) and ultrasonic pachymetry (Pocket II Pachymeter Echo graph, Quantel Medical Inc. USA).

The purpose of this study was, to compare the central corneal thickness measurements obtained with Orbscan II scanning slit topographer and ultrasonic pachymeter in eyes undergoing corneal refractive surgery.

MATERIAL AND METHODS

The proposed study was a non-interventional study spanning over a period of 12 months from January 2005 to December 2005, conducted at Hashmanis eye hospital, Karachi. The object of this study was, to compare the central corneal thickness values from Orbscan II topographer and ultrasonic pachymeter.

In this study central corneal thickness was evaluated in 108 eyes (54 right eyes, 54 left eyes) of 54 subjects (21 males and 33 females) who had undergone corneal refractive surgeries (LASIK, LASEK, PRK). Data was analyzed by SPSS software and we applied paired t-test for P value.

The average age of patients was 29.85 years. There was no upper age limit in this study. Patients below the age of 18 years were not included in this study.

Patients with clinically significant ocular pathologic conditions (e.g. keratoconus), dry eyes, underlying autoimmune vasculopathies (e.g. lupus, rheumatoid arthritis, polyarteritis nodosa etc.), systemic diseases known to effect corneal healing, functionally monocular vision, taking medication affecting wound healing such as steroids, unable to discontinue rigid contact lenses for a minimum of 4 weeks or soft contact lenses for 1 week before procedure were excluded from the study.

Informed consent was obtained form all patients. All eyes were examined with scanning slit topographer and ultrasonic pachymeter.

For Orbscan measurements, the patient's chin was placed on the chin rest and the forehead was pressed against the forehead strap. The patient was asked to look at a blinking red fixation light. The examiner adjusted the optical head using a joystick to align and focus the eye so that the cornea was centered on the video monitor. The video image was then captured and measured anterior and posterior corneal elevation (relative to a best fit sphere), surface curvature and corneal thickness. Pachymetry is determined by this instrument from the difference in elevation between the anterior and posterior surface of the cornea. This instrument averages pachymetry in nine circles of 2mm diameter that are located in the center of the cornea and at eight locations in the mid peripheral cornea (superior, superotemporal, temporal, inferotemporal, inferior, inferonasal, nasal, superonasal) each located 3mm form the visual axis. The Orbscan corneal topography system also determines the thinnest point on cornea and marks its distance from visual axis and its quadrant location (superotemporal, inferotemporal, superonasal and inferonasal).

For ultrasonic pachymetry, measurements were taken on the table before surgery. The cornea was anaesthetised with topical proparacaine hydrochloride 0.5% (Alcain) and asked the patient to look at distant object. The sterilized probe was applied as perpendicular as possible on the central cornea and three consecutive measurements were made with Pocket II. The Pocket II uses the principle of sonar (pulsed ultrasound) to measure corneal thickness. The Ultrasonic transducer makes contact with and transmits ultrasonic pulses through the surface of the cornea. Echoes are returned from the anterior and posterior surfaces of the cornea. The system measures the time between returning echoes and using the known values of the velocity of sound in the corneas and calculates the thickness.

RESULTS

Out of 54 patients included in this study, 21 patients were males and 33 patients were females. The average age was 29.85 (SD ± 8.9) years, the mean age of male patients was 27.66 and the mean age of female patients was 31.24.

A total number of 108 eyes were investigated using the Orbscan II corneal topography system and ultrasonic pachymeter the mean central corneal thickness (CCT) was 537.44µm (SD ± 27.31µm) standard error mean (SEM ± 2.63µm) with Orbscan II scanning slit topographer and mean CCT 542.04 µm (SD ± 26.35µm) and SEM ± 2.54µm with ultrasonic pachymeter. P value was 0.007.

In this study 21 patients (42 eyes) were males, the mean CCT was 539.69 µm with Orbscan topographer and mean CCT was 545.52 µm with ultrasonic pachymeter. 33 patients (66 eyes) were females the mean CCT was 536.0 µm with Orbscan topographer and the mean CCT was 539.82 µm with ultrasonic pachymeter.

The standard deviation (SD) and standard error mean (SEM) between male and female patients obtained with Orbscan II topographer and ultrasonic pachymeter are summarized in Table.

We divided all the investigated patients into three groups. In the first group we examined 19 patients (38 eyes) the mean CCT was 541.9µm with Orbscan topographer and mean CCT 549.2µm with ultrasonic pachymeter. In the second group we examined 20 patients (40 eyes) the mean CCT was 530.35µm with Orbscan topographer and mean CCT 538.35µm with ultrasonic pachymeter. In the third group examined patients were 15 (30 eyes) and the mean CCT was 541.2µm with Orbscan topographer and mean CCT 536.9µm with ultrasonic pachymeter.

The standard deviation (SD) and standard error mean (SEM) among different age groups patients are summarized in Table.

DISCUSSION

Corneal thickness can be evaluated by number of methods including ultrasonic pachymetry[12-14], optical slit lamp pachymetry[14], specular microscopy[15], confocal microscopy[16,17] and partial coherence interferometry[18]. Each of these methods has different clinical advantages and disadvantages. Discrepancies in optical pachymetry results can be obtained by different observers or with different instruments. Ultrasonic measurement requires corneal contact and it is difficult to locate accurately the same points of measurements in serial examinations. This may result in large variation in corneal thickness measurement. The Orbscan corneal topography system is a new device to evaluate corneal thickness by measuring the anterior and posterior corneal surfaces simultaneously. It provides both anterior and posterior corneal elevation maps as well as corneal thickness data. This system produces more information about corneal thickness than ultrasonic pachymeter because it evaluates corneal thickness across the entire corneal surface and yields corneal thickness in nine different locations of cornea.

In our study, the mean central corneal thickness measured by Obrscan II scanning slit topographer was slightly lesser (no statistically significant difference observed) than the mean CCT obtained by ultrasonic pachymetry, which agrees with the results as reported by Touzeau O and associates[19].

Table 1: The standard deviation (SD) and standard error mean (SEM) between male & female and among different age group patients obtained with Orbscan II topographer and ultrasonic pachymeter.

Gender & Age groups	Examined		Orbscan II topographer			Ultrasonic pachymeter		
	No. of patient	No. of eyes	Mean (µm)	SD (µm)	SEM (µm)	Mean (µm)	SD (µm)	SEM (µm)
Male	21	42	539.69	22.56	3.48	545.52	25.79	3.98
Female	33	66	536.00	30.02	3.70	539.82	26.67	3.28
18-25 years	19	38	541.90	33.3	5.41	549.20	27.20	4.42
26-35 years	20	40	530.35	26.63	3.74	538.35	24.54	3.88
36 & above	15	30	541.20	21.77	3.98	536.90	26.05	4.76

P= 0.007

Fig. 1: Orbscan II scanning slit topographer (Bausch and lomb, rochester, NY, USA)

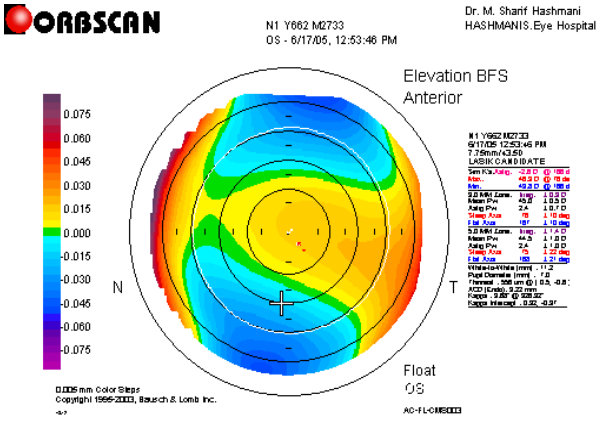

Fig. 2: Anterior best fit sphere (BFS) of left cornea from orbscan II

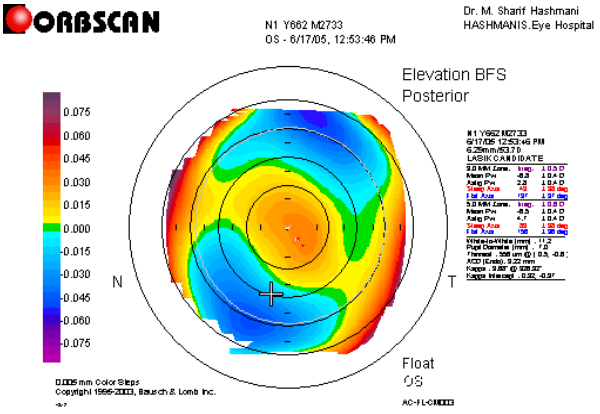

Fig. 3: Posterior best fit sphere (BFS) of left cornea from orbscan II

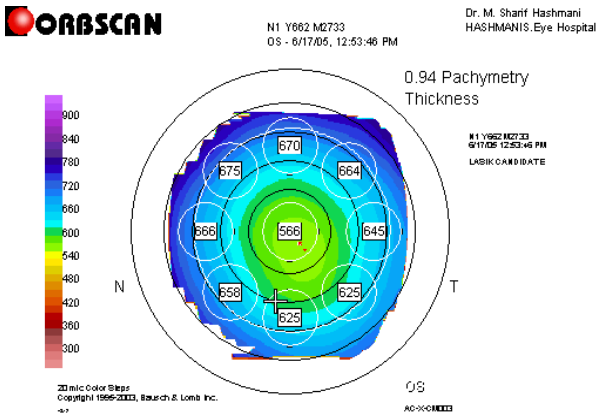

Fig. 4: Corneal thickness (Pachymetry) of Left eye from orbscan II

Fig. 5: Ultrasonic pachymeter (Pocket II

Pachymeter echo graph, Quante
l Medical Inc. USA)

The pachymetry data in the present study is not consistent with previous report by Yaylali and associates who reported that measurements of the corneal thickness with the Orbscan system were 23-28μm greater (statistically significantly different) than values obtained with ultrasonic pachymeter[20].

Further studies are required to provide the exact relationship between Orbscan II scanning slit pachymetry and ultrasonic pachymeter

CONCLUSION

The mean Central corneal thickness (CCT) from both devices was found to be not significantly different from each other but Orbscan pachymetry is repeatable, simpler to perform, non-invasive and provides corneal thickness in nine different locations.

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Trabeculectomy as such or with antimetabolites like mitomycin C is still the choicest procedure in open angle glaucomas.

Prof. M Lateef Chaudhry