Original Article

Effectiveness of Syntonic Phototherapy in Amblyopia in Terms of Improved Visual Acuity and Contrast Sensitivity

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ABSTRACT

Purpose: To compare visual acuity and contrast sensitivity in different types of amblyopia and to see the effect of syntonic therapy on amblyopia in terms of visual acuity and contrast sensitivity.

Study Design: A Quasi Experimental study.

Place and Duration of Study: Madina Teaching Hospital Faisalabad, from August 2021 to November 2021.

Methods: A total of 30 patients of either gender and age from 8 to 18 years were included. There were 15 patients with anisometropic amblyopia and 15 with strabismic amblyopia. The patients were recruited through non-probability purposive sampling technique. All the patients underwent assessment of visual acuity with Log MAR chart and contrast sensitivity with Pelli-Robsonchart. Syntonic phototherapy with red filter glasses was prescribed for 4 weeks. After 4 weeks, patients returned and underwent post-therapy assessment of visual acuity and contrast sensitivity. Paired sample t test and Independent sample t test was used with the help of IBM SPSS-23 to get a statistical result.

Results: Syntonic phototherapy showed significant improvement in mean visual acuity of 0.223 ($p = 0.00$) and contrast sensitivity of -0.200 ($p = 0.00$) in amblyopia. Anisometropic amblyopia showed better improvement in visual acuity ($p = 0.016$) and contrast sensitivity ($p = 0.035$) by syntonic phototherapy as compared to patients with strabismic amblyopia.

Conclusion: Significant improvement was seen in visual acuity and contrast sensitivity in patients with amblyopia after syntonic phototherapy. Anisometropic amblyopia showed better improvement as compared to strabismic amblyopia, in terms of visual acuity and contrast sensitivity.

Keywords: Amblyopia, Anisometropia, Strabismic amblyopia, Syntonic phototherapy.

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INTRODUCTION

Amblyopia is reduction in visual acuity either unilateral or bilateral, caused by vision deprivation or binocular interaction for which no organic cause can be identified by physical examination of the eye. In appropriate cases, it is reversible by therapeutic measures if introduced early.[1] Practically speaking, amblyopia is represented as two Snellen line difference between the visual acuity of both eyes.[2] It is the major and merely frequent source of uniocular visual impairment in children as well as adults.[3] Risk factors of amblyopia are positive family history of eye diseases, visual defects in infancy, mentally retarded children, congenital cataract, other media opacities, ptosis, corneal injury or dystrophy, premature birth, developmental and cognitive impairment, children with lesser birth weight along with anisometropia, hyperopia, myopia and strabismus.[4] Aetiology of

unilateral amblyopia include strabismus, anisometropia or composite of two, stimulus deprivation caused by media opacities like infantile cataract, ptosis, corneal opacities/opaque cornea, hyphaema, vitreous clouding or haemorrhages and prolonged uncontrolled patching or prolonged unilateral atropinisation.[5] Bilateral amblyopia is caused by bilateral opacities (cataract of equal density), ametropia, astigmatism and motor type nystagmus. According to best corrected visual acuity, amblyopia has been divided into mild amblyopia (20/25 to 20/60), moderate amblyopia (20/70 to 20/100) and severe amblyopia (20/200 or worse).[6] Amblyopia can be categorized into different types depending on etiology. Refractive amblyopia is caused by uncorrected refractive error. It includes anisometropic amblyopia and isoametropic amblyopia. Isoametropic amblyopia is originated by large degree of similar refractive error. Aniso-hypermetropia occurs in the case of 1.0D to 1.5D difference in refractive error, aniso-astigmatism if more than 2D and aniso-myopia in more than 3.0D to 4.0D difference between the two eyes. Bilateral amblyopia occurs if hyperopia is more than 4.0D to 5.0D, 2.0D to 3.0D in case of astigmatism and 5.0D to 6.0D in myopia.[7] Strabismic Amblyopia is due to deviation, usually seen in unilateral constant squint where strong favour of one eye for fixation is present.

Prevalence of amblyopia is more in esotropic subjects in comparison to exotropic subjects.[8] Amblyopia is diagnosed by different methods e.g. visual acuity assessment, neutral density filter test, contrast sensitivity testing, crowding phenomenon testing, fundoscopy, refraction, stereoacuity testing, central and eccentric fixation testing and tests for sensory abnormalities.[9] The earlier the treatment the better is the prognosis.[10] There are basically two ways to treat amblyopia, one is treating underlying aetiology while other is stimulating amblyopic eye.[11] Treating underlying aetiology include refractive error, cataract and ptosis etc. For stimulating the weaker eye, multiple options like occlusion therapy, penalization, pleoptics, pharmacological interventions and CAM stimulator are available.[12]

Syntonic phototherapy is a simple, non-invasive light therapy treatment that uses specific light colors, frequency and wavelength to improve the regulatory centers in the brain. Colored light by different filters used in syntonic phototherapy stimulates visual system and also alters the biochemistry of the brain, thus improving the sympathetic and parasympathetic nervous systems and balance among them.[13] Red filter absorbs all light except red, So red light stimulates the cones of the retina thus fovea with its exclusively cone component is predominant stimulated.[14] Red light enhances cell membrane capacitance buildup of electrical charge before discharge that enhance the nerve cell charge to break through synaptic resistance to decrease amblyopia.[15]

We conducted this study to evaluate the effectiveness of this therapy at our set up, as this area in amblyopia therapy is still void in Pakistani literature.

METHODS

A Quasi experimental study was conducted from August 2021 to November 2021 in Madina Teaching Hospital Faisalabad. Permission from the ethical review board was sought. We recruited amblyopic patients from 8-18 years old through a non-probability purposive sampling technique. Patients with strabismic and anisometropic amblyopia were included after informed consent. Patients with ocular pathologies, positive squint surgery and other types of amblyopia were excluded from this study. Total sample of 30 patients were included, out of which 15 were strabismic amblyopes and 15 were anisometropic amblyopes. After taking both verbal and written consent detailed history was taken. Detailed history and complete ocular examination was performed to diagnose amblyopia and then categorized either into strabismic or anisometropic amblyopia. Cover uncover test was used to confirm strabismic amblyopia. Subjective plus objective refraction was done to confirm anisometropic amblyopia. Visual acuity and contrast sensitivity were tested in all cases. Visual acuity was tested by using Log MAR chart at 4-meter distance. Contrast sensitivity was tested by using Pelli-Robson chart. After initial assessment syntonic phototherapy with Red filter was prescribed binocularly for 4 weeks with 5 sessions per week. Patients wore their red filter glasses and were asked to fixate at a light source that provided 1.4 Lux at the distance of 20 inches for 20 minutes in each session. The patient was kept in comfortable position throughout the sessions and were allowed to move eye if fatigued. After 4 weeks and total 20 sessions, visual acuity and contrast sensitivity were retested with Log MAR chart and Pelli-Robson chart respectively. After

the collection of data paired sample t test and Independent sample t test were used with the help of IBM SPSS-23.

RESULTS

There were 12 (40%) males and 18 (60%) females with mean age 14.93 years**.** The mean value of visual acuity before syntonic therapy in amblyopes was 0.62 ± .33 and after syntonic therapy it was .40 ± .36. The result of this study shows that there is significant difference in visual acuity before and after syntonic phototherapy in amblyopes (p = 0.00). The mean value of Contrast sensitivity before syntonic therapy in amblyopia was 1.20 ± .38 and after syntonic therapy was 1.40 ± .39. The result of this study shows that there is significant improvement in contrast sensitivity before and after syntonic phototherapy in amblyopes (p = 0.00). Table 1 and 2 show the details.

Table 1: *Visual acuity and Contrast sensitivity before and after syntonic therapy in amblyopia.*

Paired Sample T-Test			
Visual acuity	**Mean**	**Std. Deviation**	**Std. Error mean**
Before syntonic therapy	.62	.33	.060
After syntonic therapy	.40	.36	.065
Contrast Sensitivity	**Mean**	**Std. Deviation**	**Std. Error mean**
Before syntonic therapy	1.20	.38	.070
After syntonic therapy	1.40	.39	.071

Table 2: *Visual acuity and Contrast sensitivity before and after syntonic therapy in amblyopia.*

	Paired Difference			
	Mean Difference	**Std. Deviation**	**Std Error Mean**	**Sig (2-Tailed)**
Visual acuity before and after syntonic therapy	0.22	.16	.029	0.00
Contrast sensitivity before and after syntonic therapy	-.20	.21	.038	0.00

Independent t test was used to determine the effectiveness of syntonic phototherapy in different types of amblyopia. The result of this study shows that significant difference was present in visual acuity between anisometropic amblyopia patients and strabismic amblyopia patients after syntonic therapy, (p value = 0.016). Anisometropic amblyopic subjects showed better improvement in visual acuity by syntonic phototherapy as compared to strabismic amblyopic patients. Significant difference was also seen in contrast sensitivity between anisometropic amblyopic patients and strabismic amblyopic patients after syntonic therapy (p value = 0.035). Anisometropic amblyopic patients showed better improvement in contrast sensitivity by syntonic phototherapy as compared to strabismic amblyopic patients.

Table 3: *Comparison of Visual acuity and Contrast sensitivity after syntonic therapy in strabismic and anisometropic amblyopia.*

Independent Sample Test										
		Levene's test for equality of variance		**t-test for Equality of Means**						
		F	**Sig**	**t**	**df**	**Sig. (2-Tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Visual acuity	Equal variances assumed	2.61	.12	2.57	28	.016	.309	.120	.063	.56
	Equal variances not assumed			2.57	22.80	.017	.309	.120	.060	.56
Contrast sensitivity	Equal variances assumed	.036	.85	-2.22	28	.035	-.303	1.37	-.58	-.02
	Equal variances not assumed			-2.22	27.46	.035	-.303	1.37	-.58	-.02

DISCUSSION

Syntonic phototherapy with red light can be used as a treatment option for amblyopia. In 1920s clinical implementation of selected frequencies of light came in action.[16] Present research on syntonic phototherapy was focused on visual acuity and contrast sensitivity of amblyopes as well as comparison of visual acuity and contrast Sensitivity in different types of amblyopia. Results demonstrated that syntonic phototherapy showed significant improvement of visual acuity ($p = 0.00$) and contrast sensitivity ($p = 0.00$) in amblyopes. Anisometropic amblyopic subjects showed better improvement in visual acuity and contrast sensitivity as compared to strabismic amblyopes.

In a study, 55 patients between 11 to 15 years of age and diagnosed with amblyopia were treated with full time occlusion of good eye until no further improvement in visual acuity was seen. All subjects had improved visual acuity after treatment. The mean improvement was of 0.46 log MAR unit.[17] The result of present research also showed improvement in visual acuity in amblyopes. There was also improvement of contrast sensitivity in amblyopes.

Occlusion and penalization therapy of good eye had been gold standard for treatment of unilateral amblyopia. In one study, it took 6 months to show improvement.[18] Studies found that severe amblyopia improved by an average of 4.8 lines of visual acuity over 4 months duration with 6 hours of patching/day and 62% of moderate amblyopes had improvement of 3 lines of visual acuity or visual acuity better than 20/32 after patching for two hours/day for four months.[19] In this particular research, only 20 sessions were enough to show significant improvement of visual acuity and contrast sensitivity. Children were happy with the red filter glasses while their parents found syntonic therapy simple plus facile and gave good results. Eye care practitioners must be familiar with this therapy and they should keep syntonic phototherapy in mind whenever they are dealing with amblyopic patients.

Recently use of ipad has also been used to treat amblyopia. However, results are not comparable to the occlusion therapy.[20]

Limitations of this study are small sample size, single center study and no comparison between the two groups of different treatment modalities. Further research is needed to find out which therapy is better.

CONCLUSION

Visual acuity and contrast sensitivity increased significantly in patients with anisometropic and strabismic amblyopia after syntonic phototherapy. Visual acuity and contrast sensitivity improved more significantly in anisometropic amblyopes as compared to strabismic amblyopes.

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/004/2021).**

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Authors' Designation and Contribution

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