Original paper

Correlation between Refractive Error and Corneal Thickness in a sample of Iraqi Population with a Wide Range of Ametropia

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Abstract

Background: The assessment of corneal thickness has gained importance in different fields of ophthalmology in recent years, and measurement of the central corneal thickness (CCT) has become an important part of a routine examination in refractive surgery.
Aim: To determine the Correlation between Refractive Error and Central Corneal Thickness in A NAJAF Population with a Wide Range of Ametropia.
Method: In a cross sectional observational study, Involved 399 eyes of 200 Patients for whom the cen-tral corneal thickness (CCT) was measured with Ultrasonic pachymetry (TOMEY PACHYME-TER SP-3000).
The refractive error, including sphere, cylinder, and spherical equivalent (SE), were measured with Topcon (KR.8900) autorefractometer And Manual refraction.
Examination of anterior segment using slit lamp and fundoscopy using volk + 90 D, were done to exclude any underlying pathology
Results: The mean age of the study subjects was 30.71(range, 17 to 61) years. The mean spherical equiva-lent (SE) of the right eye was -3,2475 Diopter (range,-11.25 to 5.75 Diopters) while SE of the left eye was-3,2035 Diopter (range,-14.5 to 8.5 Diopters). The mean central corneal thick-ness(CCT) of the right eye 533,1600 Micron (range,407.00 to 635.00 Micron) while CCT of the left eye was 532,7638 Micron (range,394.00 to 630.00 Micron). No significant correlation were found between spherical equivalent (SE) and central corneal thickness (CCT) of right and left eye among the studied group.
Conclusion: No significant Relation found between Refractive errors and central corneal thickness (CCT).
Key words: Refractive error, corneal thickness, correlation.

Introduction

The assessment of corneal thickness has gained importance in different fields of ophthalmology in recent years, and measurement of the central corneal thickness (CCT) has become an important part of a routine examination in glaucoma management and refractive surgery [(1-2)].
Previous studies were carried out to determine and compare the effects of several sources of variation on the measurement of corneal thickness using the standard optical pachymeter and three ultrasonic pachymeters .[(3-4)]
Sources of variation included: intra- and inter-session variation, inter-observer variation, left/right eye variation, and variations due to alternate settings of ultrasonic sound frequencies. It was found that the optical pachymeter had a) two to three times as much intra-session variation as that of the ultrasound pachymeters, b) significant inter-observer variation (P = 0.015), and c) significant differences between left and right eye thickness determinations (P less than 0.005). On the other hand, ultrasonic pachymeters demonstrated a) high reproducibility, b) no inter-observer variation,

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and c) no left/right eye variation. These results have implications for the use of pachymetry in measuring corneal thickness for radial keratotomy and other refractive surgery.[5-7]

The average corneal diameter is 11.5 mm vertically and 12 mm horizontally. It is 540 µm thick centrally on average, and thicker towards the periphery. Central corneal thickness varies between individuals and is a key determinant of the conventionally-measured intraocular pressure level.[2]

Numerous studies have demonstrated that thicker corneas with greater rigidity may offer a greater resistance when subjected to applanation, resulting in artificially higher intraocular pressure readings [2-4]. In addition, with the development of corneal refractive surgery procedures, CCT values are of enormous importance during the preoperative evaluation of the patients as they Influence the decision whether or not to perform surgery, the type of recommended procedure, and rate of postoperative complications [8-10].

Although refractive errors are most commonly corrected by spectacles or contact lenses, laser surgical correction is gaining popularity. The excimer laser precisely removes part of the superficial stromal tissue from the cornea to modify its shape. Myopia is corrected by flattening the cornea and hypermetropia by steepening it.[11,12]

In photorefractive keratectomy (PRK), the laser is applied to the corneal surface. In laser assisted *in situ* keratomileusis (LASIK), a hinged partial thickness corneal stromal flap is first created with a rapidly moving automated blade. The flap is lifted and the laser applied onto the stromal bed. Unlike PRK, LASIK provides a near instantaneous improvement in vision with minimal discomfort. Serious complications during flap creation occur rarely. Intraocular lenses can also be placed in the eye but this carries all the risks of intraocular surgery and the possibility of cataract formation.[13]

Methods

In a Cross sectional approach, 399 records of patients who were examined to undergo laser refractive surgery at AL HAKEEM General Hospital during 2014-2015 were reviewed.

Complete data were available for 200 patients (399eyes) with 96 males 48 % and 104 females 52%.

Based on their age, patients were divided into three groups: Less than 30 years; 106 patients (53%), 30-45 years; 82 patients (41%) and, More than 45 years; 12 patients (6%).

Based on their refraction results, patients were divided into 4 groups based on the SE: low myopia (0.0<SE<-3.0 D), moderate myopia (-3.0<SE<-6.0) high myopia (SE>-6.0) and hyperopia (SE>0.0).

The extracted data included demographic information and results of the refraction tests including the spherical error, the cylinder and the spherical equivalent (SE). Topcon Auto-refractometer (KR.8900) were used.

The *spherical equivalent* power is calculated from the toric lens prescription by algebraic addition of the spherical power and half the cylindrical power.

All recorded CCT measurements had been done with an ultrasonic pachymeter (TOMEY SP-3000).

All participants underwent a standardized interview and examination. Each subject underwent a structured slit-lamp examination by an ophthalmologists before and after pupillary dilation. The eyes were examined for abnormalities of the anterior segment of the eye and had IOP measured with an applanation tonometer. Retinal examination were done using Volk lens 90 D. to exclude any abnormalities.

Statistical analysis

Statistical analysis was done by using SPSS (statistical package for social sciences) version 17. We use Pearson correlation(r) to correlate between different variables. Also we use descriptive analysis (mean, standard deviation, minimum, maximum) to describe our measurement data. Analysis of variance (ANOVA) had been used to find difference between different groups with measurement data. We set p value<0.05 as significant.

Results

Of the 200 patients, 52% were females and 48% were males. The mean age of the study subjects was 30.71(range, 17 to 61) years. The mean spherical equivalent (SE) of the right eye was -3,2475 Diopter (range,-11.25 to 5.75 Diopters) while SE of the left eye was-3,2035 Diopter (range,-14.5 to 8.5 Diopters).The mean central corneal thickness(CCT) of the right eye 533,1600 Micron (range,407.00 to 635.00 Micron) while CCT of the left eye was 532,7638 Micron (range,394.00 to 630.00 Micron).

The minimum, maximum, mean and standard deviation of age, spherical equivalent (SE), and central corneal thickness (CCT); pachymetry of left and right eyes are summarized in table 1.

In studying the results of our data, the analysis showed no statically significant differences between spherical equivalent (SE) and central corneal thickness (CCT) of right and left eye among the studied group (p value 0.614 ,0.732) as showed in Table(2). Also there were no significant differences with gender (p value 0.661, 0.558 among males and p value 0.870, 0.954 among females) as showed in Tables (3, 4). There was a significant difference between age and spherical equivalent (SE) (p value 0.004 ,0.001) as showed in Table(5).No significant differences was found between age of patients and central corneal thickness(CCT) (p value 0.144 ,0.237) as showed in Table (6) .

In studying the refraction, analysis of variance showed a statistically significant difference in the age of the different refraction groups with the age being highest in the hyperopic group (age: 38.64 , P<0.001) as showed in Table (7,8) .This is in comparism with another study done at Kufa university 2011 (Distribution of refractive errors Among Ophthalmology Out patients At Al Sader Medical City ,ANNAJAF)[14] by Dr. Mohammed Hussein who found significant difference between age groups as Hyperopia is more common under 12 years and Myopia is more common after while Astigmatism is commonest in all age groups.

Table 1. shows the minimum, maximum, mean and standard deviation of age, spherical equivalent (SE), and central corneal thickness (CCT); pachymetry of left and right eyes

	Minimum	Maximum	Mean	Standard deviation
Age/years	17	61	30,71	8,739
Spherical equivalent(SE) of right eye	-11,25	5,75	-3,2475	2,85858
Central corneal thickness (CCT); pachymetry of right eye	407,00	635,00	533,1600	38,10056
Spherical equivalent (SE) of left eye	-14,50	8,50	-3,2035	3,03463
Central corneal thickness (CCT); pachymetry of left eye	394,00	630,00	532,7638	37,12495

Table 2. the correlation between spherical equivalent and pachymetry (CCT) of left and right eyes among studied group.

	r	P value
Spherical equivalent of right eye and pachymetry	**0.036**	**0.614**
Spherical equivalent of left eye and pachymetry	**-0.024**	**0.732**

Tabe 3. the correlation between spherical equivalent and pachymetry(CCT) of left and right eyes among males.

	r	P value
Spherical equivalent of right eye and pachymetry	**0.045**	**0.661**
Spherical equivalent of left eye and pachymetry	**-0.061**	**0.558**

Table 4. the correlation between spherical equivalent and pachymetry of left and right eyes among females.

	r	P value
Spherical equivalent of right eye and pachymetry	0.016	0.870
Spherical equivalent of left eye and pachymetry	-0.006	0.954

Table 5. the correlation between age and spherical equivalent of left and right eyes

	r	P value
Spherical equivalent of left eye and age	**0.234**	**0.001**
Spherical equivalent of right eye and age	**0.204**	**0.004**

Table 6. the correlation between age and pachymetry(CCT) of left and right eye

	r	P value
pachymetry of left eye and age	**0.084**	**0.237**
pachymetry of right eye and age	**0.104**	**0.144**

Table 7. relation between type of refractive error of right eyes and pachymetry(CCT) and age of patients.

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		P value
					Lower Bound	Upper Bound	
Pachymetry of right eye	Hyperopia	539.0000	36.76178	7.83764	522.7007	555.2993	0.68
	Low myopia	530.9474	35.91208	4.11940	522.7411	539.1536	
	Moderate myopia	535.4933	39.09184	4.51394	526.4991	544.4875	
	High myopia	528.1481	43.18093	8.31017	511.0663	545.2300	
Age/years	hyperopia	38.64	12.148	2.590	33.25	44.02	<0.001
	Low myopia	29.30	6.924	0.794	27.72	30.88	
	Moderate myopia	30.03	8.276	0.956	28.12	31.93	
	High myopia	30.11	8.455	1.627	26.77	33.46	

Table 8. Relation between type of refractive error of left eyes and pachymetry and age of the patients.

		Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		P value
					Lower Bound	Upper Bound	
Age/years	Hyperopia	38.64	12.148	2.590	33.25	44.02	<0.001
	Low myopia	29.30	6.924	0.794	27.72	30.88	
	Moderate myopia	30.03	8.276	0.956	28.12	31.93	
	High myopia	30.11	8.455	1.627	26.77	33.46	
pachymetry of left eye	Hyperopia	536.2273	36.24379	7.72720	520.1577	552.2969	0.899
	low myopia	530.7600	35.07630	4.05026	522.6897	538.8303	
	Moderate myopia	534.3333	39.19816	4.52621	525.3147	543.3520	
	High myopia	531.1481	39.09722	7.52426	515.6818	546.6145	

Discussion

Assessment of the corneal thickness plays an important role in glaucoma management and refractive surgery. The CCT has a wide range among the normal population, and many factors have been reported to be correlated with it (15-17). Most reports agree that a correlation exists between CCT and IOP measurements with most tonometers.

While new tonometers are gradually introduced, and novel techniques are used to measure the IOP, many studies are conducted to compare them with the Goldmann applanation tonometer which is still considered the standard method, and determine the factors that might affect their performance [18-20]. The factors investigated in these studies include the corneal thickness, corneal curvature, refractive errors, and biodynamic properties of the cornea such as corneal hysteresis (CH), and the corneal resistance factor (CRF), and how they affect the IOP, and its measurement readings. Reported results are inconclusive, and some contradict each other. It is still not clear which factors must be considered when measuring the IOP with different methods [21-23]. The CCT has been found to influence IOP readings, and if other factors such as refractive error, corneal curvature, and biomechanical properties are correlated with the CCT, they can serve as a confounding factor in these studies. In the present study, we aimed at finding any possible correlation between the CCT and refractive errors. The mean CCT in the studied eyes was 533,1600 µm for the right eye and 532,7638 µm for the left eye. Data on the studied eyes was extracted from a population of patients who were examined to undergo refractive surgery. Still the mean thickness was similar to that reported in population-based studies. Mercieca et al [24] performed a study in Africa and reported a mean CCT of 532 µm in their population. The mean CCT in the study by Aghaian et al [25] was 549.9 µm for the total studied population, 555.6 µm for the Chinese subgroup, 550.4 µm for Caucasians, 550.6 µm for Filipinos, 548.1 µm for Hispanics, 531.7 µm for the Japanese, and 521.0 µm for the black people. In one study, Suzuki et al [26] reported the mean CCT in a Japanese population to be 517.5±29.8 µm. In the study by Nemura and colleagues [27] the mean CCT was 516±33 µm. The CCT seems to vary in different races.

Not many studies have evaluated the relationship between CCT and refraction. In the present study, we found no significant association between the CCT and the amount of refractive error. This had previously been reported by other studies as well. [25, 28-33] However Suzuki et al [26] found a weak negative correlation between CCT and refractive error in men but not in women (Higher CCT in myopic eyes than emmetropic eyes in men, r=-0.045). Nomura et al [27] also reported higher CCT values in moderate myopia than in emmetropic and hyperopic eyes. Brandt et al [34] reported a significant correlation between CCT and refraction (r=-0.10, P=0.0008) in the ocular hypertension study which was not significant in the multivariate mixed model. In contrast, Nemesure et al [35] found that the central cornea was thinner in more negative refractive errors than less negative or more positive refractive errors. These very contradictory results show the need for further studies in this field.

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