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RESEARCH ARTICLE

Assessment of Stereopsis in Myopic and Hyperopic Anisometropia

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ABSTRACT

Background: Anisometropia, a condition where each eye has a different refractive power, can significantly affect binocular vision and depth perception. Myopic and hyperopic anisometropia may lead to disrupted stereopsis, impacting visual performance and quality of life.
Objective: The purpose of the study was to assess and compare the impact of myopic and hypermetropic anisometropia on stereopsis.
Methodology: This cross-sectional study was conducted from August 2021 to December 2021 at Madina Teaching Hospital, Faisalabad. About 30 individuals of both sexes were included, aged from 12 to 25 years. A non-probability convenient sampling technique was employed to access the data. Patients having refractive anisometropia were included, and those with any type of ocular pathology, infections, strabismus, and amblyopia were excluded. Stereopsis was assessed binocularly with best refractive correction by the TNO chart (a clinical test for evaluating stereopsis). An independent sample *t*-test was used with the help of IBM SPSS-20 to get a statistical result.
Results: The results of the study showed that the mean value of 120 ± 69.282 seconds of arc scoa red by myopic anisometropic and 276 ± 150.20 second of arc by hyperopic anisometropic. Although the normal values for stereopsis for an emmetropic person should score 60 seconds of arc, which means that minimum value for stereopsis reveal good and increased levels for stereopsis. As the mean values for stereopsis in both myopic and hyperopic anisometropia are greater than the normal value of stereopsis, this shows that both the myopic and hyperopic anisometropic persons have decreased levels of stereopsis.
Conclusion: The results of the study concluded that anisometropia reduces stereopsis; however, these reductions are more significant in hyperopic anisometropia as compared to the myopic anisometropia. Study recommends making stereopsis assessment and management as an integral part of routine examination to improve the qualities of life who are suffering.

INTRODUCTION

The term ametropia (refractive error) depicts any condition where light is inadequately focused on the retina of the eye, bringing about obscured vision. This is a typical eye issue and incorporates conditions, for example, myopia (near-sightedness), hypermetropia (far-sightedness), astigmatism, and presbyopia is an age-related decrease of vision. (Agarwal *et al*. 2002). Anisometropia is a condition in which both eyes of an individual have different refractive power (Khurana *et al*. 2014). In myopic anisometropia, the sharpness of distance vision in each eye is lower than normal, the more nearsighted eye having less clearance of vision. In any case, when the measure of nearsightedness in the less nearsighted eye is small (minus 0.25 or 0.50 D), the visual sharpness in that eye is adequately great with the goal that the patient may not know about the issue, regardless of whether the visual keenness in the more nearsighted eye is very poor.

In hypermetric anisometropia, the visual sharpness of the two eyes is moderately good as long as the patient has adequate accommodation (Khurana and Khurana 2015). Stereopsis is specifically referring to perception of depth in relation to binocular single vision (Fig. 1), which makes basics for seeing three dimensional images (Howard and

Rogers 1995).

Coarse stereopsis and fine stereopsis are two main aspects of depth perception. Coarse stereopsis (also known as qualitative or gross stereopsis) is used to detect stereoscopic motion which is changes in binocular disparities in a real-life three-dimensional scene over time in ones surrounding (Barry 2009). Fine stereopsis (quantitative stereopsis) enables an individual to perceive the depth of an object in central visual area (pannum's fusional area). Fine stereopsis is essential to perform fine motor tasks (Barry 2012). TNO (Toegepast Natuurwetenschappelijk Onderzoek) test is used for assessment of stereopsis (Fig. 2)

Stereo acuity development in children with normal binocular single vision. The lower limits of stereo acuity compatible with normal binocular single vision were 3 1/2 years, 3,000 seconds; 5 years, 140 seconds: 5 1/2 years, 100 seconds; 6 years, 80 seconds; 7 years, 60 seconds; and 9 years, 40 seconds (Shah *et al*. 2009).

MATERIALS AND METHODS

A cross-sectional study was conducted from August 2021 to December 2021 in the Department of Ophthalmology, Madina Teaching hospital Faisalabad, Pakistan. All patients included in the study were selected through non-probability convenient sampling technique. Total number of patients included in the study was 30. Both genders were included, age ranged from 12 to 25 years. 15 patients with refractive hyperopic anisometropia (spherical) and 15 patients with refractive myopic anisometropia (spherical) were included. All the patients have anisometropia of greater than 1D without any ocular pathology. All cases with strabismus, media opacity, patients with history of any ocular surgery, ocular trauma, cataract, pseudophakia, aphakia, amblyopia, keratoconus, and ocular pathologies were excluded. After taking both verbal and written consent detailed history was taken.

Subjective plus objective refraction was done to confirm myopic and hyperopic anisometropia. Stereopsis was tested in both myopic and hyperopic anisometropia. TNO chart was used to measure the stereopsis with best corrected visual acuity of the anisometropic patient. After the collection of data, independent sample *t*-test was used with the help of IBM SPSS-20 to get statistical results.

RESULTS

To check the normality of data Shapiro-wilk test was applied. After analysis, it showed, that non-significant ($p>0.05$), so parametric test was used. The study included 30 anisometropic patients with age ranging from 12–25 years. Out of them 15 had myopic anisometropia and 15 had hyperopic anisometropia. The study showed that 12(40%) were male and 18(60 %) were female with mean age 16.93.

For qualitative assessment of stereopsis, among the myopic anisometropic group, gross stereopsis was present in

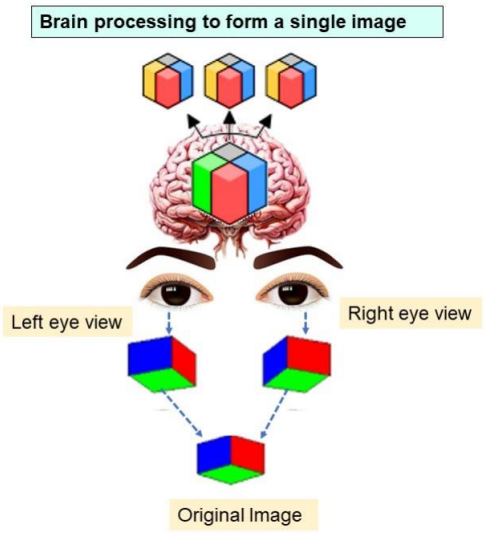

Fig. 1: Stereopsis view

Fig. 2: TNO test for stereopsis

13(86.6%) and remaining 2(13.3%) showed absence of gross stereopsis. Results obtained from the hyperopic anisometropic group showed that gross stereopsis was present 11(73.3%) and the remaining 4(26.6%) did not had gross stereopsis and showed absence of stereopsis. More subjects from myopic anisometropic group showed presence of stereopsis as compared to the hyperopic anisometropic group By analyzing both of the results, presence of gross stereopsis in myopic anisometropic was more significant than that of hyperopic anisometropic.

Quantitative assessment of stereopsis for myopic and hyperopic anisometropia was done which resulted means value of 120 ± 69.282 sec of arc scored by myopic anisometropic and 276 ± 150.20 sec of arc by hyperopic anisometropic subjects included in this study. Although the normal values for stereopsis for an emmetropic person should score 60 sec of arc which means that minimum value for stereopsis reveals good and increased levels for stereopsis. As

Table 1: Comparison of stereopsis of myopic anisometropia and hyperopic anisometropia

Levense's test for equality of variance			*t*-test for equality of means						
Parameters	F test	Significance	*t* test	df	Significance (2-tailed)	Mean difference	Standard error difference	95% confidence interval of difference	
								Lower	Upper
Equal variance assumed	6.789	0.018*	-2.982	18	0.008**	-156.00	52.307	-265.892	-46.108
Equal variance not assumed			-2.982	12664	0.011*	-156.00	52.307	-269.308	-42.692

* P<0.05; ** P<0.01

the mean values for stereopsis in both myopic and hyperopic anisometropia are greater than the normal value of stereopsis, shows that both the myopic and hyperopic anisometropic persons have decreased levels of stereopsis.

On comparison, we find that as myopic anisometropic persons have scored mean value of 120 sec of arc, which is closer to the normal value that is 60 sec of arc as compared to the mean value for stereopsis scored by hyperopic anisometropic subjects that is 276 sec of arc, which is less close to the normal value for stereopsis (Table 1). In this table *P*-value of being less than 0.05 i.e., 0.008 shows that there is difference between the mean effects of the myopic and hyperopic anisometropes which makes it statistically significant. Our results showed that both the myopic and hyperopic anisometropic persons have decreased levels of stereopsis than that of normal value, but this reduction is more obvious among hyperopic anisometropes as compared to the myopic anisometropes.

DISCUSSION

The aim of our study was assessment of stereopsis in myopic and hyperopic anisometropia. Our main objectives are to compare stereopsis in myopic anisometropes with hyperopic anisometropes. Results obtained in the previous research study completely agree to our study that anisometropia causes reduction of stereopsis (Habiba and Hussain 2017).

Another study which agrees to our results that spherical hyperopic anisometropia had much adverse effects on binocular visual functions and stereopsis than that of myopic anisometropia (Weakley 2001). Previous research suggested that anisometropia causes reduction of stereopsis in myopic and hyperopic forms of anisometropes, which makes an agreement to the results of our study but disagrees when his results says that these reduced changes are more significant among myopic type of anisometropia. This opposition is due to the fact that previous study experimentally induced anisometropia on emmetropes to carry out his study, but we have assessed stereopsis on subjects having refractive anisometropia and our results disagree to that research results because our results show that reduction of stereopsis is more obvious among hyperopic form of anisometropia as compared to the myopic form of anisometropia (Nabie *et al.* 2017).

According to past research, increasing degree of anisometropia causes decrease in the levels of stereopsis which supports the results of our study. Likewise, it has been found in the study that anisometropia has adverse effects on stereopsis which also agree to our study (Tarczy-hornoch *et al*. 2011). Lee *et al*. (2013) reported that wearing glasses was better in myopic anisometropia as compared to the hyperopic anisometropia that agree to our study but they also concluded that the stereopsis was clinically normal in anisometric patients wearing their subjective corrections despite of the extent of anisometropia, that contradicts our findings, our study found that there is decrease in stereoacuity with increasing degree of anisometropia.

CONCLUSION

Our results showed that Anisometropia has worse effects on stereopsis in both myopic and hyperopic forms of anisometropia. Loss of stereopsis is more significant in hyperopic anisometropia as compared to myopic anisometropia. anisometropia causes a reduction of stereopsis, which in turn affects the quality of life of patients. This study suggests making stereopsis an integral part of routine examination. Patients, especially those of a younger age, should be carefully treated as their chances of developing amblyopia is common with anisometropia.

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AUTHOR CONTRIBUTIONS

SA: Conceptualization of study design, data analysis, data interpretation; AK: Data collection, data analysis; QA: Data collection, write-up; ZR: Literature search; RFN: Literature search, write-up

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest

DATA AVAILABILITY

The data will be made available on a fair request to the corresponding author

ETHICS APPROVAL

Not applicable

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