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Stereoacuity in Varying Degrees of Myopia Before and After Correction

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ABSTRACT

Background: Stereoacuity is measure of three-dimensional perception due to binocular disparity, helps in recognizing depth while perceiving distance, along supporting in recognition of solid objects. **Objective:** To compare the stereoacuity among varying degrees of uncorrected myopia and after its correction. Secondly, to compare stereoacuity before and after correcting myopia. **Study Design:** Comparative cross-sectional study. **Settings:** University Of Lahore Teaching Hospital, Lahore Pakistan. **Duration:** Study duration was from September 2020 to May 2021. **Methods:** Sample size was calculated by sample size calculation formula and it was 60. 17 males and 43 were females, aged 18 to 25 years by using non-probability convenient sampling technique. Proforma was used to collect relevant data after taking informed consent. Stereoacuity was measured by using Titmus test before and after correcting varying degrees of myopia. **Results:** Varying degrees of myopia included 34 patients having low myopia, 21 moderate myopia and 5 patients were high myopic. There was significant difference of stereoacuity in low, moderate, high degrees of myopia (p value =0.00). Mean stereoacuity was 579 ± 1050 seconds of arc. More reduction in stereoacuity was noted in high myopes. Comparing stereoacuity before and after correction depicted significant improvement in stereoacuity (p value =0.019) after correction. **Conclusion:** Varying degrees of myopia have significant difference in their stereoacuities. So, correction of myopia is very important for preserving of the third grade of binocular single vision.

Keywords: *Stereopsis, Myopia, Binocular disparity, Degrees of myopia, Binocular vision.*

INTRODUCTION

Eye is one of complex human body's organs. It consists of three layers i.e., cornea, sclera and the retina. Retina is the inner layer where image is formed in emmetropic patient.[1]

Refractive error is the condition in which rays of light from infinity are focused not on the retina. It may be because of axial length and optical power of the eye. One refractive error of currently scientific interest is myopia, in which rays of light from infinity focused Infront of retina.[2] Myopic patient experience blurring vision at distance, while they have good near vision. Myopia is divided it into many types depending upon the anatomical features, degree of myopia, rate of myopic progression, physiological and pathological, hereditary and environmentally induced, age of onset. Some of these are mild, moderate, severe, axial, index, curvatural myopia.[3] Treatment options for myopia includes concave lenses' spectacles, contact lenses, refractive procedures besides this there are pharmaceutical agents i.e., atropine that slow down the progression.[4] Each eye sees a slightly different perspective when a visually normal human being looks at an object and sends those images back to the brain. The differences are integrated into a single one between the two images and the differences are used to illustrate what is nearer, etc. producing the 3-dimensional effect. This is the stereopsis.[5] In one of the studies conducted by regarding aniseikonia and amblyopia, it was found that addition to strabismus, aphakia, monofixation syndrome and nystagmus these are some of the causes of impaired development of the stereopsis.

Besides this unilateral reduced visual acuity also results in the reduced stereoacuity.[6] Ability of the eyes perceiving 3 Dimensional develops in the very starting months after birth. Stereopsis continues over much smaller range of binocular disparities making the eyes enable in getting fine depth perception even when the object is dense textured, for example tree bark, in which there are no cues monocularly or if present are very few.[7]

Stereoacuity not only helps in recognizing the depth while perceiving the distance, but also supports in recognition of some solid objects. Visual system requires binocularity in order to gain 3D perception, and in this way maintaining an exclusive presentation of the object seeing through two eyes. Fusion is the sensory mechanism that unites the images of the eyes as a single, and eye movements not only in the case of fusion but also vergence have evolved thus supporting stereopsis. Minimum disparity is used to measure the stereoscopic acuity eliciting the depth sensation.[8] Stereopsis may be decreased by anisometropia by reducing binocularity. Controversy surrounds the precise process by which anisometropia reduces stereoacuity. Decreased stereopsis has been theorized to be caused by foveal suppression in the defocused eye.[9] The performance of numerous tasks, including motor gestures, is supported by normal or higher levels of stereopsis. The sort of sport, the position played, the environment and style of the performance as it unfolds all work together to define the set of visual skills needed and resulting relevance of stereopsis.[10] In case of pathology like, retinitis pigmentosa (RP) abnormal inter-ocular retinal sensitivity and insufficient Panum's area usage, which results in an inaccurate retinal localization, progressive RP degeneration in the cone system may decide a considerable impairment in binocular vision.[11] By using virtual reality technology, defects in binocular visual function were found in children whose television torticollis persisted after regular refractive error correction. Television torticollis may be associated with the deficit of binocular integration for vertical bars and far distance stereopsis.[12] Regarding stereopsis in patients with refractive errors i.e., hypermetropia, myopia, astigmatism etc. was investigated and conclusion was reduced stereoacuity. Management includes correcting the cause which in this case would be the correction of refractive error.[13]

METHODS

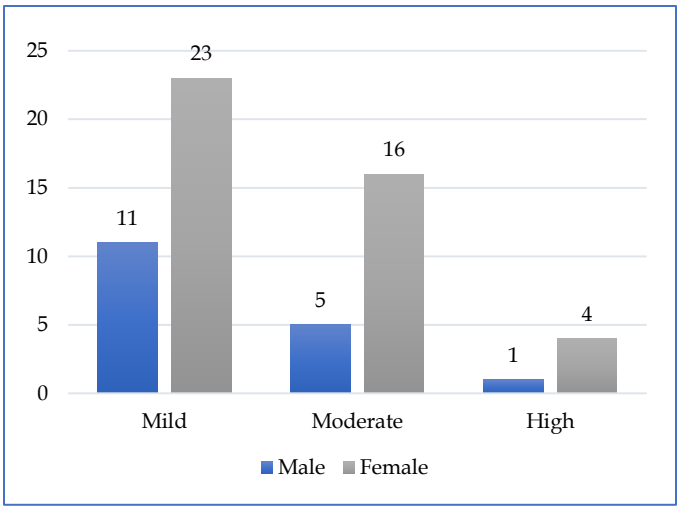
This comparative cross-sectional study was conducted in the University of Lahore Teaching Hospital, Lahore from September 2020 to May 2021. Sample size was calculated by sample size calculation formula, $n = [z^2p (1-p)]/ d^2$, it was 57, but on safe side 60 subjects were selected by non-probability consecutive sampling. Subjects of both genders aged 18-25 years old were included and were divided into three groups. Group 1 having Low myopia (-0.5DS to -2.00DS), group 2 Moderate myopia (>-2.00DS and up to -6.00DS) and group 3 High myopia(>-6.00DS). The subjects who were hypermetropes, astigmats, amblyopes, aphakis, pesduphakics, binocular anamolies or having any systemic and other ocular pathologies were excluded. Data was collected from the subjects by researcher administered proforma. Complete demographic data ocular and systemic history was taken from each subject. After that Subject's best corrected visual acuity was taken by snellen's chart. Subjective refraction was done and prescription was documented. Titmus fly test was used for measuring stereoacuity in varying degrees of myopia. This instrument consists of a booklet having two plates. It is viewed by wearing Polaroid spectacles. Right plate was having a large fly, while on left there was a series of animals and circles. Procedure of using this titmus test was easy and was done at a distance of forty centimetres. It was done binocularly before and after the correction of myopia. All the volunteers were instructed about the whole procedure. They were ensured that their information will be kept confidential and will be used for research purpose only.

Data was analyzed through SPSS version 22. Paired sample t test was applied for comparison of stereoacuity of the patients between the before and after correction. For comparison between varying degrees of myopia, analysis of variance ANOVA test was applied.

RESULTS

This was a comparative cross-sectional study and the purpose of this study was to check the stereoacuity in varying degrees of myopia and also to check the stereoacuity before and after correction. This study included total of 60 patients out of which, 17 were males and 43 were females. Gender wise distribution of degree of myopia is given hereby (Figure 1).

Figure 1: Gender wise distribution of degree of myopia



To find out the results of the first objective i.e., to compare the stereoacuity in the varying degrees of uncorrected myopia and after its correction, one way ANOVA test was applied and the results were significant (Table 1).

Before correction of the varying degrees of myopia, the significant results (p value = 0.00) depicts that there lies a difference of stereoacuities among uncorrected varying degrees of myopia.

Similarly, by applying one way ANOVA significant result (p value = 0.03) showed that after correcting the myopia, stereoacuity still differs among low, moderate and high myopia.

Table 1: ANOVA test results of Stereoacuity in varying degrees of myopia before and after correction

Parameter	Sum of Squares	Mean Square	Sig
Stereoacuity among mild, moderate and high degrees of myopia before correction	40993437.479	20496718.739	.000
Stereoacuity among mild, moderate and high degrees of myopia after correction	73.333	36.667	.003

For comparing the stereoacuity between before and after the correction of varying degrees of myopia, Paired sample t test was applied. Significant results of stereoacuity before and after correction of varying degrees of myopia (p value = 0.019) were obtained. It showed that after correcting varying degrees of myopia there was significant improvement of stereoacuity (Table 2).

Table 2: Paired sample t test results of stereoacuity between before and after correction of varying degrees of myopia

Pair 1	Number of patients	Mean ± SD	Sig
Stereoacuity before correction of varying degrees of myopia & stereoacuity after correction of varying degrees of myopia	60	538.67 ± 1049.68	0.019

DISCUSSION

In the current study stereoacuity before and after correcting the myopia was evaluated using titmus test. The results were significant (p value = 0.019) and showed significant improvement in stereoacuity after correction. It agreed with a cross sectional study that was conducted to assess the stereopsis' level and fusion in anisometropic type of amblyopes. Stereopsis was evaluated by Titmus test and it was found that significant (p value = 0.03) stereopsis was worse in anisometropic-amblyopes than the non-anisometropic ones and the control groups. It was concluded that Full Prescription glasses improved binocularity and vision.[14] Another study was carried in the year 2014 and its results agreed with our study. That was a prospective observational study carried out in the Ophthalmology Department of Saveeta Medical college. Stereopsis was evaluated using TNO test at a distance of 30 cm using red green glasses. A baseline stereopis was evaluated before the myopic error were corrected and after correction of these refractive errors. There was a significant improvement (p value = 0.003) in stereopsis after correcting myopic refractive error.[15] Similar to this a study was done with the aim of investigating stereopsis among refractive errors. The stereoacuity in hyperopia, myopia and astigmatism was significantly different (p value = 0.03) before and after correcting the refractive error. Stereoacuity was more effected in hypermetropia, while myopia had comparative better value of stereopsis.[16] To investigate the association of stereoacuity in myopic subjects with and without refractive correction in patients with amblyopia and squint and those without amblyopia and squint. Stereoacuity was measured with TNO stereoacuity test. TNO stereoacuity test was performed at a distance of 40 cm. There was significant (p < 0.0001) difference between the aforementioned two.[17]

A cross-sectional study was conducted in Khatam-Al-Anbia Eye Hospital of Mashhad University of Medical Sciences. That study included 80 subjects with myopic as well as hyperopic refractive correction. The results showed that the patients with severe degree of myopia or hyperopia had significantly reduce in stereoacuity (p value = 0.02) as compared to the individual with low dioptric value.[18] This study agreed with the current study's results that presents significant (p value = 0.00) different levels of stereoscopic vision in different levels of myopia. The results of a study that was conducted with the aim to investigate the stereopsis in myopic refractive error study were quite similar to present study that mentions significant improvement (p value = 0.019) in the stereoacuity after the patients were assessed with the spectacles.[19] The assessment of the stereoacuity was carried out on a normal emmetropic group and the range of age and sex matched group having refractive error of different severity of hypermetropia and myopia. The

result of this study concluded that the presence of the stereoacuity changes depend on the severity of refractive error in both types of ametropia. It was observed in this study that there was a significant association of reduction (p value = 0.03) of both visual acuity and stereoacuity when compared with the normal emmetropic groups in both cases with and without glasses.[20] This study agrees with the current study as there is statically difference of stereopsis among the different levels of myopia (p-value = 0.03).

CONCLUSION

This study concluded that patients with varying degrees of myopia have significant difference in their stereoacuities as well as there is significant improvement in stereoacuity after correcting the myopia. Therefore, correction of myopia is very important for preserving the third grade of binocular single vision.

LIMITATIONS

There were no significant limitations in the study.

SUGGESTIONS / RECOMMENDATIONS

By this study it is recommended that screening of myopia should be done more often in pediatrics so that early diagnosis and consequently early management is possible. To reduce the problems as a result of decreased stereopsis, like inability to perform activities that require depth perception of the objects, underlying cause should be treated or managed as soon as possible.

CONFLICT OF INTEREST / DISCLOSURE

There are no conflicts of interest.

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