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EVALUATION OF TEAR FLUID AND OCULAR DOMINANCE IN PATIENTS WITH REFRACTIVE ERROR

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Abstract

Tear fluid has a critical role for the function of the refraction index of the light and the quality of the image. The purpose of this study is to compare tear fluid and ocular dominance in patients with refractive errors. One hundred three patients with mean age of 35.63±14.95 who was referred to ophthalmology service for refraction examination were enrolled to the study. The handedness and ocular dominance were determined by the Edinburgh hand preference questionnaire and other tests. Visual acuity was tested by ophthalmological methods and Schirmer test was administered in patients.

Our study was included seventy-three female and thirty male patients. Right hand-dominance was found as 94.1% and right eye dominance as 66.0%. Myopia was higher in both right (-0.74±1.16D) and left eye (-0.68±1.01D) dominance. There were statically negative correlation between hypermetropia degree and tear volume in the left eye (p= 0.015; r = -0.240) there is a negative non-statically correlation for the right eye (p=0.060; r= -0.186). There was no correlation either between the myopia degree and tear fluid, eye dominance, tear fluid.

The existence of a negative correlation between the amounts of hypermetropia with tear fluid, suggesting that the evaluation of tear fluid should be considered in clinical significance.

Keywords: Ocular dominance, tear fluid, hypermetropia

1. Introductıon

Cerebral lateralization is defined as an anatomical or functional difference between the two hemispheres of the brain [1]. Another explanation of lateralization is the use of half of any anatomical structure or in a functional situation on the human body more than the other half. It comes in existence in organs which are in the paired for instance legs, hands and eyes [2]. In all human population, left-handedness of individuals is found in between 5% to 25.9%. Its prevalence varies from culture to culture

and from region to region for unknown reasons [3]. Ocular dominance was first described by Rosenbach, and he showed that equal vision can be provide each of eyes in isolation [4]. He applied a sighting test on patients which is very simple: Subjects should focus at a distant target with one of their index finger while their both eyes open. The finger is seemed doubled during it is figured outside Panum's area. Generally, the most people had rather the image of one eye to another. Alternate occlusion defines the dominant eye: if the index finger is aligned with the target, it means that viewed by the dominant eye and the findex finger is seemed offset to one side while viewing with the other eye [5]. Then Miles drew attention to the relation between dominant eye and hand preference, meanwhile he pointed out that harmony between the two may not always exist [6]. In humans, when hand preferences are examined, it is seen that the distribution of the left-hand preference in the society is one-tenth. The relationship between hand preference and dominant eye did not reach full clarity. The left eye is dominant in one-third of the people who prefer the left hand [7].

Tear fluid has a critical prescription for the function of the eye surface. It is that covers and protects the eye, as well as it is the largest refractive surface of the visual system. It also affects the quality of the image by changing its homogeneity. Therefore, the amount and content of the tear film is a vital component of clear vision [8]. Since the tear film includes dynamic structure of proteins, lipids, and mucins riding on the epithelium's hydrophobic surface, it is very complex. Stable vision depends on the tear film stability. Dry eye diseases cause some oscillation during vision while reading or using video display, and it is not reduced until remarkable ocular surface damage comes in existence. Even though there is a questionable relationship between ocular dominance and fixation preference, assessing ocular dominance or fixation preference may have importance role for variety of ophthalmic diseases treatment such as refractive error or amblyopia [9].

A small number of studies have examined the difference between myopia and hypermetropia. Generally, the right eye has been preferred for analysis in many of these studies. According to analysis there is no significant consideration of potential effects of ocular dominance in development of refractive error [10, 11]. However, the visual cortices are more predisposed to choose visual input by the dominant eye than nondominant eye as in hand and cerebral hemisphere dominance. For this reason, ocular growth and refraction may provide some information about the ocular dominance that has to reflect the differential operation of the two visual paths [10, 12].

In the literature, many studies have compared the dominant and non-dominant eye using some parameters such as refractive error (isometropia and anisometropia, spherical and astigmatism), visual acuity, and intraocular pressure [13-15]. However, there are no studies that investigate the relationship between refractive error, handedness, and eye dominance with the tear. Hence, this study was planned to compare refractive error with the tear fluid volume, dominant eye, and handedness.

2. Material and Method

2.1. Participants

Our perspective and clinical study was approved by Local Ethics Committee. The study was performed in the Department of Ophthalmology of Yenikent Hospital and Sakarya Training & Research Hospital. Participants who had congenital, functional, or anatomic eye pathology and infectious and inflammatory disorders were excluded. 103 participants who had refractive pathologies and aged

between 18 to 65 years were included to the study. After being informed, their consents were obtained, and then the study protocol was applied.

2.2. Determination of Handedness

The hand preference of the patients was determined by the Edinburgh hand preference questionnaire [16]. In this questionnaire, patients were asked which hand they used to do things like writing, painting, ball and rock throwing, holding scissors, brushing teeth, holding a knife while cutting bread, holding a spoon, holding a hammer, holding a match and the answers as "always right", "usually right", "both hands", "usually left", and "always left" are given with +10, +5, 0, -5, -10 points. The value between +100 and -100 is called the Geschwind score (GS)[17]. If this score is negative, it is lefty; if it is positive, it is righty. "GS +80 and over" were considered as strong right-handedness.

2.3. Determination of Ocular Dominance

Dominant eye determined with looking at a keyhole, dark bottle, telescope, rifle, and microscope. It was the preferred eye when viewed in one eye and was not influenced by education or orientation [7]. While we determined the dominance of the eyes, the patients were seated with their arms released to their sides perpendicular to the chair. Thus, the hand was not affected the preference. They looked into a dark box on the table and asked them to say what they saw. The eyes they used when they first looked into the box were considered as the dominant eye of the patients.

2.4. Application of Schirmer Test

Standard Schirmer test paper was placed between the bottom cover and the eye on 1/3 outside of the eye. Paper was removed after five minutes. The result was measured by a millimetric scale.

2.5. Statistical Analysis

All analyses were performed with commercial software (SPSS ver. 22.0; SPSS, Chicago, IL) and the numerical data were presented as the mean ±SD and the categorical data were expressed as frequence and percentages. The relationship between refractive error and Schirmer value *(mm)* was evaluated using the Pearson's correlation test. A level of "$p<0.05$" indicated statistical significance.

3. Results

3.1. Characteristics of patients

73 female (70.9% of participants) and 30 male (29.1% of participants) patients enrolled the study. Mean age was 35.63±14.95 years. While 97 (94.1%) patients were using their right hand, 6 (5.9%) were using their left hand. Right ocular dominance was present in 68 (66%) and left ocular dominance in 35 patients (34%).

As refractive error, group patients with myopia and hypermetropia were enrolled. Myopia was encountered the most (61.2 %). The dominant eye ratios according to the refractive errors are summarized in Table 1.

Dominant eye of the right-handed patients is found as 66.0% right eye as well as dominant eye of left-handed patients as 66.7% right eye.

Table 1: Characteristics of patients

Patients: (n=103)	n	Percent
Sex		
Male	30	29.1%
Female	73	70.9%
Hand dominance		
Right-handed	97	94.1%
Left-handed	6	5.9%
Ocular Dominance		
Right-eye	68	66.0%
Left-eye	35	34.0%
Refractivity Error		
Hypermetropia	40	38.8%
Myopia	63	61.2%

3.2. The Ocular Dominance and Refractive Error

As it is summarized in Table 2, myopia was higher in both right (*-0.74±1.16D)* and left eye *(-0.68±1.01D)* dominance. There was no significant difference according to ocular dominance.

Table 2: The ocular dominance according to refractive error

Refractive Error	Ocular Dominance %		Right Eye Ocular Dominance (D) mean±SD		Left Eye Ocular Dominance (D) mean±SD	
	Right Eye	Left Eye	Right Eye	Left Eye	Right Eye	Left Eye
Hyper-metropia	41.2	34.3	0.36±0.61	0.35±0.61	0.21±0.48	0.19±0.38
Myopia	58.8	65.7	0.74±1.16	0.68±1.01	1.19±1.38	1.14±1.38

SD: Standard Deviation

3.3. Comparison of ocular dominance and refractor error according to tear fluid

There was a significant positive correlation of Schirmer values for both eyes (right and left eye; p=0.000). There was a statically negative correlation between hypermetropia degree and tear volume in the left eye (p= 0.015; r = -0,240) while there is a negative non-statically correlation for the right eye (p=0.060; r= -0.186). Meanwhile, there was no correlation between the myopia degree and tear fluid volume. Nonetheless, there was no statistical correlation between dominant eye and tear fluid volume. (Table 3)

Table 3. Comparison of ocular dominance and refractor error according to tear fluid

Characteristics (n=103)	Right Schirmer (mm) Mean ±SD	Left Schirmer (mm) Mean ±SD
Right Schirmer (mm)	**	**
Left Schirmer (Mm)	**	**
Right Myopia (D)	18.39 ±8.13	17.20±8.70
Left Myopia (D)	19.36±8.21	17.45±8.60
Right Hypermetropia (D)	17.74±8.49	15.42±9.17
Left Hypermetropia (D)	18.81±8.98	16.48±9.77*
Right– Ocular Dominance (N)	18.70±8.63	16.13±9.07
Left – Ocular Dominance N	19.94±8.47	19.42±8.60

Tested with Pearson correlation-test by correlation.

* Significant at p≤ 0.05

** Significant at p≤0.001

4. Discussion

This study; the relationship between tear fluid, handedness, and ocular dominance has been investigated in patients with refractive error. Our results provided a negative association between hypermetropia and tear fluid. The results indicated that there no statistically significant effect of the tear fluid and handedness and ocular dominance.

Evaluation of the dominant eye is very important in clinical practice. Especially in patients with presbyopia, contact lens, and glasses, as well as during refractive surgery or before cataract surgeries; the dominant eye should be determined [18]. According to our results in excessive refractive error in the dominant eye, when the dominant eye is used for near or far fixation, it is conceivable that fixating with the dominant eye exerts an accommodative overload on that eye compared to the non-fixating contralateral eye. "Does the dominant eye have better visual acuity than non-dominant eye?" The question was asked in previous studies and it was shown that this is not the case. There are also some studies supporting our results concerned that there is no relation between refractive error and dominant eye [18, 19]. In our study, the dominant eye of both right-handed and left-handed patients was the right eye. It has been showed that in the previous studies while the right eye dominance is around 80%, and the left eye dominance is around 10% [20]. Our results were consistent with the previous studies [21] However, some results about handedness and eye dominance are controversial. Miles et al. [22] have drawn attention to the relationship between the dominant eye and handedness, and they have indicated

that hand preference and eye dominance does not always display concordance. The reason is disclosed while evaluating eye domination; the motor movement can be influencing them. Although the relationship between hand preference and the dominant eye does not reach full clarity, researchers on this subject continue intensively[23].

In our study, myopia was higher in both right and left eye dominance. Mansour et al. [24] have tried to investigate the relationship between in hand dominance and refractive differences between eyes, and they showed that even so the right eyes were slightly more myopic than left eyes, a significant correlation could not been established between hand dominance and differences between eyes. According to two-year follow-up of myopia study; they noted that ocular dominance did not effect on myopia development [10]. This is due to the fact that there is not much refraction difference between the two eyes. Furthermore, in our study, it may be difficult to determine the relationship between the patient population and the advanced stage myopic patient. According to our results it was seen that the right eye dominance is more frequently seen and they are significantly more myopic in our study population.

Recent investigations about the focus on the dynamics of the tear exposed the important role in the optical quality of the eye and our results about the comparison of tear fluid and other parameters are as follows. There was no statistical correlation between tear fluid and ocular dominance or myopia. However, tear volume was higher in patients with lower hypermetropia degrees. Although we cannot capture strong relations in our results, studies on the importance of visual quality are ongoing. One factor contributing to instability in the optical quality of the eye that has recently been receiving increasing attention is the tear film. Deterioration of the tear film homogeneity and reduction of the amount can increase the sensitivity to the cornea and exposure of the underlying irregular pre-corneal surface. Due to the irregular pre-corneal surface; patients could have either normal deviation from the corneal bubble or the long axis of the eye[25]. For this reason, it is indisputable that the optical quality is optimal if almost all structures are in the physiological range. Investigations proved that tear disorders caused ocular surface drying, corneal ulceration and perforation, and increased incidence of infectious diseases[26]. They even stressed the potential for vision defects and blindness. Several clinical studies have suggested that increased deviations in the tear film disruption may cause to decrease the retinal image quality. A study about artificial tears in 30 patients with dry eye syndrome indicated that using artificial teardrop in visual acuity caused a significant increase in optical quality. As it is seen from this result and finding, while optical aberrations decreases, optical quality of the image improves with installation of artificial tears in dry eyes [27]. Another study [28] compared the tear film variability between normal and dry eyes and concluded that tear film changes were different. Koh et al.[29] showed ocular aberrations analysis and dynamic variability. These changes may be attributed to the increasing irregular tear film.

As a consequence, any local changes and irregularity in the tear film thickness can affect the refraction index of the light and the quality of the image that is affecting the refractive system. According to our results, the reason for the correlation with the tear in hypermetropic patients; the hypermetropia may be caused by a small eyeball or a poor eye age change in the lens system in these patients. Hypermetropia is characterized by anatomical and functional disorders such as the shortness of the eye sphere or weakness of the lens system. Therefore, the tear volume can be taken into account when refractive defects are evaluated in these patients.

5. Conclusion

Our study evaluated the relationship between hand/ocular dominance and tear fluid in patients with refractive error. According to our results there was no statistical correlation between dominant eye and tear fluid and there was an inverse relationship between tear volume and hypermetropia. The existence of a negative correlation between the amounts of hypermetropia with tear fluid is suggesting that the correction of hypermetropia may have clinical significance.

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