Original Article

Assessment of Visual Acuity by Using Blue and Yellow Light Filters in Amblyopic Eye

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ABSTRACT

Purpose: To assess and compare the effect of blue and yellow filters on visual acuity in amblyopes.

Design of Study: Comparative cross-sectional study.

Place and Duration of Study: Ophthalmology Department of Madinah Teaching Hospital, Faisalabad from November 2018 to May 2019.

Methods: Participants (n□30) of age 7 to 28 years were studied. All types of amblyopia were included and subjects with systemic or ocular diseases were excluded. After history taking and doing ophthalmoscopy, visual acuity was measured with and without pinhole in the amblyopic eye. Visual acuity was also recorded by using blue and yellow filter with and without pinhole by placing in front of amblyopic eyes to assess the difference in visual acuity with filters and with pinhole. Comparative analysis of changes in visual acuity in amblyopic eye with and without blue filter, with and without yellow filters and with blue and yellow filters were performed by Paired sample T-test for qualitative variable (visual acuity) by using SPSS 20.

Results: Visual acuity in amblyopic eye without filter (mean0.52 ± .28) was lower than with blue (mean 0.31 ± .26) and yellow filters (mean 0.46 ± .30) and visual acuity with blue filter was higher than with yellow filter with the incorporation of Pinhole (P.H). The probability value of blue filters was (P = 0.00) and with yellow filters (P = 0.001) at the level of 5% of confidence interval. Participants feel more clarity, sharpness with blue filters but more comfort with yellow filters.

Conclusion: Visual acuity of amblyopes was significantly improved with blue filters as compared to yellow filter.

Key Words: Amblyopia, ophthalmoscopy, stereopsis, strabismus, visual acuity.

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INTRODUCTION

Amblyopia can be uniocular or binocular.[1] If figured out early and managed, good visual acuity can be restored. On the other hand, if not given any treatment, it can lead to improper or halted development of vision.[2] Fusion and stereopsis depend on clear images perceived by each eye simultaneously. Failure to fuse image and have depth perception results in difficulty in routine work and problematic vision.[3,4]

There are different types of amblyopia; Stimulus deprivation, Strabismic, Anisometropic, Ammetropic and Meridional which is caused by uncorrected astigmatism.[5,6,7]

Treatment options for amblyopia are spectacles and patching therapy of better eye by forced fixation of amblyopic eye. Other options include cycloplegic drugs in better eye to blur its vision, penalization.[8, 9]

Optical filter is a device which transmits light of different wavelength in a particular range. Filters are manufactured into a different number of shapes and sizes and also can be used to pass or eliminate unwanted bands of wavelengths.[10] There are different types of optical filters; Absorptive filters which reduce

incident light through absorption of particular wavelengths, Dichroic filters have more precise ability to obstruct or block unwanted wavelengths and Optical filters are commonly used in photography like absorptive filters and in many optical instruments.[11]

The electromagnetic spectrum has different wave lengths of light which are either visible or not visible to the eyes of humans. Light which is able to be seen by human eye in the electromagnetic spectrum is called visible light and have range 380nm – 780nm.[12]

Blue light in the visible spectrum possesses a smaller wavelength and red light possesses a larger wavelength. Wavelengths of light rays are inversely proportional to the energy produced. The light which has a shorter wavelength has higher energy and more penetration and light which has a longer wavelength has low energy and less penetration. Eventually blue light causes more damage in eyes due to high energy than red light.[13] Blue light exposure can cause eye strain, headache, fatigue and sleep problems. People who are using computers and other digital devices may have less blinking as compare to other people and also suffer from dry eye. Blue light also damages the retinal pigmented epithelium cell and can lead to age related macular degeneration.[14]

Human eyes naturally contain a large amount of yellow pigment in the center of the retina.[15] A human who keeps more yellow pigment in the macula may have more advantage to filter atmospheric particles which cause decrement of vision than a human who contain less yellow pigment in macula.[16,17] In this study we used blue and yellow filters to assess visual acuity in amblyopic eyes. We want to access the variations in visual acuity in eyes with amblyopia by placing blue and yellow light filters in front of amblyopic eyes.

METHODS

This study was carried out in Madinah Teaching Hospital, The University of Faisalabad. Thirty amblyopic eyes of 30 subjects were assessed. Both genders with age range of 7 – 28 years were enrolled in study through non-probability convenient sampling technique. Sample size was estimated using Slovin's Formula n = N/(1+Ne2). To be 95% confident, the true value of the estimate was within 5 percentage points of 0.5, (that is, between the values of 0.45 and 0.55), the required sample size was 30. Ethical approval was sought from the Research Committee of The University of Faisalabad. Informed consent was taken before data collection tenets of declaration of Helsinki were followed.

People with Ocular diseases, Syndromes which cause ocular abnormalities, poor co-operation, mental retardation, history of trauma to eye, Pseudophakia or aphakia were excluded. Self-designed questionnaire was used to collect data. Visual acuity was checked with Snellen chart at 6 meters distance. Eye comfort during visual acuity examination was taken as a qualitative entity. The individuals were asked about the eye comfort with blue and yellow filters. Visual acuity was measured without pinhole and without any type of filter and also with pinhole in the amblyopic eye. After that visual acuity was measured by using blue filters and yellow filters without pinhole and with pinhole in front of the amblyopic eye. The difference in visual acuity with filters and with incorporation of pinhole was recorded.

The size of pinhole was 1mm and blue and yellow filters were of reduced aperture and with plastic rim. The material of filters was glass. The property of blue light blocking filter was; Sphere: 0.00, Cylinder: 0.00, Hi-index 1.60sp, Super-hydrophobic, hard multicoated lens, UV protection 420, Abbe Value 38, and Specific Gravity 1.28. Blue filter wavelength was UV-380/EMI and yellow filter wavelength was UV-400/EMI.

Data was analyzed in SPSS version 20. Comparative analysis of changes in visual acuity in amblyopic eye with and without blue and yellow filters was performed by Paired sample T test.

RESULTS

A total of 30 participants, 18 (60%) males and 12 (40%) females with age 18 ± 6.2 years were included. Among these 7.6% had form Deprivational, 19.3% had Strabismic and 73.3% had Anisometropic amblyopia. Visual acuity in amblyopic eye without filter (0.52 ± .28) was lower than with blue (0.31 ± .26) and yellow filters (0.46 ± .30). Visual acuity with blue filter (0.31 ± .26) was higher than with yellow filter (0.46 ± .30). Table 1 shows comparison between the visual acuity with and without filters.

DISCUSSION

The visible spectrum ranges from 380 nm – 780 nm. In the visible spectrum of light, the blue edge of spectrum has a smaller wavelength and extreme penetration

Table 1: *Comparison of visual acuity with and without different filters.*

	Mean Difference	Standard Deviation	Standard Error Mean	Confidence Interval – 95%		t	df	Sig.
Visual acuity without blue filter Visual acuity with blue filter	.21000	.13222	.02414	Lower.16063	Upper.25937	8.699	29	0.00
Visual acuity without yellow filter Visual acuity with yellow filter	.06000	.08944	.01633	Lower.02660	Upper.09340	3.674	29	0.001
Visual acuity with blue filter Visual acuity with yellow filter	.15000	.11671	.02131	Lower.19358	Upper.10642	7.040	29	0.000

while the red edge of the spectrum has a larger wavelength and slight penetration. The wavelength of blue light ranges from 380nm to 500nm. Blue-violet has a harmful effect on the eyes as well as on other parts of the body.[18]

In this research the main objective was to determine the effect of blue and yellow filters on visual acuity in amblyopic eyes and to compare the effect of blue and yellow light filters on visual acuity of amblyopic eyes.

Fowler and colleagues studied yellow spectacles in twenty children who had amblyopia in both eyes.[19] In younger children, vision improved when they used yellow lenses for up to nine months. The optimal results were due to the function of the yellow filter that blocks the blue fringes. The results suggested that by using yellow filters on binocular amblyopic children, vision was improved immediately and remained unchanged even after they were not using the spectacles.[19]

Metzler and colleagues studied monochromatic visual evoked potentials in 50 strabismic children (age 3 – 7 years) with amblyopia and visual acuity 0.3.[20] Blue filter treatment confirmed vigorous repression of paracentral areas of retina of the eyes with functional amblyopia by dull feedback to a blue stimulus. Clinical trial stimulating these areas with blue light results showed blue filter treatment protocol provided better results for treating amblyopia. They revealed that stimulation of these areas of the retina accelerates a better recovery in eyes with functional amblyopia.[20]

Our results showed improved visual acuity with pinhole and significant improvement of visual acuity with blue and yellow filters. The probability value of blue filters was (P = 0.00) and with yellow filters (P = 0.001) with incorporation of Pinhole. The subjects felt more clarity, sharpness with blue filters but more comfort with yellow filters.

Limitation of study was a small sample size and across sectional design. A longitudinal study with months of follow up is needed to see the effect of using filters for a longer duration.

CONCLUSION

The study revealed that blue light blocking filters and yellow light transferring filters provide a significant improvement in visual acuity and eye comfort in amblyopes. Visual acuity of amblyopes was significantly improved with blue filter as compared to yellow filter.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board **(TUF/IRB/035/2022)**

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Author's Designation and Contribution

Anam Majeed; Optometrist: *Concepts, Design, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

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