Original Article

Assessment of Phoria Associated with Myopia in Students and Staff before and after Correction of Refractive Error

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ABSTRACT

Aim: To assess the phoria associated with myopia before and after correction of refractive error.

Study Design: Cross-sectional study.

Duration and Setting of the Study: The study was conducted from March 2023 to August 2023 at the ISRA University Islamabad Campus.

Methods: Using a non-probability sampling technique, students and staff members of the university with myopia ages 18 and above were selected. Ethical approval of the study was obtained from the ethical committee of the Pakistan Institute of Rehabilitation Sciences (PIRS) at ISRA University Islamabad. Verbal consent from the participants was obtained. Data was collected using a self-constructed questionnaire. Assessment of participant was performed using the cover-uncover test, Maddox Rod and Maddox Wing test. Study data was analyzed using the statistical software SPSS 20.

Results: Total participants were 100, including 54% female. Before the correction of refractive error, the mean value for phoria was 1.96 ± 0.84 prism Dioptre (pd) and after correction, the mean value was 1.65 ±0.91 pd. A significant difference was found before and after correction of refractive error ($P<0.01$). The study showed that without refractive correction, 52% of participants had exophoria, 30% had orthophoria, 14% had esophoria, 02% had hyperphoria, and 2% had hypophoria. While after correction for myopia, 61% of participants had orthophoria, 24% had exophoria, 11% had esophoria, 3% had hyperphoria, and 1% had hypophoria.

Conclusion: The study highlights the significance of refractive correction, especially in treating exophoria. Treatment resulted in a notable shift towards orthophoria. Doing an eye examination, eye care practitioners should consider the prevalence of various ocular disorders and adjust refractive corrections accordingly.

Key words: Exophoria , Esophoria , Refractive error, Myopia.

INTRODUCTION

Worldwide 1.406 billion people have myopia. Out of that 163 million people had high myopia in 2000. It is also predicted that, by 2050, there will be 4.758 billion people with myopia and 938 million will have high myopia.[1] In myopia, the eyeball is typically longer than average or the cornea and lens have excessive curvature, causing light to focus in front of the retina instead of directly on it. As a result, distant objects appear blurry; while near objects can be seen more clearly. The exact causes of myopia are not fully understood, but both genetic and environmental factors are believed to play a role. Research suggests that if one or both parents have myopia, there is an increased likelihood of developing the condition. Environmental factors such as excessive near work, prolonged screen time, and lack of outdoor activities have also been associated with a higher risk of myopia development, particularly in children.[2] Myopia can range from mild to severe, and it is typically diagnosed through a comprehensive eye examination conducted by an eye care professional. This examination includes measuring visual acuity, determining the refractive error through a procedure called refraction, and assessing the overall health of the eye.[3,4]

Heterophoria or latent squint is defined as a condition in which eyes in the primary position or in their movement are maintained on the fixation point under stress only, with the aid of corrective fusion reflexes. When the influence of fusion is removed, the visual

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axis of one eye deviates.[5,6] Heterophoria refers to the tendency of the eyes to deviate from their normal alignment when binocular vision is not actively maintained. It is different from heterotropia, which involves a manifest misalignment of the eyes. Heterophoria can be classified based on the direction of deviation, such as esophoria (inward deviation), exophoria (outward deviation), hyperphoria (vertical deviation), and cyclophoria (torsional or rotational deviation).[7] These deviations can occur at near, distance, or both. Heterophoria are relatively common and can be present in both individuals with normal vision and those with refractive errors like myopia, hyperopia, or astigmatism. However, certain studies suggest that certain types of heterophoria, particularly esophoria at near distances, may be more prevalent in myopic individuals. The exact relationship between heterophoria and refractive errors, including myopia, is not fully understood. Some researchers propose that excessive near work and accommodative demands associated with myopia development may influence the prevalence or magnitude of heterophoria, particularly esophoria. However, more research is needed to establish a clear understanding of this relationship.[8,9]

Myopia and phoria are correlated to each other. Concomitant strabismus is due to refractive error. Increase in myopia also increases chances of phoria in subject. Phoria is a misalignment of the eyes so that their natural resting point is not perfectly aligned. It is only seen when fusion is broken that is one eye is covered or when the two eyes are looking at different targets accomplished via Maddox rod 10.[9,10,11,12,13]

METHODS

A cross sectional quantitative study was conducted at ISRA University, Islamabad campus. Study participant were students and staff with myopia in ISRA University, Islamabad age group 18 year and above. Sample size was 100 and non-probability sampling technique was used. The duration of study was from March 2023 till August 2023. Data was collected through a self-designed questionnaire. Phoria in selected participants was detected with the help of equipment/tests including Cover test, Maddox rod, Maddox Wing. Verbal consent from the study participant was taken and ethical certificate was obtained from the Ethical Committee of Pakistan Institute of Rehabilitation Sciences (PIRS) ISRA University, Islamabad.

RESULTS

Among the total 100 participants including 97 students and three staff member, 54 (54%) were female. Amount of phoria before and after correction of myopia using uncover test at near and distance are shown in Table 1 and Table 2.

Table 1: Amount of phoria before and after refractive correction using uncover test at

	Uncover test before refractive correction		Uncover test after refractive correction	
	n	%	n	%
Orthophoria	49	49	80	80
Exophoria	44	44	14	14
Esophoria	6	6	5	5
Hyperphoria	1	1	1	1
Total	100		100	

n=number, %=percentage

Table 2: Amount of phoria before and after refractive correction using uncover test at distance

	Uncover test before refractive correction		Uncover test after refractive correction	
	n	%	n	%
Orthophoria	44	44	71	71
Exophoria	44	44	20	20
Esophoria	10	10	7	7
Hyperphoria	2	2	2	2
Total	100		100	

n=number, %=percentage

Assessment of phoria using Maddox rod before and after refractive correction was performed on all participants. Before correction the mean value for phoria came out to be 1.96 $\pm$0.84 prism diopter and after correction it came out to be 1.65$\pm$0.91 prism diopter. Significant differences (p=0.001)

were seen before and after correction.

Table 3: Amount of phoria before and after refractive correction using Maddox rod

	Maddox rod test before refractive correction		Maddox rod test after refractive correction	
	Frequency	%	Frequency	%
Orthophoria	29	29	59	59
Exophoria	52	52	22	22
Esophoria	15	15	15	15
Hyperphoria	02	02	3	3
Hypophoria	02	02	1	1
Total	100		100	

%=percentage

Assessment of phoria using Maddox wing at horizontal before and after refractive correction shows mean value for horizontal phoria came out to be 6.67 ± 4.488and after correction it came out to be 3.46±2.548. Significant differences (p=0.000) were seen before and after correction.

Table 4: Amount of horizontal phoria before and after refractive correction using Maddox wing

	Maddox wing test before refractive correction		Maddox wing test after refractive correction	
	Frequency	%	Frequency	%
Orthophoria	00	00	02	02
Exophoria	85	85	70	70
Esophoria	15	15	28	28
Total	100		100	

%=percentage

Assessment of phoria using Maddox wing at vertical before and after refractive correction was performed. Before correction the mean value for vertical phoria came out to be 0.21 ±0.808and after correction it was 0.21±0.808. Significant differences (p=1.000) were not seen before and after correction.

Table 5: Amount of vertical phoria before and after refractive correction using Maddox wing

Maddox wing test before refractive correction			Maddox wing test after refractive correction	
	Frequency	%	Frequency	%
Orthophoria	88	88	88	88
Hyperphoria	09	09	09	09
Hypophoria	03	03	03	03
Total	100		100	

%=percentage

Table 06: Amount of phoria before and after refractive correction

	(%)before refractive correction	(%)After refractive correction
Orthophoria	30	61
Exophoria	52	24
Esophoria	14	11
Hyperphoria	02	03
Hypophoria	02	01
Total	**100%**	**100%**

DISCUSSION

The results shown by our study are consistent with the outcomes of the previous research conducted in 2021 on the "Assessment of Types of Phoria in Myopic patients before and after Refractive Correction" from the University of Lahore Teaching Hospital, Lahore. They used a Maddox rod for evaluation of Horizontal and vertical phoria at distance. In this study, the phoria in myopic participants is decreased after the Refractive Correction and the results are similar to our study.[5]

Results of the types about distance horizontal heterophoria studies showed that orthophoria accounted for 7.3%, while the other 92.7% ones had different kinds and extents of heterophoria (exophoria more than esophoria: 79.33% vs 13.3%). In the near heterophoria tests, 96% ones had different kinds and extents of heterophoria (exophoria:86% vs esophoria: 9.3%).[6,11,12] Current study results also have similar findings as without refractive corrections, results also had heterophoria greater than orthophoria and the percentage of exophoria is more like the study conducted at North Sichuan Medical College.[13,14]

In 2020 a study was conducted on the Prevalence of heterophoria in a population of school children in central China, "the Anyang Childhood Eye Study". The results of this study showed that total 2260 students in grade 7 were examined. The response rate among eligible children was 95.64%.[14,15,16] In total 486 children i.e 22.66% of the population was diagnosed with heterophoria in which 479 were diagnosed with exophoria at near distance,and 6 with esophoria.[17] Totally 89

(4.15%) children were diagnosed with heterophoria in which 82 had exophoria, and 7 had esophoria at far distance. Exophoria was common at near fixation (22.33%). Myopia was examined to be related to exophoria at near distance (OR 3.03, 95%CI 2.33-3.95) and far distance fixation (OR 1.90, 95% CI 1.09-3.32).[18] Results of the current study also correlate with the above study findings as before correction the mean value for horizontal phoria came out to be 6.67 ± 0.45 and after correction it came out to be 3.46±0.25. Significant differences (p=0.000) were seen before and after correction and before correction the mean value for phoria came out to be 1.96 ± 0.84 and after correction, it was 1.65 ±0.91. Significant differences (p=0.001) were seen before and after correction.[19,20]

CONCLUSION

From the results both horizontal and vertical phoria at a distance using the Maddox rod while following correction, it was observed that horizontal phoria occurred more frequently than vertical phoria. Among horizontal phoria, there was a notable shift of the exophoric pattern, which can be associated with insufficient fusional reserves. The overall finding suggests a reduction in phorias among myopic individuals after refractive correction.

RECOMMENDATION

The study's generalizability may be limited by the dominance of student participants. Future research could aim for a more diverse sample, including a broader range of occupations. Similarly, longitudinal studies could explore the stability of refractive corrections and the persistence of ocular conditions over time.

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Authors' Contributions:

SG: Conceptualization and design of the study, drafting, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.

KA: Data acquisition, review and approval of the final manuscript and agrees to be accountable for all aspects of the work.

NM: Data analysis, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.

AB: Data interpretation, review and final approval of the final manuscript and agrees to be accountable for all aspects of the work.

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