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COMPARATIVE EVALUATION OF THE STEREOACUITY IN SUBJECTS HAVING EMMETROPIA, ISOMETROPIA AND ANISOMETROPIA

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ABSTRACT

Background: Stereoacuity is a measure of stereopsis and the ability to distinguish variations in depth depending on binocular disparity. A child's daily activities may be adversely affected by astereopsis impairment. **Objective**: The current clinical investigation set out to assess stereoacuity in people with anisometropia, isometropia, and emmetropia in comparison.

Methods: Seventy-two children, aged five to fifteen, were evaluated for the study. They were split into three groups: emmetropes, including 250 subjects; isometropes, comprising 250 subjects; and anisometropes, comprising 202 subjects. When measuring stereoacuity using a combination of contour targets, the Titmus stereo test was employed. Ambylopic eyes were 78 and 129 among isometropes and anisometropes, respectively.

Results: There were 357 men and 345 women in the research. Stereoacuity was much lower in anisometropes than in emmetropes and isometropes. The stereoacuity was lower in ambylopes. A decent stereoacuity was seen in most patients with anisometropia of <3.0. A progressive decline in stereoacuity was seen when the anisometropia degree increased to >3.0 D. There was a noticeable loss of stereoacuity in cases of severe anisometropia greater than 6.0 D. There was a decrease in stereoacuity when the anisometropia was ≥2.12 D.

Conclusion: In anisometropes, the three conditions with the lowest stereoacuity were myopia, myopia with astigmatism, hypermetropia, and hypermetropia with astigmatism. In comparison to emmetropes and isometropes, the study suggests that anisometropes have the worst stereoacuity. Ambylopes experience a higher loss in stereoacuity than non-amblyopes. Stereoacuity diminishes as anisometropia increases in degree. Myopes in anisometropes have lower stereoacuity than hypermetropes.

Keywords: Anisometropia, ambylopes, emmetropia, isometropia, stereoacuity

INTRODUCTION

A single visual impression felt in depth is the outcome of the abrupt activation of horizontally different retinal parts, which leads to stereopsis. While fine stereopsis is necessary to perform fine motor activities, gross stereopsis is necessary for orientation in a place during a walk. For activities linked to surface inspection and analysis, a stereoscopic picture is also required.[1]

Stereopsis, also referred to as the third degree of vision, is the distinctive and visual perception of a three-dimensional structure that is observed via binoculars when genuine or stimulated three-dimensional images are viewed. Stereopsis has to do with the convincing sense of solidity or three dimensions.[2] Between a perceptual feeling of reality and the space between the objects, stereopsis clearly conveys space. The visual characteristics are traditionally considered a result of various views of an object that can be afforded with the motion parallax (self-motion) and disparity (binocular vision).[3]

Anisotropia was interpreted by the majority of earlier literature data as a variation in 1D interocular refractive power. It is commonly recognised that anisometropia impairs binocularity and reduces stereopsis. It has been shown that the primary cause of the decrease in stereopsis is the suppression of the fovea in the defocused eye. There is little information in the literature about stereopsis assessment.[4]

Therefore, the purpose of the current clinical investigation was to compare the stereoacuity of people with anisometropia, isometropia, and emmetropia.

MATERIALS AND METHODS

The goal of the current cross-sectional retrospective clinical investigation was to assess stereoacuity in people with anisometropia, isometropia, and emmetropia in comparison. Since the study involved the retrospective examination of data from CPSCO and the DHR-approved Institutional Ethical Committee (IEC), consent was waived. The study's inclusion criteria were participants with anisometropia of >1D, isometropia, or emmetropia between the ages of 5 and 15. Subjects who were reluctant, had a history of ocular trauma, had undergone prior ocular surgery, had lenticular opacity, non-centric fixation, ocular deviation, or fuzzy media were excluded.

An interocular difference of greater than 1.00 D in the spherical equivalent and 0.75 D in the cylindrical equivalent was considered anisometropia for the purposes of this study. Amblyopia was defined as bilateral visual acuity of 6/12 or worse, or a difference in visual acuity of two lines or more on the ETDRS (Early Treatment Diabetic Retinopathy Study) chart between the eyes. Following the final inclusion of research subjects, each participant had a thorough visual examination and a full history collected. A single refraction specialist performed the cycloplegic and post-mydriatic refraction tests on each individual by hand. With the patients sat four metres away, an ETDRS chart was utilised to measure the subjects' distant visual acuity and refractive status. The results were reported in logMAR units.

The cycloplegic refraction was recorded after the near vision on a Jaeger chart. After that, the refractive correction was advised. The spherical component including the ½ cylinder component of the spherical equivalent was computed for each of the research subjects. To rule out any existing ocular disease, a thorough fundus and slit-lamp examination was performed on all participants utilising slit-lamp biomicroscopy as well as indirect and direct ophthalmoscopy with a 90-D lens.

One orthoptist expert who was unaware of the refractive status of any research participants completed the Titmus Stereo Test 5 to evaluate stereoacuity using mixed contour targets. Before the test, the individuals wore their best refractive correction to gauge their stereoacuity. The individuals were instructed to see the stereo chart from a distance of 40 cm while donning the polarised glasses. The last one, which determined if the animal or circle accurately judged seconds of arc, was used to determine the stereopsis level. The maximum (finest) stereoacuity was measured at 40 seconds of arc, while the lowest stereoacuity was measured at 3552 seconds of arc.

The study's subjects were split up into three groups: 202 individuals in Group III, 250 people in Group II, and 250 subjects in Group I, which consisted of emmetropes. Isometropes and anisometropes were further divided into four subgroups based on the kind of refractive error: hypermetropia with astigmatism, hypermetropia, myopia with astigmatism, and myopia.

The difference in spherical equivalent or the degree of anisometropia between two eyes in the anisometropic group was further classified as mild, moderate, and severe with >1-3 D, >3-6 D, and >6 D respectively.

In the anisometropic group, the degree of anisometropia, or the difference in spherical equivalent between two eyes, was further defined as mild, moderate, and severe, with >1-3 D, >3-6 D, and >6 D, respectively. Using the SPSS software version 21.0, an independent t-test and a one-way ANOVA (analysis of variance) test were used to statistically analyse the collected data. P-value greater than 0.05 were regarded as statistically significant.

RESULTS

Seventy-two people, aged five to fifteen, were evaluated for the study. They were split into three groups: emmetropes, including 250 subjects; isometropes, comprising 250 subjects; and anisometropes, comprising 202 subjects. When measuring stereoacuity using a combination of contour targets, the Titmus stereo test was employed. Ambylopic eyes were 78 and 129 among isometropes and anisometropes, respectively.

Within the anisometropia group, the following conditions were seen in 17.32% (n=35), 19.80% (n=40), 33.66% (n=68), and 28.71% (n=58) of the research participants, respectively: hypermetropia, hypermetropia, myopia with astigmatism, and myopia. Of the research individuals, 43.56% (n = 88), 36.13% (n = 73), and 19.80% (n = 40) had mild, moderate, or severe anisometropia, respectively. Within the isometropia group (II), the following study patients had the condition: 13.2% (n=33), 15.6% (n=39), 38.8% (n=97), 34.4% (n=86), and hypermetropia with astigmatism. The research participants had a mean age of 9.72±2.42 years and ranged in age from 5 to 15 years. In the current study, there were 48% (n = 337) men and 51.85% (n = 364) females. In terms of age or gender, there was no discernible difference between the three research groups.

In anisometropics, the right eye showed more refractive error than the left, with 52% and 48% of patients, respectively. One eye was designated as the fellow eye and the other as the worst because to its high refractive index. Of those with anisometropia, 64% (n=129) had amblyopic eyes. 36.2% (n=21), 48.5% (n=33), 71.3% (n=28), and 75.5% (n=28) of the eyes with myopia, myopia with astigmatism, hypermetropic group, and hypermetropia with astigmatism, respectively, had the worst amblyopia. 4.2% (n = 2), 5.2% (n = 3), 11.3% (n = 4), and 14.7% (n = 10) of the participants with myopia, myopia with astigmatism, hypermetropic group, and hypermetropia with astigmatism, respectively, had amblyopia in their colleague eyes. The worse eyes in every category had significant anisometropia and were amblyopic.

A small number of Group II participants had isometropic amblyopia (isometropia) due to bilateral and equal high refractive error. 31% (n=88) of the eyes in isometropes were amblyopic. 7.5% (n = 6), 11.5% (n = 5), 17.5% (n = 16), and 38.8% (n = 13) of the myopia, myopia with astigmatism, hypermetropic, and hypermetropia with astigmatism subgroups, respectively, had amblyopic right eyes. 7.6% (n=7), 11.5% (n=4), 15.3% (n=14), and 39% (n=13) of the left eye's population with myopia, myopia with astigmatism, hypermetropic, and hypermetropia with astigmatism, respectively, had amblyopia.

The Titmus Stereo Test measured stereoacuity in seconds of arc, ranging from best (40) to worst (3552). The anisometropia group's mean stereoacuity was 614.42±1027.82, with a range of 40–3552 seconds of arc. There was a statistically significant negative connection between the degree of anisometropia and stereoacuity, with $p<0.001$.

Amblyopic eyes in the anisometropia group had lower stereoacuity (1002.23±1199.86 versus 148.14±447.86, respectively) than non-amblyope eyes ($p<0.001$). Stereoacuity in the isometropia group was 132.36±405.434, with $p<0.001$ showing that amblyopes had poorer stereoacuity than non-amblyopes (583.67±889.96 and 46.36±11.73, respectively). The range of 40–60 seconds of the arc was the mean stereoacuity (40.14±1.56) in the emmetropic group. When the same subgroup of subjects without anisometropia was assessed for stereoacuity, the mean scores were as follows: 378.85±310.157 for subjects with hypermetropia and astigmatism, 676.06±1010.877 for subjects with hypermetropia, 783.14±1246.369 for subjects with myopia and astigmatism, and 518.23±1014.29 for subjects with myopia. According to Table 1, the astigmatism subgroup had the highest stereoacuity in myopia, and the difference was statistically significant ($p=0.031$).

The degree of anisometropia was shown to correlate negatively with stereoacuity on the bivariate correlation study. Additionally, the subgroups with the lowest stereoacuity are those with myopia, myopia with astigmatism, hypermetropia with astigmatism, and hypermetropia, in that order. Table 2 shows that the results were statistically significant with $p<0.001$.

A comparison of subjects with unequal vision of more than two lines (amblyopes) and those with less than two lines (less than two-line differences) revealed that the former had worse stereoacuity in anisometropes, with a difference in stereoacuity of 1039.96±1245.96 compared to a statistically significant difference with $p<0.01$. Regarding the stereoacuity in the four subgroups of isometropia individuals, the Hypermetropia with Astigmatism subgroup had a lower mean stereoacuity (452.56±922.26) than the other subgroups and was within the normal range in Table 3 demonstrates a statistically significant difference with $p<0.001$ between the groups with mean stereoacuities of 58.23±48.53, 94.23±152.44, and 81.83±280.68 for hypermetropia, myopia with astigmatism, and myopia.

When the total stereoacuity of amblyopes and non-amblyopes of both isometropia and anisometropia groups was analysed, it was found that amblyopes had poorer stereoacuity (930.27±116.87) than non-amblyopes (79.29±238.87) this difference was statistically significant ($p<0.001$).

When the stereoacuity of the three groups—emmetropes, isometropes, and anisometropes—was compared, the mean values were 40.14±1.56, 132.36±405.45, and 614.42±1027.82, respectively. This indicates that anisometropes had worse stereoacuity than emmetropes and isometropes, with a statistically significant difference ($p<0.001$), as Table 4 illustrates.

DISCUSSION

The bivariate correlation study revealed that stereoacuity reduced as anisometropia degree increased. Additionally, the subgroups with the lowest stereoacuity were found to be myopia, myopia with astigmatism, hypermetropia with astigmatism, and hypermetropia, in that order. With $p<0.001$, the results were statistically significant. When it came to anisometropes, subjects with unequal vision of differences greater than two lines (amblyopes) had worse stereoacuity with a stereoacuity of 1039.96±1245.96 compared to subjects with differences less than two lines (622.27±1226.76), a difference that was statistically significant (p<0.01). These findings were in line with earlier research by Habiba UE8 in 2017 and Weakley DR9 in 2001, when the authors noted a drop in stereoacuity along with a decrease in the degree of anisometropia.

According to the study's findings, the mean value of stereoacuity in a subgroup of subjects with anisometropia was 378.85±310.157 for subjects with hypermetropia and astigmatism, 676.06±1010.877 for subjects with hypermetropia, 783.14±1246.369 for subjects with myopia and astigmatism, and 518.23±1014.29 for subjects with myopia. With p=0.031, the difference was statistically significant. The astigmatism subgroup showed the highest stereoacuity in myopia. The reason why myopes have worse stereoacuity than hypermetropes might be due to this significant discrepancy in spherical equivalent. These outcomes were similar to those of earlier research conducted in 2013 by Yang JW et al. and in 2015 by Levi DM et al., who observed similar stereoacuity in patients with anisometropia as those in the current study.

The results of the study also demonstrated that, for the four subgroups of subjects with isometropia, the mean stereoacuity was within the normal range in the groups of hypermetropia, myopia with astigmatism, and myopia, with mean stereoacuities of 58.23±48.53, 94.23±152.44, and 81.83±280.68, respectively. This difference was statistically significant, with a p-value of less than 0.001. This is explained by the fact that the hypermetropia group with astigmatism had a higher number of amblyopes. These results were consistent with those of studies by Levi DM et al. (2010) and Nabie R et al. (2019), the authors of which reported conclusions similar to those of the current investigation.

According to the study's analysis of the total stereoacuity in the isometropia and anisometropia groups of amblyopes and non-amblyopes, amblyopes had poorer stereoacuity (930.27±116.87) than non-amblyopes (79.29±238.87), a difference that was statistically significant (p<0.001). These findings were similar to those of Jeon HS12 in 2017 and Gawecki M13 in 2019, whose authors hypothesised that amblyopes had poorer stereoacuity than non-amblyopes.

When the stereoacuity of the three groups—emmetropes, isometropes, and anisometropes—was compared, the mean values were 40.14±1.56, 132.36±405.45, and 614.42±1027.82, respectively. This indicates that anisometropes have worse stereoacuity than isometropes and emmetropes, with a statistically significant difference (p<0.001).

According to the results of the current investigation, anisometropes had the worst stereoacuity when compared to emmetropes and isometropes, according to studies by Vincent SJ et al.14 in 2003 and Huynh SC et al.15 in 2006.

CONCLUSION

Taking into account its limitations, the current study finds that when compared to emmetropes and isometropes, anisometropes had the worse stereoacuity. Compared to non-amblyopes, ambylopes have a larger decrease in stereoacuity. Stereoacuity decreases as the degree of anisometropia increases. When it comes to anisometropes, myopes exhibit lower stereoacuity than hypermetropes.

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TABLES

Group	**Mean ± S. D**	**p-value**
Hypermetropia with astigmatism	378.85±310.157	0.031
Hypermetropia	676.06±1010.877	
Myopia with astigmatism	783.14±1246.369	
Myopia	518.23±1014.29	

Table 1: Stereoacuity in four subgroups of subjects with anisometropia

Group	**Pearson's correlation coefficient**	**p-value**
Hypermetropia with astigmatism	-6997	<0.001
Hypermetropia	-0.342	0.002
Myopia with astigmatism	-0.756	<0.001
Myopia	-0.817	<0.001

Table 2: Analyzing the degree of anisometropia with stereoacuity in different subgroups

Group	**Mean ± S. D**	**p-value**
Hypermetropia with astigmatism	452.56±922.26	<0.001
Hypermetropia	58.23±48.53	
Myopia with astigmatism	94.23±152.44	
Myopia	81.83±280.68	

Table 3: Stereoacuity in four subgroups of subjects with isometropia

Group	**Mean ± S. D**	**p-value**
Emmetropia	40.14±1.56	<0.001
Isometropia	132.36±405.45	
Anisometropia	614.42±1027.82	

Table 4: Stereoacuity profile comparison in subjects having emmetropia, isometropia, and anisometropia