ASSESSMENT OF STEREOACUITY AND ITS CORRELATION WITH MYOPIC REFRACTIVE ERROR AMONG STUDENTS IN PUDUCHERRY

Abstract

Aim: The aim of the study is to perform the assessment of stereoacuity and its correlation with refractive error among students in Puducherry.

Background: Stereopsis is the term used to describe the process by which a person perceives depth by examining an object's three-dimensional three dimensions using their binocular vision. The minimum angle of binocular disparity that can cause a person to experience stereopsis or depth perception is known as threshold stereoacuity and is measured in arc. Depth perception plays a precise role in our daily near work activities. This study was conducted to see whether there is an improvement in stereoacuity after correcting the refractive error and to assess the stereoacuity and its relationship with myopic refractive error among students in Puducherry in the age group of 10 to 25 years.

Method: This was a Prospective study done with 384 subjects with only myopic refractive error were participated in this study. A prospective study was done to assess the stereoacuity and its relationship with refractive errors. The study begins with the consent form and then all participants were undergoing vision assessment and baseline fine stereoacuity was assessed with titmus stereo test card. Refractive error was corrected with glasses. After one month the subjects were reviewed with their corrected glasses and again reassessment of vision and improvement in stereoacuity were noted.

Results: In this study out of 384 subjects, 260 were myopes with mean of -1.94 ± .771

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SD (range - 0.25D to -6.00 D) , 124 were astigmatic subject with mean of -4.96 ± .820 SD (range -0.25D to -4.50D) were associated with decreased stereoacuity on titmus stereo test . P value =<0.0001 and there was significant improvement in stereopsis after correction of refractive error

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Conclusion: Myopia >1.50 D has reduced stereopsis and >3D has abnormal stereopsis. Astigmatism ranges between 0.50D to 1.00D has reduced stereopsis and >1.00D has abnormal stereopsis. However, with the use corrective lenses there is improvement in stereopsis.

Keywords: Stereoacuity, titmus stereo test, myopia, astigmatism

I. INTRODUCTION

When a typical person focuses their attention on an object, the image is created on the fovea of both eyes separately, but in the case of binocular single vision, the image is formed on the fovea of only one eye. It is perceived by the individual as a single image.[1]

Stereopsis is the term used to describe the process by which a person perceives depth by examining an object's three-dimensional three dimensions using binoculars. The minimum angle of binocular disparity that can cause a person to stereopsis or depth perception is known as threshold stereoacuity and is measured in arc seconds. Adults' stereopsis is influenced by sociodemographic factors, ocular and optical factors, such as best corrected visual acuity level, between-eye variance in best corrected visual acuity, type and degree of refractive error, intraocular variation in cylindrical refractive error, and spherical power type. Stereoacuity can be improved by correcting the refractive error and by maintaining the binocular vision.[2]

Stereoacuity is the smallest amount of difference that results in stereopsis. The measurement of stereopsis is used to identify binocular abnormalities. Stereopsis may be affected by any factor that impairs binocular vision. Stereopsis can be reduced by refractive error. Since stereopsis is a binocular mechanism, anything that impairs binocular vision can likewise have an impact on it. Early detection and treatment of binocular vision abnormalities can avoid them, stereopsis and binocular vision that is ideal for daily near tasks.[3]

The assessment of stereopsis is one aspect of binocular vision examination. For this, there are numerous approaches. Stereoacuity is a static difference that primarily relies on fine stereopsis to gauge an object's depth; it is also known as a quantitative measurement of stereopsis. When performing near activities, stereopsis is essential. Better stereoscopic vision is achieved by lowering the stereoacuity arc second (i.e.., 40 sec of arc).[4]

In seconds of arc, stereo acuity is expressed. Contour and random dot tests are two types of stereoacuity that can be used in analysis. One of the frequently employed tests is the Titmus stereo test, which can be used to measure how well stereopsis works. It is effective for measuring stereopsis performance. Less than 40 seconds of arc is often regarded as the threshold for stereo acuity.[5]

The range of stereopsis in persons is adversely affected by all sorts of refractive errors. Refractive properties may be linked to binocular vision performance. Certain types of refractive errors were linked to a larger proportion of binocular abnormalities. The majority of the research on stereoacuity in people with refractive error has founded in children and young adults.[6]

Refractive error makes it difficult to precisely focus light on the retina. The most prevalent refractive errors are myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. Reduced stereopsis, which compromises binocular single vision, is most frequently caused by refractive error. Myopia, one of several refractive disorders, is one with a high prevalence.[7]

Stereopsis is reportedly lacking at birth and only starts to develop at four months old. There have not been many reports up until now on how stereopsis changes with age. However, the Titmus test is used to quantify stereopsis, and it was found that patients with refractive error had improved stereopsis from childhood to adults. The capacity of the eye to distinguish between two points is known as visual acuity. The locus within the eye that is conjugate with optical infinity during minimal accommodation is referred to as the refractive state. Tasks requiring eyesight are challenging when refractive defect is uncorrected. All types of refractive errors have a negative impact on stereopsis because they cause impaired binocular function and poor sensory fusion, which disrupts the stereopsis.[8]

At first screening of an eye exam frequently includes a stereoscopic vision test. The presence of refractive abnormalities like myopia, hypermetropia, or astigmatism in a person is one of the factors that contributes to a reduction in stereoscopic vision. This occurs as a result of the absence of the prerequisites for producing a decent stereoscopic vision.[9]

Myopia is a condition in which the parallel light rays focus in front of the retina. Myopia frequently causes a reduction in stereoacuity (arc sec) because it interferes with the conditions necessary for producing good stereoscopic vision.[10]

People who perform more near works are more likely to acquire myopia in both children and adults. Myopia is increasing at a rate of about 70 to 80 percent , it some may even call it an epidemic. The prevalence of myopia has increased in both children and adults, rising from 5.8% to 21.[11]

II. MATERIALS & METHOD

There were 384 participants involved including both male and female individuals, and their age ranged from 10 to 25 years of the participants. After clarifying the purpose and design of the study to the parents and attaining the participant's consents, informed permission was acquired. All Patients will be undergoing compressive eye examinations which includes, the visual acuity and refraction was done by using Snellen chart at 6m distance and Jaggers chart used for near vision at 33 cm with a normal room light illumination. Ishihara chart measured at the distance of 70 cm to assess the color vision. Slit lamp examination done to seen the anterior chamber of the individuals. Retinoscopy is used to find out the refractive error. Duo chrome test balanced in the final prescription of the individuals. Stereopsis was checked and recorded using titmus stereo test card. This baseline stereoacuity was noted without correction. Participants were advised to wear the corrective glasses. At one month follow up BCVA and stereopsis were rechecked. Any improvement in visual acuity and stereopsis was recorded.

1. **Procedure:** The booklet was held at 40 cm perpendicular to the subject's visual axis while the test was conducted with the subject wearing polarizing eye goggles. The disparities on this test range in arc from 3000 to 40 seconds. The test includes:

   - A fly for gross stereopsis (3000 seconds of an arc) Shapes test (400 to 100 seconds of an arc)
   - Graded circle test (800 to 40 seconds of an arc)
   - A large-disparity housefly shape and nine sets of circles are all included in the Stereo

Fly test. The fly was displayed first, after which the participant was asked to identify the shapes and one different circle in each pair which is disparate in each set.

Figure 1

In each test, the subject's ability to detect the lowest disparity was noted, and his or her stereo acuity was calculated using the lowest value of an arc second. To quantify the depth perception for their near activities, we assessed the fine stereoacuity from 3000 to 40 arc seconds.

2. Eligibility Criteria

Inclusion criteria:
- Age groups (10 to 25 years)
- Both genders
- Only Myopic refractive error

Exclusion criteria:
- Emmetropic subject
- Squint patients
- Amblyopia patients
- Suppression
- Nystagmus
- H/O ocular trauma / surgery
- Hypermetropic subjects
- Other ocular diseases

III. STATISTICAL TOOL DETAILS

The collected data will be analyzed with SPSS statistics software 28.0 version. To describe about the data descriptive statistics frequency analysis, percentage analysis will be used for categorical variable and for continuous variables the mean and standard deviation will be used. For the entire statistical tool, the probability value of 0.05 will be considered as significant level.

IV.   RESULTS

In this present study out of 384 patients, 260 were myopes with mean of -1.94 ± .771 SD (range -0.25D to -6.00 D) , 124 were astigmatic subject with mean of -4.96 ± .820 SD (range -0.25D to - 4.50D) .

Out of which uncorrected myopia > -1.50 Dsph were associated with reduced stereopsis (80-120 sec of arc) and > -3.00 Dsph were associated with abnormal stereopsis. (200- 800 sec of arc).

Considering uncorrected astigmatic refractive error power ranges between -0.50 and < -1.00 Dsph had reduced stereoacuity (80-120 sec of arc) and > -1.00 Dsph had abnormal stereoacuity (80- 120 sec of arc).

Reduced stereoacuity ranges between (80 – 120 sec of arc) and abnormal stereoacuity ranges between (200- 800 sec of arc). However, there is significant improvement in stereopsis after correction of refractive error.

Table 1 : Agegroups of the Patients

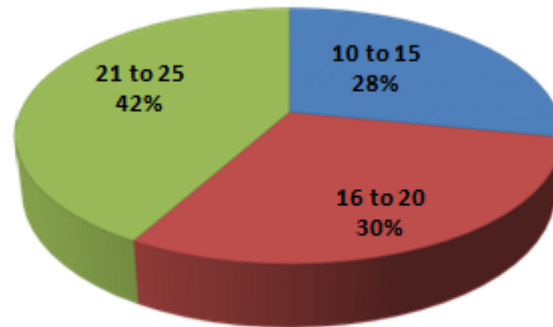| Sl no	Age groups	No. Of participants	Percentage
1	10 to 15	108	28
2	16 to 20	115	30
3	21 to 25	161	42
	TOTAL	384	100

Figure 2: the age group of the participants, out of 384 participants 108 where 10 to 15 years (28%) , 115 where 16 to 20 years (30%) , 161 where 21 to 25 years (42%).

Table 2 : Genders

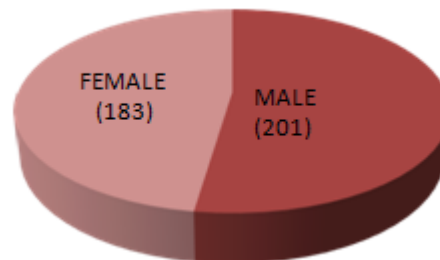| S.No	Genders	No. Of Participants	Percentage
1	Male	201	52.34
2	Female	183	47.66
	Total	384	100

Figure 3: shows the gender of the participants in which male is 201 participants (52.34%) and inwhich female is 183 participants (47.66%)error of participants

Table 3: The profile of mean refractive error of participants. The profile of mean refractiveerror of participants and shows that the profile of mean refractive error of the mean and standard deviation for myopia is -1.94 ±.771 and the range -0.25D to -6.00D and astigmatism is -4.96±.820 and the range-0.25D to -4.50D

Sl No.	Parameters	No. Of Participants	Mean(D) Standard Deviation	Range (D)
1	Myopia	260	-1.94 ± .771	- 0.25D to -6.00D
2	Astigmatism	124	-4.96 ± .820	-0.25D to -4.50D
	Total	384		
The profile of mean refractive error of participants				

Table 4: Stereoacuity in patients with myopia and astigmatism before correction of refractive error

Myopia	Stereopsis without correction			Total	p value
	40 to 60 seconds of arc	80 to 140 seconds of arc	200 to 800 seconds of arc		
1	15	67	3	85	<0.005
2	1	80	24	105	
3	1	2	67	70	
Total				260	
Astigmatism					
4	14	23	7	44	<0.005
5	2	20	19	41	
6	1	8	30	39	
Total				124	
stereoacuity in patients with myopia and astigmatism before correction of refractive error					

Table 5: stereoacuity in patients with myopia and astigmatism after correction of refractiveerror

Myopia	Stereopsis with correction			Total	P value
	40 to60 seconds of arc	80 to 140 seconds of arc	200 to 800 seconds of arc		
-0.25 to -1.50	82	1	2	85	<0.005
-1.75 to -3.00	101	2	2	105	
>-3.00	34	30	6	70	
Total				260	
Astigmatism					
-0.25 to -0.50	42	1	1	44	<0.005
-0.50 to -1.00	36	3	2	41	

>-1.00	21	15	3	39	
Total				124	
stereoacuity in patients with myopia and astigmatism after correction of refractive error					

Table 6: Improvement in stereoacuity after correction

Stereopsis With Titmus Stereo Test	No. Of Participants Before Correction	No. Of Participants After Correction	P Value By Chi SquareTest
40 to 60	34	316	
80 to 140	200	52	<0.005
200 to 800	150	16	
Total	384	384	
Improvement in stereoacuity after correction			

V. DISSCUSSIONS:

Stereopsis is the perception of depth and three-dimensional form that is based on visual data and horizontal disparities acquired from two eyes. Exercises involving practical skills, such as threading needles, catching balls (particularly in fast-pitch sports), pouring liquids, etc., benefit from stereopsis.

However, the Titmus test is used to quantify stereopsis, and it was found that patients with refractive error had improved stereopsis from childhood to adults. However, the Titmus test is used to quantify stereopsis, and it was found that patients with refractive error had improved stereopsis from childhood to adults.

The range of stereopsis in persons is adversely affected by all sorts of refractive errors. Refractive properties may be linked to binocular vision performance. Certain types of refractive errors were linked to a larger proportion of binocular abnormalities. The majority of the research on stereoacuity in people with refractive error has founded in children and young adults.

In the present study 10-25 age healthy individuals are taken for the correlative assessment of stereo acuity test by using titmus stereo test.
In this study, we observed the influence of myopic refractive error on performance of stereo acuity and the improvement of stereopsis after the use of corrective glasses. We found that myopia of >-3 D was associated with abnormal stereopsis. P value for stereoacuity without correction was 0.0001 that is statistically significant, suggesting that there was reduction of stereoacuity.

The estimation on the level stereopsis and proportion of poor stereopsis in patients with refractive error. This might be due to the difference in target population and study

setting. After correction of refractive error the number of patients with poor stereopsis was dropped and compared to before correction, so the present study also strongly agrees with that another study byTilahun, Mered, M., Hussen,r etal….,

According to the results of the present study there was a statistically significant difference between the mean score of   stereopsis between male and female subjects, so that the stereopsis rate of male students was slightly better than females however the previous study by Ahmadi F, Mirzajani A, Jafarzadehpur E, etal…., showsthe mean scores of stereopsis between male and female subjects, so that the stereopsis rate of female students was slightly better than males

Elamurugan, Vignesh; et al Astigmatism was the most prevalent refractive error followed by myopia. Stereopsis was also found to have no correlation with the age and visual acuity at the time of testing or the age at which the child first started wearing spectacles. Stereopsis values obtained from Randot and Titmus fly stereo tests showed moderate agreement. although in this present study disagree with their study.
However, by assisting the stereoacuity with titmus stereo test among the age of 10 – 25 years healthy individuals were significantly correlated.

VI. CONCLUSION

Based on my observation, myopia of >3D, Astigmatism of >1 D are associated with abnormal stereopsis. There was significant improvement in baseline stereopsis after correction of refractive error thus we suggest there is a definite role in screening of preschool children so that the refractive error gets detected and treated early.
 Also, titmus stereo test was effective and easy test for screening and quantifying stereopsis in children and adults. The observations of improvement in stereopsis with use of corrective glasses encourage the practice of prescribing corrective glasses for children.

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