SHORT COMMUNICATION

The difference in accommodative amplitude and facility between the dominant and non-dominant eyes

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Abstract

The cross-sectional study was planned to compare the amplitude of accommodation and accommodative facility between the dominant and non-dominant eyes in young university students. The sample comprised 70 healthy young adult students at King Saud University, Saudi Arabia, who were aged 19-27 years with a mean of 21.46±1.54 years. The dominant eye for each subject was determined using the hole-in-a-card test. The push-up method and ±2.00 diopter flipper lenses were used to measure the amplitude of accommodation and accommodative facility, respectively. The mean amplitude of accommodation and accommodative facility of the dominant eye were 8.56±2.15 diopter, and 9.76±2.84 cycle/min, respectively. The corresponding figures for the non-dominant eye were 8.26±2.24 diopter, and 9.21±2.79 cycle/min. The mean difference in the amplitude of accommodation and the accommodative facility was 0.30±0.80 diopter and 0.54±1.61 cycle/min higher in the dominant eye. However, despite the statistically significant difference between dominant and non-dominant eyes in terms of the amplitude of accommodation and accommodative facility, these differences might not reach clinical relevance.

Keywords: Accommodation, Eye dominance, Ocular dominance.

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Introduction

Ocular dominance is the tendency to favour visual inputs from one eye over the other.[1] Ocular dominance can be categorised into three categories. First, sighting dominance refers to the preferred eye when fixating on a target through a hole in a card.[2] Second, sensory dominance refers to the eye that dominates the most during binocular rivalry.[3] Third, oculomotor dominance refers to a misalignment of the two eyes during fixation disparity testing.[4]

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Accommodation is the process of changing the dioptric power of the eye to focus on a target placed at a distance closer than the far point of that eye.[5] The full range of accommodation that the eye can exert as the target is placed at the eye's far point (fully relaxed accommodation) to the eye's near point (maximum accommodation) defines the amplitude of accommodation.[6] The ability of an eye to change its focus repeatedly from one distance to another is called an accommodative facility.[6] Studies have investigated the relationship between ocular dominance and visual acuity (VA),[7] pupil diameter,[5] vergence,[1] and refractive error.[1,8] Also, studies have looked at the difference between dominant and non-dominant eyes in terms of accommodative function, such as accommodative response.[9-11] However, fewer studies have investigated the relationship between amplitude of accommodation (AA) and accommodative facility (AF) with respect to ocular dominance.[10, 11] The current study was planned to compare the amplitude of accommodation and accommodative facility between the dominant and non-dominant eyes in young university students._

Methods and Results

The cross-sectional study was conducted at the King Saud University, Riyadh, Saudi Arabia, from May to September 2022. The sample was raised using probabilistic convenience sampling technique, and comprised subjects from the Optometry Department. Subjects without any history of binocular vision anomalies, ocular disease, or refractive surgeries who had best corrected visual acuity (VA) of 20/20 or better at 6 metres and 40cm were included. Subjects with binocular anomalies, history of ocular/head trauma, cataract and ocular pathology, or currently on systemic medication were excluded. Each subject was corrected for any existing refractive error using trial lenses placed in trial frames to reach a VA of 20/20 or better at 6 metres and 40cm.

A total of 70 healthy young adult students were recruited to meet the sample size requirements that were calculated (using SPSS 28) with 80% confidence level and 0.05 level of significance in line with previous studies.[10,11] Data was collected after taking informed consent from all the participants.

AA was measured using a Royal Air Force (RAF) ruler with the help of the push-up method. With optimal distance

Table:-1 Sphere, cylinder and spherical equivalent (SE) values.

	Dominant Eye Median (IQR) Mean ± SD 95% CI	Non-Dominant Eye Median (IQR) Mean ± SD 95% CI	Mean Difference Median (IQR) Mean ± SD 95% CI	Statistical Significance ($p<0.05$)
Sphere (D)	0.00 (0.19)	0.00 (0.25)	0.00 (0.00)	0.009
	-0.46 ± 1.85	-0.55 ± 1.83	0.09 ± 0.52	
	-0.9 to -0.2	-0.99 to -0.11	-0.03 to 0.21	
Cylinder (D)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.001
	-0.16 ± 0.43	-0.19 ± 0.44	0.03 ± 0.27	
	-0.26 to 0.06	-0.29 to-0.09	-0.03 to 0.09	
SE (D)	0.00 (0.78)	0.00 (0.84)	0.00 (0.00)	0.003
	-0.54 ± 1.95	-0.65 ± 1.95	0.10 ± 0.50	
	-1.01 to -0.08	-1.11 to -0.19	-0.02 to 0.22	

IQR: Interquartile range, SD: Standard deviation, CI: Confidence interval, D: Diopter.

Table:-2 Amplitude of accommodation (AA) and accommodative facility (AF) values in dominant and non-dominant eyes.

	Dominant Eye Median (IQR) Mean ± SD 95% CI	Non-Dominant Eye Median (IQR) Mean ± SD 95% CI	Mean Difference Median (IQR) Mean ± SD 95% CI	Statistical Significance ($p<0.05$)
AA (D)	8.00 (2.00)	8.00 (2.00)	0.00 (1.00)	0.003
	8.56 ± 2.15	8.26 ± 2.24	0.30 ± 0.80	
	8.04 to 9.07	7.73 to 8.79	0.11 to 0.49	
AF (Cycle/min)	10.00 (4.00)	9.00 (3.00)	1.00 (2.00)	0.001
	9.76 ± 2.84	9.21 ± 2.79	0.54 ± 1.61	
	9.08 to 10.43	8.55 to 9.87	0.16 to 0.93	

IQR: Interquartile range, SD: Standard deviation, CI: Confidence interval, D: Diopter.

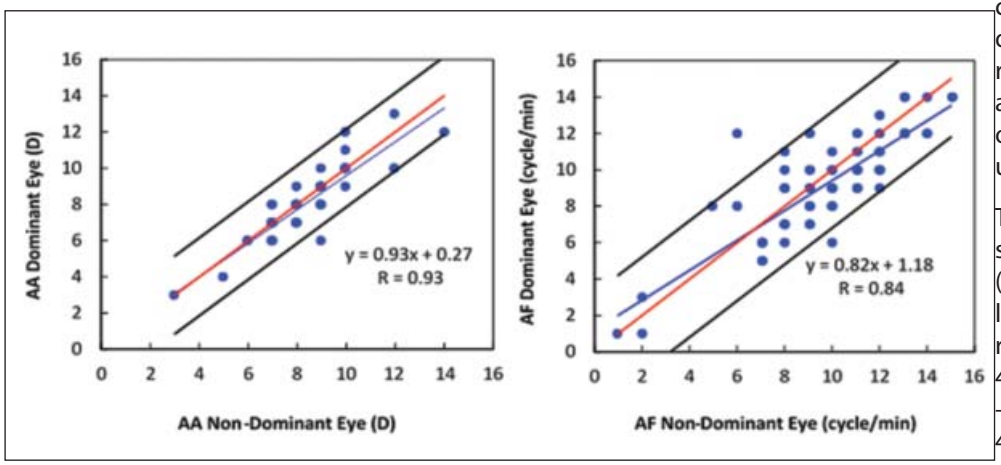

Figure: Figure: Plots of dominant and non-dominant eyes in terms of (A) amplitude of accommodation (AA), and (B) accommodative facility (AF). Red and blue lines represent y=x and the line of best fit, respectively. Black lines represent a 95% confidence interval (CI)

correction in place, the target was placed 40cm away and in front of the subjects' eyes, and they were instructed to focus on the 20/20 line on the Snellen's chart. The subject was asked to keep the target as clear as possible during the test. The target was moved gradually towards the subject's nose until he/she reported the first sustained blur while the target was approaching, and this was the test endpoint. The distance between the spectacle plane and the target was recorded and converted to a dioptre (D). The measurement was repeated three times, and the average value was recorded.

AF was measured using a ±2.00D flippers test during which the subjects were instructed to fixate on the 20/30 line on a target placed at 40cm. The subjects were informed that when the lens was placed in front of their eyes, the target might become blurred, and they would need to focus to make the target clear again. The +2.00D lens was placed in front of the subjects' eyes until the subjects reported that the target was clear, and then the lens flipper was flipped to the -2.00D lens until the subject reported that the target was clear again. Clearing both +2.00D and -2.00D counted as one cycle. This was repeated for one minute, and the number of cycles was recorded. The measurement was repeated three times, and the average value was recorded.

The data collected from dominant and non-dominant eyes was assessed for normality using the Kolmogorov-Smirnov test, which indicated that the data was not normally distributed. Therefore, nonparametric tests were used. Median values with interquartile range (IQR) of all the measured variables were calculated along with mean and standard deviation. Wilcoxon signed-rank test was used for statistical significance, and the significance level was set at $p<0.05$. The correlation coefficient (R) was calculated to determine the strength of the relationship between dominant and non-dominant eyes in terms of AA and AF. Data was analysed using SPSS 28.

The mean age of the 70(100%) subjects was 21.46±1.54 years (range: 19-27 years). Right and left spherical equivalents)SEs) ranged between +5.00D and -4.00D with a mean of -0.54±1.95D, and +5.00D and -4.25D with a mean of -0.65±1.95D, respectively. All subjects had a mean spherical equivalent of anisometropia ≤0.50D.

Overall, 55(79%) subjects were right-eye-dominant, while 15(21%) were left-eye-dominant. The mean differences in sphere, cylinder and SE were statistically significant ($p<0.05$) between dominant and non-dominant eyes (Table 1).

The mean measured AA and AF were 8.56±2.15D and 9.76±2.84 cycle/min for the dominant eyes, respectively. The corresponding values for the non-dominant eyes were

8.26±2.24D and 9.21±2.79 cycle/min, respectively). The mean differences between the dominant and non-dominant eyes in terms of AA and AF were 0.30±0.80D and 0.54±1.61 cycle/min, respectively (p<0.05) (Table 2). There was a stronge positive correlation between the dominant and non-dominant eyes in terms of AA (r=0.93, p<0.001) and AF (r=0.84, p<0.001) (Figure).

Discussion

In the current study, the right eye was the dominant eye in 79% cases. Odigie et al. in 2019 reported that the right eye was dominant in 62.5% of their subjects,[11] and Momeni et al. in 2013 reported that 75.7% of the recruited subjects were right-eye dominant.[10]

The tendency to have right-eye dominance was also reported in other studies.[12,13]

Despite the earlier thought that ocular dominance had no significant impact on refraction,[14] Cheng et al. showed that dominant eyes are significantly more myopic than non-dominant eyes in adult subjects with anisometropia >0.5D myopia and more evidence with anisometropia >1.75D.[15] Similar results were shown in another study that defined anisometropia as >0.75D.[16] In contrast, Linke et al. showed that the non-dominant eyes were more myopic than the dominant eyes defined as anisometropia >2.5D, but ocular dominance had no significant impact on SE refraction in subjects with SE anisometropia <0.5D.[12] The current study recruited subject with anisometropia ≤0.50D and showed that the non-dominant eyes were more myopic than the dominant eyes (p=0.003).

A strong correlation was found between the dominant and non-dominant eyes in terms of the AA and AS (Figure) (p<0.05). Hoffman et al. in 1980 suggested that a normal range difference between eyes in terms of AA and AF was 0.50D and 2 cycle/min, respectively.[17] Therefore, the reported mean differences between dominant and non-dominant eyes in the current study (AA 0.30D and AF 0.54 cycle/min) reached the level of statistical significance, but were less than 0.50D and 2 cycle/min to be clinically relevant.

The current sudy has limitations owing to cross-sectional design and a small sample size. Larger, multicentre and prospective studies are needed to validate the current findings.

Conclusion

Despite being statistically significant, the difference between dominant and non-dominant eyes in terms of AA and AF could not reach the level of clinical relevance.

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BHA: Agreement to be accountable for all aspects of the work.

Dislcaimer: None.

Conflict of Interest: None.

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