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Influence of Ocular Dominance on Anisometropic Myopia.

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Research Article

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ABSTRACT

During Binocular viewing, the preferential use of dominant eye because of its increased static ciliary muscle tone, might allow the dominant eye more myopic then non dominant eye in anisometropic myopia. However certain studies found that, there was no apparent association between ocular dominance and refraction. The present study was therefore conducted to analyze, the effect of ocular dominance on anisometropic myopia. This study was done at Physiology research laboratory, Thanjavur medical college, Thanjavur. 49 Medical students with anisometropic myopia were recruited. Refractive error was measured by autorefractometry. Ocular dominance was first tested by miles test and then VEPs (Visual Evoked Potentials) were performed by checker board pattern reversal stimuli system. Out of 49 Anisometropia, the dominant eye was more myopic in 27 (55.1%) subjects and the spherical equivalent refraction was not significant with non dominant eyes (p=0.6037). There were no significant differences in mean spherical equivalent refraction between dominant and non dominant eyes of < 0.5D (p= 0.9266) and in anisometropia of ≥0.5D (p= 0.9281). Among 35 non cross dominance anisometropia (Right handed right ocular dominance), the dominant eye was more myopic in 18(51.4%) subjects and it was not significant with non dominant eyes (p=0 .6622). Out of 14 cross dominance anisometropia (Right handed left ocular dominance) the dominant eye was more myopic in 9 (64.28%) subjects and it was not significant with non dominant eyes. (p= 0.4896). There was no significant effect of ocular dominance on anisometropic myopia. Further research is needed to evaluate the influence of ocular dominance on high anisometric myopia of ≥ 1.75D and also to determine the influence of cross and non cross ocular dominance on myopia to resolve the disparity existing in present studies.

INTRODUCTION

Despite the symmetry of the body, there is an inherent preference for the parts of one side of the body over the other. It is apparent in the hands. In addition to hand preference, there is also preference for the visual input of one eye over the other. The preferred eye is known as dominant eye [1, 2].

Ocular dominance (eye dominance) was first described by Giovanni Battista Porta in 1593 [3,4]. It is the tendency to prefer visual input from one eye over the other [5] and may be explained by which one of the eyes commonly dominates or leads the other eye, both in fixation & attention or in perceptive function [6].

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Ocular dominance is related to some ocular mechanism or function, such as eye movement [7] or amblyopia [8] and is considered to be important in the control of reading [9].

Ocular dominance may be especially important in sports which require aim, such as archery, golf or shooting and it is an important consideration in predicting patient satisfaction with monovision correction in cataract surgery, refractive surgery and contact lens wear [10, 11, 12].

Kinds of ocular dominance [13]

The various types of ocular dominance tasks may be divided in to three sub categories: Sensory, Oculomotor and Directional dominance.

Directional dominance is the most familiar, sometimes referred as sighting dominance. It can be tested in various ways. Miles test is an important one.

Myopia also known as 'Short Sight' is that dioptric condition of the eye in which, with the accommodation at rest, incident parallel rays come to a focus anterior to the light sensitive layer of the retina [14].

The prevalence of myopia has increased strikingly in recent years in many parts of the world.[15] It has been reported as high as 70– 90% in some Asian countries, 30 - 40% in Europe & United states and 10 - 20% in Africa [16]. Some research suggest that the prevalence of myopia in India is only 6.9 % [17, 18] and it has become, according to WHO, one of the major causes of blindness & visual impairment [19].

The etiology of myopia remains unclear, although both genetic & environmental components are considered to be involved. The "Use–abuse theory" explains that sustained near work or prolonged reading leads to the development of myopia [20].

Anisometropia is a condition in which the refractive state of the two eyes shows a considerable difference. [21] It is not uncommon in myopic patients [20].

During Binocular viewing, the dominant eye plays a primary role with an increased static tonus of its ciliary muscle compared with that of the non dominant eye [22] . The preferential use of the dominant eye for viewing might allow the dominant eye more myopic than non dominant eye. If ocular dominance has a role in the mechanism of myopia, this effect is apparent in those with anisometropic myopia.

However certain studies found that ocular dominance had no significant effect on spherical equivalent [23, 24]. Therefore the present study was done to evaluate whether ocular dominance influences refractive error.

MATERIALS AND METHODS

This study was done at physiology Research Laboratory, Thanjavur medical college, Thanjavur from February 2010 to July 2014 .Forty nine Medical students with anisometropic myopia were recruited .All were aged between 17 – 21yrs. Refractive error was measured in each subject by autorefractometry. In this study a diagnosis of anisometropic myopia was made with a difference of at least 0.25D between the two eyes and the mean interocular difference was 0.4897.

Ocular dominance was first tested by Miles test and then VEPs were performed by Checkerboard Pattern reversal stimuli system. Subjects with amblyopia, corneal opacity, squint, and colour blindness, history of ophthalmic surgery, history of ptosis, glaucoma, significant retinal pathology, those on miotics or mydriatics, neuromuscular disorders or other diseases that might affect visual acuity were excluded. Informed written consent was obtained from all the participants and experimental protocol was approved by college ethical committee.

Miles test

In 1928, W.R.Miles established the basis for how eye dominance is determined [25, 26, 27]. The following method is simple and accurate way to check eye dominance for both adults and children.

- Extend both arms forward of your body and place the hands together making a small triangle (approximately ½" to ¾" per side) between your thumbs and the first knuckle.
- With both eyes open look through the triangle and center something such as doorknob or the bull's eye of a target in the triangle.
- Close your left eye- If the object remains in view, you are right eye dominant. If your hands appear to move off the object and move to the left, then you are left eye dominant.
- To validate the first test, look through the triangle and centre the object again with both eyes open.
- Close your right eye- If the object remains in view, you are left eye dominant. If your hands appear to move off the object and move to the right, then you are right eye dominant.

VEP

VEPs are visually evoked electrophysiological signals recorded from human scalp. It depends on the functional integrity of central vision at any level of visual pathway including retina, optic nerve, optic chiasma & occipital cortex [28, 29].

Pre test Instructions [30, 31]

- about the procedure of the test and got informed consent.
- To avoid hair spray or oil after the last hair wash.
- The room parameters should be maintained constant throughout the experiment.
- Not to use any eye drops (miotic/ mydriatics) 12 hrs before the test.

The study was done with 4 channels Digital Polygraph. Digital intex colour monitor, 17 ½ model-no: IT-173SB.

VEP- Experimental Design and Recording

VEPs were performed by checkerboard pattern reversal displayed on a TV monitor subtending 15°×12° at a viewing distance of 90cm and individual squares in the checkerboard pattern subtended a visual angle of 60°. The stimuli reversal rate was 2 per second. Electrode scalp placement and recording parameters were carried out according to the standard of the International Society for Clinical Electrophysiology of Vision (ISCEV) [29].

Standard disc EEG electrodes were placed at the Oz position (active electrode) and reference electrode was placed at Fz position & ground electrode on the patient's vertex (Cz).The subject was instructed to fix his gaze at the center of the screen. The latency of P_{100} and amplitude were measured.

Statistical Analysis

Ocular dominance by VEP analysis, spherical equivalent between the 2 eyes, was evaluated with paired t-test. Ocular refraction between groups were analysed by unpaired t-test and chi- square test. P value <0.05 was taken as significant.

RESULTS

For the 49 subjects, the mean age was 18.3878 years, 31(63.3%) subjects were female. The mean spherical equivalent was – 2.2041 in the right, - 2.1939 in the left eye. There was no significant difference in the spherical equivalent between right & left eye p = (0.907). (Table -1)

Table 1: Spherical equivalent in right & left eye

Spherical Equivalent Dioptres (D)			
Right	Mean	SD	P
	-2.2041	1.76458	0.907
Left	-2.1939	1.77238	

According to miles test, 35 were Right ocular dominant anisometropic myopia & 14 left ocular dominant anisometropic myopia. All the subjects were Right handed. (Table .2)

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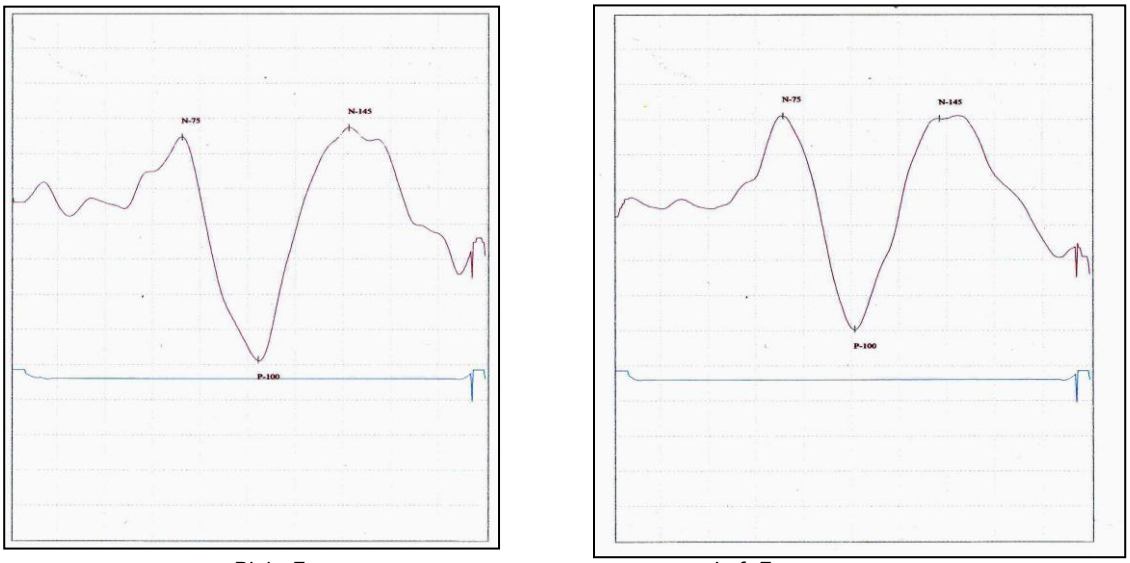
Table 2: (n=49)

Handedness	Ocular Dominance	Miles Test
Right Handed	Right eye	35
	Left eye	14

35 Right ocular dominant anisometropic myopia were analysed by Visual Evoked Potential (VEP). (Fig.1). their p100 latency (p=0.035) and amplitude (p=0.001) were statistically significant (Table 3). 14, were cross dominance (Left ocular dominant anisometropic myopia) their p100 latency was significant (p=0.000) however their amplitude was not significant (p=0.401) (Table 4). However based on miles test and p100 latency they are considered as left ocular dominant. Hence 14 showed cross dominance (right handed with left ocular dominance) and 35 were non cross dominant (Right handed right ocular dominance)

Figure 1: Shows the difference p100 latency and amplitude of right and left eye of anisometropic myopia.



Right Eye Left Eye

Table: 3 Right ocular dominant anisometropic myopia (Non-crossed Dominance) n=35

Parameters	Mean	SD	P
P100 Latency (ms)			
Right eye	99.7714	5.05898	0.035
Left eye	101.4571	4.97401	
P100 Amplitude (μv)			
Right eye	11.7840	5.65137	0.001
Left eye	10.1934	5.14100	

Table: 4 Left ocular dominant anisometropic myopia (crossed dominance) n=14

Parameters	Mean	SD	P
P100 Latency (ms)			
Right eye	104.1071	3.64364	0.000
Left eye	99.0000	4.06675	
P100 Amplitude (μv)			
Right eye	10.7821	4.65799	0.401
Left eye	9.8493	5.11438	

Out of 49 anisometropia, the dominant eye was more myopic in 27 (55.1%) subjects and their spherical equivalent refraction was not significant with non dominant eyes. (p= 0.6037), (Table -5). 25 were anisometropia of ≥0.5D they were significantly more myopic with 24 subjects of anisometropia <0.5D. (p=0.0390), (Table-6.).There were no significant difference in spherical equivalent refraction between dominant and non dominant eyes of <0.5D (p=0.9266), and in anisometropia of ≥0.5D (p=0.9281).

Out of 35 uncrossed dominant anisometropic myopia, the dominant eye was more myopic in 18(51.4%) and it was not significant with non-dominant eyes (p=0.6622).

Out of 14 cross dominant anisometropic myopia, the dominant eye was more myopic in 9(64.28%) of subjects and it was not significant p= (0.4896)

Table 5: Anisometropia n=49

		Dominant Eye	Non dominant eye	P
Spherical equivalent dioptres (D)	Mean	2.3241	2.5909	0.6037
	SD	1.6522	1.9219	
More myopic		27 (42.85%)	22 (44.89%)	

Table 6: Anisometropia ≥ 0.5 D and <0.5D

Spherical equivalent	Mean	SD	P
≥ 0.5 D	2.9500	1.9167	0.0390
< 0.5D	1.7574	1.6446	

DISCUSSION

Ocular dominance concept was first introduced in 1593 by Giovanni Battista Porta [3, 4]. Ocular dominance is established in many children after age of three [21] and is stable and it cannot shift unless the eyesight of dominant eye becomes greatly decreased [29].

Recent concepts regarding the etiology of myopia focussed around the visual input dependent feedback mechanisms [32]. The 'use –abuse theory' explains that sustained near work or prolonged reading leads to the development of myopia [21] . "Blur- hypothesis" (Retinal defocus) – states that if the accuracy of accommodation during near work is not maintained, then the defocused retinal image leads to the development of myopia [22]. Recently, several articles have been published regarding ocular dominance and refractive error, to determine the mechanisms influencing the myopia development. Ocular dominance was considered to be independent of refraction [21]. The present study shows that there were no significant differences in mean spherical equivalent between dominant and non dominant eyes in anisometropic myopia. Audrey Chia et al found that ocular laterality & dominance have no significant effect on Spherical equivalent in children with significant interocular differences with a mean anisometropia of 0.04D[23]. As a corollary of the above, Zhikuan Yang et al [24] found that there was no statistically significant effect of ocular dominance on the development of myopia over a two year period. These studies are in consistent with the present study.

However, Ching – Yu- Cheng et al examined the association of ocular dominance and anisometric myopia and report that the dominant eye has a greater degree of myopia than the non dominant eye[33] in subjects with high anisometropia ≥1.75D but no significant difference was observed in anisometropia of <1.75D. The reason for greater degree of myopia in dominant eyes may be due to the differences in accommodative responses between two eyes.

Ibi [34] studied the characteristics of dynamic accommodative responses between dominant and non dominant eye. He observed that the static focus of the ciliary muscle is increased in dominant eye which may explain why the dominant eye is more myopic in non – amblyopic anisometropic.

Mansour AM et al compared the refractive error between two eyes of 1336 subjects and found that the right eye was generally more myopic than the left [35]. Although, this retrospective study did not include ocular dominance, the authors described that, as the majority of the population are right eye dominant, the dominant eye may be more myopic eye. They speculate that increased accommodation in the dominant eye at near work may causes increase in myopia in right eyes. Kyong- Jin cho et al studied the refractive errors of dominant and non dominant eyes and found that the dominant eye showed a lower degree of astigmatism than the non-dominant eye [36]. This is in contrast to the findings of Ching – Yu-Cheng et al [33] but in accordance with the present study.

In this study, we sought to investigate the correlation between ocular dominance and anisometropic myopia and confirmed that there was no significant association between ocular dominance and anisometric myopia with the mean interocular difference of 0.4897D and also in anisometropia of <0.5D and ≥0.5D. Further research is needed to evaluate the influence of ocular dominance on high

anisometropia of ≥1.75D and also to determine the influence of cross and non cross ocular dominance on anisometropic myopia to resolve the disparity existing in the present studies.

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