

Dry Eyes and Central Corneal Thickness

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ABSTRACT

Aim: To study the effect of dry eye on Central Corneal Thickness (CCT) by comparing CCT of normal persons with CCT of dry eye patients.

Study Design: A cross-sectional study.

Duration and Settings of the Study: Eye Department of Mayo Hospital Lahore from October 2023 to December 2023.

Methods: This research was approved by the ethical review board of the College of Ophthalmology and Allied Health Vision Sciences (ERB reference no. 1472/23). A perform-based cross-sectional study was performed in eye OPD of Mayo Hospital Lahore from October 2023 to December 2023. The sample size was calculated by formula where the level of significance (α) is 5%, standard deviation (σ) 30.9, and test value of the population mean (μ_o) 540. Using a non-probability convenient sampling method total sample size was 77 patients. We performed this research on 80 patients. This sample is divided into two groups 23 are of non-dry eye disease patients and 57 were of dry eye patients. Patients with dry eyes were added to this study while those having a history of diabetes, uveitis, glaucoma, elevated intraocular pressure, ptosis, eyelid disorders, corneal diseases, any eye surgery, including surgery on the lids, and contact lens wearers were not included in our study. CCT was measured using ultrasonic pachymetry. Data was analyzed using SPSS version 25 Mann Whitney statistics were used for the significance of the study.

Results: Patients with dry eye disease had significantly lower CCT compared to the normal group ($P < 0.001$). Its mean was 543.74 and 462.19 micron in the right eye respectively and 539.65 and 466.78 micron in the left eye respectively.

Conclusion: In the dry eyes, there was a noticeable decrease in the corneal thickness of the central cornea.

Keywords: Dry Eye Syndrome, Slit Lamp, Corneal Pachymetry, Cornea, Corneal Layers

INTRODUCTION

The tear film serves as an interface between the external environment and the eye, preserving the integrity and functionality of the ocular surface.

Tear-film (TF) stability, which keeps the ocular surface epithelium from drying out, is made possible by the collaboration of the various elements that make up the ocular surface, such as the TF's constituents and the epithelium. Thus, the TF breakdown that causes dry eye happens when those components are inadequate or compromised.¹

Dry eye disease is a dynamic and complicated condition affecting the ocular surface and ocular adnexa. Finding the etiological trigger, restoring

homeostasis, and ending the vicious cycle are the most crucial steps in treating this cyclical illness. Increased tear film osmolarity and ocular surface inflammation, along with accompanying ocular symptoms (discomfort, visual impairment), are crucial components of the diagnosis. Inflammation can be verified using a variety of approaches and procedures and is not always linked to hyperemia. To detect ocular surface inflammation, there is still no "gold standard" or adequate test in clinical practice today.² Dry eye disease affects millions of people worldwide and becomes more prevalent as people age and use digital devices more frequently.³ It is believed that many people have undiagnosed dry eye disease (DED), which impairs vision and lowers productivity at work.⁴ Due to a number of risk factors, including aging and prolonged use of eye drops containing preservatives, DED has been associated with glaucoma therapy and post-cataract surgery.⁵ Those who wear hard contact

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COI: The authors have disclosed no conflict of interest.

lenses and have keratoconus run the risk of developing DED because of their contact lens use.⁶ Therefore, it is becoming increasingly crucial to accurately assess CCT in DED. Numerous studies on CCT and DED found that patients with DED had thinner CCTs and that measuring CCT is helpful for DED follow-up.⁷

Central corneal thickness is a metric for assessing corneal health that accounts for the hydration and metabolism of the cornea.⁸ It is a crucial parameter for identifying corneal diseases, such as keratoconus and Fuchs dystrophy, because it affects the cornea's endothelial pump function.^{9,4} When adjusting IOP in glaucoma patients, an accurate CCT value is crucial. Additionally, CCT is a significant confounder of most tonometry techniques.¹⁰ CCT is a possible independent risk factor for glaucoma. The measurement of CCT value affects the outcomes of refractive surgery, contact lens prescription, and corneal transplantation.¹¹ Multiple DED examinations, such as tear film break-up time (TFBUT), kerato-conjunctival vital staining, tear osmolality, and tear volume, are used to diagnose DED.^{12,13}

There are several ways to calculate CCT. Ultrasound pachymetry (USP) is the gold standard for reproducibility and portability and has been used extensively. Several other non-contact techniques exist for measuring CCT, such as anterior segment optical coherence tomography and Pentacam rotating Scheimpflug camera.

METHODS

This research was approved by the ethical review board of the College of Ophthalmology and Allied Health Vision Sciences (ERB reference no. 1472/ 23). A proforma-based cross-sectional study was performed in eye OPD of Mayo Hospital Lahore from October 2023 to December 2023. A sample size of 77 was calculated by formula where the level of significance (α) is 5%, standard deviation (σ) 30.9, and test value of the mean of the population (μ_0) 540.¹⁴ Using non-probability convenient sampling method total sample size was 77 patients. We performed this research on 80 patients. This sample is divided into two

groups, 23 are of non-dry eye disease patients and 57 were of dry eye patients. Patients with dry eyes were added to this study while those having a history of diabetes, uveitis, glaucoma, elevated intraocular pressure, ptosis, eyelid disorders, corneal diseases, any eye surgery, including surgery on the lids, and contact lens wearers were not included in our study. CCT was measured using ultrasonic pachymetry. Data was analyzed using SPSS version 25. Mann-Whitney statistics was used for the significance of the study. Data p value = 0.05 was considered significant.

RESULTS

The sample size was 154 eyes. Total 57 patients were of dry eye (DED) and 23 were persons with normal eyes. Both males and females were included. After data collection for analysis of data, a test of significance was applied which showed the significance of the data. After that, the Whitney test was applied.

Table 1. Central Corneal Thickness (micron)

	CCT mean values in micron			P (value)
	Normal Eye	Moderate DED	Severe DED	
OD	539.8	466.8	427.6	P < 0.001.
OS	543.8	462.1	435.7	P < 0.001.

CCT=Central Corneal Thickness, DED= Dry Eye Disease, OD=Ocular Dexter, OS=Ocular Sinister

Table no. 1 shows the mean value of CCT in the right eye and left eye of a non-dry eye person, in a patient with moderate dry eye, and in a patient with severe dry eye. The mean of normal and dry eye is statistically significant.

Table 2: Central Corneal Thickness (micron) in Female

DE grading	Right eye		Left eye	
	Corneal thickness (micron)	P-value	Corneal thickness (micron)	P-value
Normal	539.2		537.4	
Moderate DE	461.6	P < 0.001	464.5	P < 0.001
Severe DE	440.0		429.7	

CCT= Central Corneal Thickness, DE= Dry Eye

In table no. 2, mean values of CCT in non-dry eye, moderate dry eye and severe dry eye has been given in gender female. There is no significant difference in right and left eye.

Table 3: Central Corneal Thickness (micron) in Male

DE Regarding	Right eye		Left eye	
	Corneal thickness (micron)	P-value	Corneal thickness (micron)	P-value
Normal	549.6		542.5	
Moderate DE	463.3	P < 0.001	470.2	P < 0.001
Severe DE	427.1		423.2	

CCT=Central Corneal Thickness, DE=Dry Eye

In table no. 3, mean values in gender male in person with no dry eye, patient with moderate dry eye, and patient with severe dry eye are given. No significant value in the right and left eye is shown.

DISCUSSION

The purpose of this study was to determine how dry eye affected CCT. Most research addressing the effects of dry eye on the corneal surface has results that are more impacted by tear film than by corneal tissues since reflection-based equipment depends on tear film reflection. Because dry eye is important for the health of the cornea and VA, this study can add to the body of knowledge about DED and its effects on the corneal surface.

Ocular surface damage and inflammation, neurosensory abnormalities, hyperosmolarity and tear film instability, and other factors all play etiological roles in the common multifactorial disease known as dry eye, which is accompanied by ocular symptoms.² its prevalence in the world ranges from 5% to 34%.¹⁵ Dry eyes are typically brought on by medications, contact lens wear, refractive surgery, or maybe cataract surgery. Dry eye symptoms include watery or teary eyes, redness, itching, burning feeling in the eyes, and mucus that causes the eyes to feel "glued shut" at night. Eye strain and the sensation of something in the eye are other common complaints. There may also be light sensitivity and itching. One test used to evaluate dry

eye is the tear break-up time test, which we utilized to measure participants' dry eyes in this study. Sodium fluorescein dye is applied to the eye during a TBUT test, and the tear film is examined under a slit lamp with the patient not blinking until very few dry patches appear. More than 10 seconds is typically seen as normal.^{10,11,12} Less than five seconds is classified as severe dry eye, and five to ten seconds is considered moderate.¹⁶ Participants with dry eyes were then divided into those with moderate and severe dry eyes, In 57 patients TBUT was less than 10 seconds. Of these 57 DED patients, 36 had moderate DED, and the remaining 21 had severe DED.

The cornea typically has two narrowest zones: the paracentral and peripheral zones, where it thickens, and the geographic center, which is typically 1.5 mm away. A typical human cornea's average center thickness ranges from 540 to 550µm.¹⁷ The cornea's thickness is affected by dry eyes. The impact of dry eye on CCT varies depending on how severe it is. Following the measurement of dry eye, 88 subjects' CCT was recorded. CCT can be measured using a variety of techniques, including as Pentacam, OCT, non-contact techniques, and ultrasonic techniques. Ultrasound pachymetry (USP) is the gold standard for quantifying CCT.¹⁸ We measured CCT in this investigation using a pachymeter. Prior to usage, the pachymeter was properly prepped and sanitized; the instrument probe was cleansed; the patient provided verbal consent; and the patient received a local corneal anesthetic, such as alkaline, to ensure their comfort. On the pachymeter screen, the CCT value is automatically displayed. In this study, we compare the CCT value of a person with no dry eye, and of the patient with moderate and severe dry eye. The CCT of both the right and left eye is noted separately. As a result out of 88 participants 23 with normal eyes (Normal) showed a mean value of CCT in the right eye 543.74 micron and the left eye 539.65 micron. Total of 57 were with dry eyes the mean value of CCT in the right eye was measured as 452.44 micron and in the left eye, it was measured as 452.31micron. This result shows a decrease in CCT

value in patients with dry eye. After categorizing dry eye into severe and moderate values, CCT differed accordingly. The mean calculated in moderate dry eye in OS was 462.19 micron and in OD the mean calculated was 466.78 micron. As moderate dry eye the mean of CCT in severe dry eye patients was noted as 435.71 micron in the right eye and 427.52 micron in the left eye. After comparing the mean value of CCT in moderate and severe dry eye we can see there is a significant difference in both values. CCT in severe dry eyes was markedly reduced. Moreover, the P values of CCT also show significant differences according to the Mann-Whitney test and Kruskal-Wallis test the P value is 0.000. In the previous article, research was done on Iraqi population and the results were significant.¹⁹ A total of 280 eyes were evaluated (140 normal eyes from 70 persons and 140 dry eyes from 70 cases). Patients with dry eye syndrome showed considerably lower CCT ($P < 0.001$). Its means were 536.5 and 561.3 micron, in that order. Comparing CCT of dry eyes to a population with similar age and gender revealed a substantial reduction. In another article, the effect of dry eye on CCT is noted.²⁰ Using the Orbscan corneal topography equipment, the corneal thickness at nine places in the central and peripheral cornea was assessed in 38 eyes of 21 patients with aqueous tear deficient dry eye and 34 eyes of 21 normal people. Nine spots in the central and mid-peripheral cornea had significantly thinner averages in dry eyes compared to normal eyes. The superior cornea was found to be the thickest area in both groups, measuring 0.629 ± 0.030 mm in normal eyes and 0.589 ± 0.031 mm in dry eyes. The measurements for normal eyes and dry eyes showed that the middle of the cornea was the thinnest, measuring 0.571 ± 0.028 mm and 0.534 ± 0.034 mm, respectively.

CONCLUSION

Dry eye affects central corneal thickness. In this study, this effect is seen by comparing the CCT of normal and dry eye patients of age and gender-matched groups. Depending on the severity of dry eye the effect on CCT

differs. In severe dry eye, the corneal thickness decreased markedly, and in mild dry eye disease, central corneal thickness reduced noticeably.

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