COLOR VISION DEFICIENCY AND CONTRAST SENSITIVITY IN AMBLYOPIC CHILDREN

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ABSTRACT

PURPOSE: *To check the color vision deficiency and contrast sensitivity in children with amblyopia.*

METHODS: *A cross sectional study was conducted in Ophthalmology outpatients department of Mayo Hospital Lahore. Total 30 patients of age 3 to 15 years were selected. The patients were having no other ocular pathology except amblyopia. Visual acuity was recorded with ETDRS visual acuity chart. After that, color vision of each amblyopic child was tested using Farnsworth D-15 Dichotomous color vision test and contrast sensitivity was tested using Pelli-Robson contrast sensitivity chart.*

RESULTS: *This study includes 30 amblyopic children. Amblyopic children perform well in Farnsworth D-15 Dichotomous color vision test. Out of 30 amblyopic participants, 27 (90%) were having normal colour vision while 3 (10%) had color vision defect. This was compared with prevalence of color vision defects in normal population (11%). Chi-square test was applied with no significant difference (p=0.877). Similarly, the mean and standard deviation for contrast sensitivity recorded in amblyopic eyes was 1.25±0.368. This was compared with contrast sensitivity in normal eyes of the same patients. Contrast sensitivity in normal eyes was 1.30±0.368. Mann Whitney-U test was applied that showed no significant difference (p=0.297).*

CONCLUSION: *This study concluded that the color vision and contrast sensitivity are not affected in amblyopic patients.*

KEYWORDS: *Amblyopia, contrast sensitivity, Color vision, Farnsworth D-15 Dichotomous color vision test, Pelli Robson contrast sensitivity chart.*

INTRODUCTION

Prevalence of amblyopia across the world is estimated to be 3%.[1,2] Amblyopia originates from Greek meaning "blunt vision" and is also known as lazy eye which corresponds to decrease in the visual acuity of an eye due to insufficient stimulation of central or peripheral retina leading to dissimilar visual input in both eyes.[3] Amblyopia is known to be a reversible defect or deficiency of visual acuity that can be and needs to be corrected before visual maturation.[4,5] Amblyopia in fact is a phenomena occurring in the visual cortex primarily when asymmetrical stimulus from both eyes flow into the primary visual cortical area 17. Several vision processing at cortical level deprive visual stimulus especially at the level of primary visual cortex area (V1) resulting in abnormal spatial vision in amblyopic eye.[6] Amblyopia was previously considered to occur in one eye but, now it seems to be a disorder presented in both eyes primarily.[7] The color of the objects can be said as the reflected wavelength from there surface. Because of easily availability of D-15 test, it was used in assessment of color vision in Amblyopes. Due to damaged pathway of chromatic stimulus, amblyopes show bad performance in assessing color vision during its assessment, as amblyopia and color vision shares common neural pathway so it is important to assess color vision of amblyopia. Amblyopic eyes show poor color vision and decreased visual acuity with increasing age. Visual acuity is not responsible for reduced color

vision in the lazy eyes.[6] Apart from, contrast sensitivity is actually is important as the visual acuity because it gives a better idea about how better a patient can function visually. It is tested by using Pelli Robson contrast sensitivity chart. This research was done to study the correlation of contrast sensitivity and color vision component with amblyopia with a view to contribute to the future studies on diagnosis and its management of amblyopia among children.

OBJECTIVES

The objectives of this study were to find out the correlation of contrast sensitivity using Pelli Robson and color vision deficiency using Farnsworth D-15 Dichotomous color vision test in amblyopic children.

METHODOLOGY

Ethical clearance to conduct this Cross sectional study was obtained from the college of Ophthalmology and Allied Vision Sciences, King Edward Medical University Lahore. This study was conducted from September to December 2019. A total of 30 patients involved in this study, visual acuity was recorded using ETDRS visual acuity chart of amblyopic children. Then, color vision was tested using Farnsworth D-15 Dichotomous color vision test and contrast sensitivity was tested using Pelli-Robson contrast sensitivity chart. The ethical sanction and informed consent was also obtained. All the data was collected with self-made proforma. All the data were entered and analyzed using statistical package for social sciences (SPSS version 20.00). The data was analyzed by Chi- Square test and Mann-Whitney U test. p value of $\leq$ 0.05 was taken as significant.

RESULTS

Color vision was checked among all amblyopic patients. Three out of 30 (10%) patients had color vision defects, whereas 27 (90%) had normal color vision with amblyopia. This finding was compared with normal prevalence of color vision defect in normal population i.e., 11%, (table 1).

Table 1: Color Vision Defects in Amblyopic and normal individuals

		Color Vision	Defect	Total
		Yes	No	
Category	Amblyopic	3	27	30
	Normal	11	89	100
Total		14	116	130

Chi-square test showed no significant difference in normal eyes vs amblyopic eyes as regards color sensitivity (Chi square value = 0.024, p=0.877).

Contrast sensitivity was measured in both amblyopic and normal eyes of the patients. The mean and standard deviation of contrast sensitivity in amblyopic was 1.25±0.37 (95% CI: 1.11-1.39) and those in normal eyes was 1.30±0.37 (95% CI: 1.16-1.43).

Table 2: Descriptive Statistics of contrast sensitivity (*N=30)

	Minimum	Maximum	Mean	Std. Deviation	Standard Error
Amblyopic Eyes*	0.15	1.65	1.25	0.36813	.06721
Normal Eyes*	0.3	1.65	1.3	0.36813	.06721

Data in each group was not normally distributed (Shapiro-Wilk test p<0.001) so Mann Whitney-U test was applied, that showed no significant difference in contrast sensitivity of amblyopic eyes and normal eyes (p=0.297), fig 1.

Table 3: Statistical analysis of contrast sensitivity between amblyopic and normal eyes.

Null Hypothesis	Test	Sig.	Decision
The distribution of CS is the same across categories of type.	Independent-Samples Mann-Whitney U Test	.297	Retain the null hypothesis.

Asymptotic significance are displayed. The significance level is .05.

DISCUSSION

This study was performed on correlation of color vision deficiency and contrast sensitivity in amblyopic children. In 30 participants 46.7% of the population was female and 53.3% of male. A study was done by Bradley and R. D. Freeman to measure contrast sensitivity in anisometropic amblyopia.[8] In the study contrast sensitivity functions were measured for sinusoidal gratings. Its sample size included 10 anisometropic amblyopes in which a deficit was found in high spatial frequency from tests of amblyopic eyes of all subjects. In their results the defect was decreased with spatial frequency and found a correlation with the magnitude of anisometropia. There was small difference in low frequencies between the two eyes accordingly. The sensitivity difference in some cases was high however in some it was low. According to the additional tests the low frequencies difference was due to magnification difference in two eyes. It was concluded that monocular contrast deprivation is the causal agent in anisometropic amblyopia.

It has been found that all the factors which are responsible for causing amblyopia, anisometropia contributed to 3.5% of the amblyopia, being the most common cause of amblyopia and little (2.8%) was contributed by strabismus to cause amblyopia when compared with anisometropia. Hence it was concluded that anisometropia is the most influential Amblyogenic factor rather than the strabismus.[7] But in this study out of fifty amblyopic patients, twenty three were having strabismic amblyopia and eleven were suffering from Anisometropic amblyopia. In other words this means that the study has found strabismus to be the influential Amblyogenic factor but not the anisometropia.

In some of the studies it was concluded that amblyopia due to refractive errors was most common cause of deficient vision in amblyopes.[9-11] This may be true for some studies but in this study of all causes of amblyopia, most common is strabismus and only five ametropic amblyopes were ruled out, which indicates that amblyopia is mostly associated with strabismus but not with refractive errors.

In another study for contrast sensitivity in amblyopia, the fellow eye of untreated and successfully treated amblyopes, investigation was done for the contrast sensitivity of fellow eye of amblyopic subjects and successfully treated amblyopic subjects. This study has documented 48 amblyopic patients and tests were performed uni-ocularly on both eyes having mean age of 11.51 years and those for successfully treated subject were 22 having mean age of 11.22 years with VA 20/20 in each eye. The inclusion criteria was VA 20/40 considered in milder amblyopes and VA 20/20 in fellow eye. According to their results contrast sensitivity was affected in fellow eye of 48 amblyopic patients, even though who were not treated with occlusion therapy and which were compared with controlled patients. It suggests that normal eye of amblyopic patients behave abnormally when evaluated for contrast sensitivity.[12,13] It was concluded that assessment of contrast sensitivity provides important information regarding visual function and influence of occlusion therapy in amblyopia.

CONCLUSION

From the study it has been concluded that color vision and contrast sensitivity components of visual functions are not affected significantly in amblyopia. Furthermore the study has shown that there is no significant relation found between amblyopia and color vision when performed with Farnsworth D-15 Dichotomous color vision test and neither between amblyopia and contrast sensitivity when performed with Pelli-Robson chart.

RECOMMENDATION

My research on "Correlation of color vision deficiency and contrast sensitivity with amblyopia in children" revealed that color vision and contrast sensitivity in amblyopes is not significantly affected when measured with Farnsworth D-15 Dichotomous color vision test and Pelli Robson chart. However, the results cannot be generalized due to time limitation and small sample size. For a broader view regarding color vision and contrast sensitivity in amblyopes, it is recommended that studies on a larger scale and with bigger sample size be undertaken. Having said that, the current practice should continue and it is suggested that:

- Color vision and contrast sensitivity of amblyopic patients should be measured by the optometrists using other standards of contrast sensitivity and color vision tests.
- Contrast sensitivity is very much important and should be assessed in amblyopic patients most probably because it very important measure of visual functions especially in dim light, glare and fog.
- Color vision in amblyopic patients should be assessed too as it provides organisms with important sensory information about their environment and one is able to make discriminations based on the wavelength composition of the light independent of its intensity.

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