

Original Article

Comparison of Stereopsis in Patients with Fully and Partially Accommodative Esotropia

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Purpose: To evaluate stereopsis in patients with fully and partially accommodative esotropia.

Methods: A total of 60 patients 31 with fully accommodative and 29 with partially accommodative esotropia patients were included in the study to compare the outcome of stereopsis using four stereoacuity test (Lang I test, Lang II test, Lang 2 Pencil test, and Frisby test) the visual acuity and strabismus screening were assessed according with patients age and standard charts and instruments to rule out the degree of visual acuity and the size and the type of deviation, and stereoacuity of all were measured using the four Stereoacuity tests. This study was conducted using predesigned Performa, in College of Ophthalmology and Allied Vision Science Mayo Hospital Lahore, Pakistan.

Result: 25(41.7%) were male and 35(58.3%) were female, with mean age of 9.52. Out of 60 patients, 31(51.7%) were having fully accommodative esotropia and 29(48.3%) were having partially accommodative esotropia. The test result of stereoacuity using four tests reveals presence of good stereoacuity detection in patients with fully accommodative Esotropia and poor stereoacuity in partially accommodative esotropia. Of all 31 patients fully accommodative esotropia, 22 patients (36.67%) were able to read 550 Sec of Arc in Lang I test and 18 (30%) read 200 Sec of Arc in Lang II Stereoacuity chart, in Frisby test, 24 patients (40%) detected disparity between 85-340 Seconds of arc and only 3 (5%) showed no Stereoacuity in Frisby test. While patients with partially accommodative esotropia; however, demonstrated poor Stereoacuity outcome in all four tests. of all 29 patients 13 (21.67%) had 1200 seconds of arc and 12(20%) showed no Stereoacuity and only 4 patients (6.67%) revealed 600 seconds of arc, in Lang II test 8.33% out of 48.3 %, had Stereoacuity of 600 seconds of arc and 40% had no Stereoacuity. similarly, 45. % out of 48.3 % showed no stereopsis in Frisby test; however, both patients showed almost similar results in Lang 2 Pencil test, 18 patients (30%) and 12 patients (20%) reveal Stereoacuity of 3000-5000 seconds of arc in fully and partially accommodative esotropia respectively and the remaining showed no Stereoacuity.

Conclusion: The study result demonstrates the presence of good stereoacuity in patients with fully accommodative esotropia and Poor stereoacuity detection in partially accommodative esotropia in three tests (Lang I, Lang II, Frisby test) however similar stereoacuity, outcome was revealed in Lang 2 pencil test both study population.

Keyword: Stereopsis, Stereoacuity, Fully accommodative esotropia, partially accommodative esotropia.



Introduction:

Visual acuity and color vision has profound meaning and important value for the lives of human in terms of independent living in general. Stereopsis bears a similar meaning and value in terms of vivid recognition of the world around us; hence, both the visual acuity as well as stereopsis are necessary for daily living and are dependent on each other¹. The measurement, scaling and grading of stereopsis has its own methods and instruments just like other methods of determining visual functions².

The development of Stereopsis (depth perception) starts early at age of three to four months and continues to improve until the 12th month of age. Therefore, the measurement of stereoacuity in children is important as it is protective against very serious visual problems such as amblyopia, strabismus (Accommodative esotropia) and anisometropia (different refractive error in the two eyes)³. Wheatstone achieved breakthrough in the idea of binocular stereopsis followed by his invention of stereoscope to explicitly show binocular disparity⁴.

Disparity arises when viewing an object, the visual information of that object travels through the refractive media to visual pathway and reaches visual cortex in an area called Panum's Area, where the image from each eye that carries slightly different details due to the anatomical location of eye is perceived and information combined into single three-dimensional object. This depth perception of the object is called stereopsis. For simplicity the human eyes produce different 2D image of the object we look and our brain constructs this 2D image into 3D dimensional structure thus the process of constructing the 3D image is called stereopsis. In general stereopsis referred to as state of experiencing of palpable solidity of object⁵.

Several scholars have criticized the importance of stereopsis (Binocular disparity) and referred it as the only sources of depth, sure vivid and quantifiable information of any object and some scholars like Wheatstone argue that real appreciation of the depth of an object (stereopsis 3D) occurs only in the presence of good stereopsis.

Yet another study criticized the importance of stereopsis and highlighted the link between normal visual development during childhood and the outcome of stereopsis, pointing that any visual deprivation such as strabismus during the visual development in infants and imperfection in the central visual system (corneal, lens opacification) could lead poor stereopsis. While having normally developed vision and clear media and pathway and proper alignment yield good outcome of stereopsis. For stereopsis to occur fusion is necessary, according to study Fusion of the image in to single begins during 8 Weeks of age and almost all children develop full potent of fusion at 20 months of age. Clinically the

evaluation and measurement of patient's stereoacuity become an important and routine screening task just like visual acuity and color vision both for adults and younger children⁶.

The stereoacuity measures the depth threshold; the most common stereopsis tests include random dot stereogram, LANG stereotest 1 & 2, the Titmus stereo test, Frisby test and random dot E test⁷.

The purpose underlining the assessment of stereoacuity is to detect various visual problems including amblyopia and misalignment in the visual axis such as amblyopia and strabismus. Early screening of stereoacuity means early detection and prevention of serious visual consequence. However, the stereopsis screening has its own limitations such lack of understanding and inability to verbally communicate or answer the test that may be seen in infants and younger children which posse difficulties for testing their stereoacuity⁸.

A Retrospective, population-based cohort study of 627 people had been done in which new cases of childhood strabismus provided that the prevalence of esotropia is more common in western population. The prevalences are 380 (60.1%) with esotropia, 205 (32.7%) with exotropia, and 42 (6.7%) with hypertropia. The five most common forms of strabismus included accommodative esotropia (27.9%), intermittent exotropia (16.9%), acquired non-accommodative esotropia (10.2%), esotropia in children with an abnormal central nervous system (7.0%), and convergence insufficiency (6.4%). In this study provides population-based data on the most prevalent forms of childhood strabismus. Accommodative esotropia, intermittent exotropia, and acquired non accommodative esotropia were the predominant forms of strabismus in this Western population⁹.

A similar study have shown that the prevalence of esotropia is more common in children with accommodative and acquired non-accommodative were the most prevalent forms of esotropia ,In this study it was noted that, congenital, sensory, and paralytic forms of childhood esotropia were less common in western population. Mohny, et al, have shown that esotropia with non-accommodative acquired, or with central nervous abnormalities were more common, While congenital and paralytic esotropia is uncommon. It also provided that children having accommodative esotropia, 17.2 % were associated with defects in central nervous system either congenital or acquired during the birth or later. On the other hand, 6.8% of acquired non-accommodative esotropia is commonly associated with defects in ocular sensory system¹⁰.

A population-based study of Greenberg, et al. the prevalence of esotropia in 385 children, cases were reported as fully accommodative, 140 children (36.4%); acquired no

accommodative, 64 children (16.6% partially accommodative, 39 children (10.1%); congenital, 31 children (8.1%); sensory, 25 patients (6.5%); paralytic, 25 patients (6.5%); undetermined patients were, 13 (3.4%); and other, 4 (1.0%). The prevalence esotropia especially accommodative and acquired non accommodative forms of esotropia are the most common childhood deviation in the first decades of life and the paralytic, congenital, and sensory forms of esotropia is are less common during the preschool age¹¹.

Materials and Methods:

A total of 60 patients were included in the study to compare the outcome of stereopsis using four stereoacuity test (Lang I test, Lang II test, Lang 2 Pencil test, and Frisby test) the visual acuity and strabismus screening were assessed according with patients age and standard charts and instruments to rule out the degree of visual acuity and the size and the type of deviation, and stereoacuity of all were measured using the four Stereoacuity tests.

This study was conducted using predesigned Performa, in College of Ophthalmology and Allied Vision Science (Mayo Hospital) Lahore, Pakistan. Prior approval was sought from ethical review board of College of Ophthalmology and Allied Vision Sciences.

Data Collection Method:

Sixty patients with accommodative esotropia were included in the study. Data was collected after taking informed consent from patients or parents, Structured survey (proforma) questionnaires was administered to all 60 patients of accommodative esotropia all patients were examined according to the structure of proforma and information obtained from the patients with the questionnaire was included their bio-data, education/employment, knowledge about their symptoms.

Data Analysis Method:

A cross-sectional study of all children with accommodative esotropia or those meets our inclusion criteria. All Children undergone clinical examination (orthoptic assessment) Patients was divided into two groups fully accommodative esotropia (Group 1) and partially accommodative esotropia group (2) stereopsis of fully and partially accommodative esotropia was collected and analyzed using SPSS version 20.0 to make frequency tables graphs and results were compared.

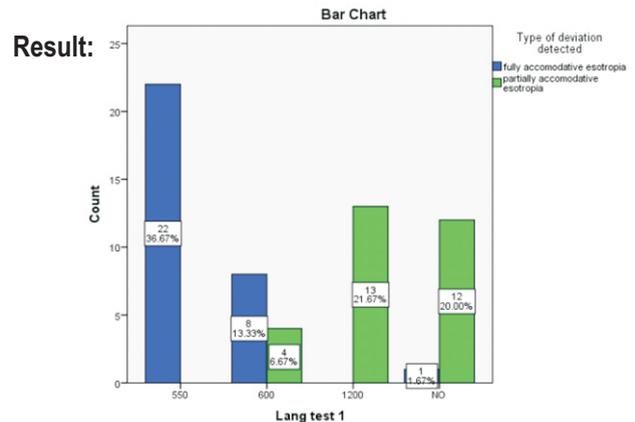


Figure 1: Type of deviation detected in esotropia at Lang test 1

The above Bar chart indicates the Stereoacuity outcome of patients with fully and partially accommodative esotropia.

The Lang I test result indicates fine receptivity of the test among fully accommodative esotropia patients, and low perceptivity to zero recognition of test among partially accommodative esotropia, of all 30 patients with fully accommodative esotropia 22 (36.67%) patients perceive 550 seconds of arc and 8 (13.33%) patients read long test 600 seconds of arc. And total of 29 patients with partially accommodative only 4 patients (6.67%) have disparity of 600 seconds of arcs and 13 (21.67%) have 1200 seconds of arc while 12 (20%) patients don't perceive the test chart.

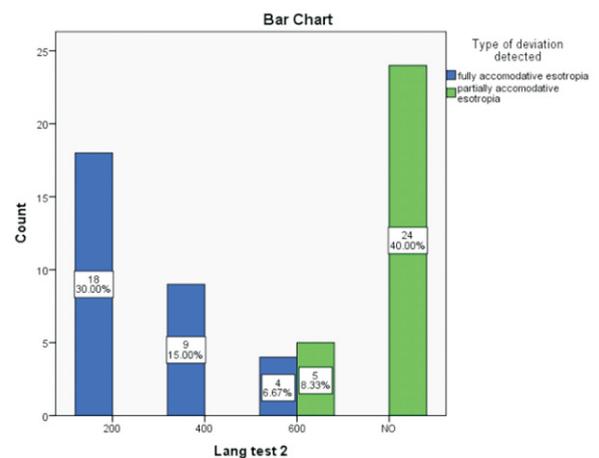


Figure 2: Lang 2 stereo test among fully and partially accommodative esotropia.

The Bar Graph above shows the test result of Lang II test in patients with fully accommodative and partially accommodative esotropia. The test result reveals the appropriateness of the test significance in patients with fully accommodative esotropia, in terms of detection the test parameters and poor performance of test in patients with partially accommodative esotropia of all patients with fully

accommodative esotropia (31) patients 30% detect stereo acuity of 200 Seconds of Arc and 15% perceive 400 seconds of Arc, while all patients with partially accommodative esotropia (29) patients only 5 patients read the Stereoacuity of 600 Seconds Arcs and 24 patients (40%) don't perceive test result.

Table 1: Lang 11 pencil test among fully and partially accommodative esotropia.

| | | Type of deviation detected | | Total |
|--------------------|--------------|-------------------------------|-----------------------------------|-------|
| | | Fully accommodative esotropia | Partially accommodative esotropia | |
| Lang 2 pencil test | 3000 to 5000 | 18 | 12 | 30 |
| | NO | 13 | 17 | 30 |
| Total | | 31 | 29 | 60 |

The table above shows the test result of Lang II Pencil test,

A total of 31 patients with fully accommodative esotropia 18 patients (30%) detect fine stereo acuity of 3000-5000 Sec of arc, and 13 patients (21.67%) have no Stereoacuity. while 29 patients with partially accommodative esotropia, 12 patients detected fine Stereoacuity of 3000-5000 sec of arc and 17 patients 28.33% reveal zero Stereoacuity.

Table 2: Frisby stereo test among fully and partially accommodative esotropia.

| | | Type of deviation detected | | Total |
|--------------------|-----|-------------------------------|-----------------------------------|-------|
| | | Fully accommodative esotropia | partially accommodative esotropia | |
| Frisby stereo test | 340 | 9 | 0 | 9 |
| | 170 | 3 | 0 | 3 |
| | 85 | 12 | 0 | 12 |
| | 600 | 4 | 2 | 6 |
| | NO | 3 | 27 | 30 |
| Total | | 31 | 29 | 60 |

The Frisby stereo test shows presence of fine Stereoacuity detection in patients with fully accommodative esotropia, and no significant in patients with partially accommodative, total of 31 patients with fully accommodative esotropia 20% (12) patients read fine Stereoacuity of 85 seconds of arc and only 5%(3) reported zero Stereoacuity, while a total of 24 (45%) patients with partially accommodative esotropia perceive no Stereoacuity.

Discussion:

Esotropia is known to be one of the commonest childhood ocular misalignments, with early onset presents before the age of the six months¹². Accommodative esotropia is most common form of childhood esotropia and usually occurs when accommodation compensates a degree of hyperopia, and because of convergence accompanies accommodation; the two or either eye turn inward (Nasally) resulting Esodeviation and possibly deterioration of stereoacuity vision (depth perception). Majority of children with accommodative esotropia may be able to maintain bifixation while others may use cross fixate for one or either eye alternatively. However, if children are anisometropia (one eye is more hyperopic than other eye) in such cases the child tends to use the better eye for fixation and unused eye has considerable deteriorated vision (amblyopia)¹³.

As the visual acuity and color vision has profound meaning and important value for the lives of human in terms of independent living in general, both the visual acuity and stereopsis are necessary for daily living and are dependent with each other.¹ Stereopsis is more influenced in strabismus (accommodative esotropia) than other visual disorder such as anisometropia and amblyopia, even recovering or improvement from the loss of stereoacuity in strabismus is much tricky and requires comprehensive treatment and follow up. Reduced or diminished stereoscopic depth perception or stereoacuity, during normal binocular viewing condition is more common deficit known to be influenced or associated with various ocular and visual distortions including strabismus (accommodative esotropia) amblyopia and reduced visual acuity that occur during early visual development¹⁴.

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The prevalence esotropia especially accommodative and acquired non accommodative forms of esotropia are the most common childhood deviation in the first decades of life and the paralytic, congenital, and sensory forms of esotropia is are less common during the preschool age.¹¹

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