DOI: https://doi.org/10.54393/pjhs.v4i06.857

PAKISTAN JOURNAL OF HEALTH SCIENCES

https://thejas.com.pk/index.php/pjhs

Volume 4, Issue 6 (June 2023)

Original Article

Effectiveness of Optometric Photo-Therapy in Amblyopia

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ARTICLE INFO

Key Words:

Amblyopia, Anisometropia, Anisometropic Amblyopia, Light Therapy, Optometry

How to Cite:

Younus, M. ., Abbas, S., Muhammad Nadeem, M. ., Iqrar, A. ., Naseem, K. ., Bukhari, A. ., & Anwar, M. . (2023). Effectiveness of Optometric Photo-Therapy in Amblyopia: Optometric Photo-Therapy in Amblyopia. Pakistan Journal of Health Sciences, 4(06). https://doi.org/10.54393/pjhs.v4i06.857

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Received Date: 7th June, 2023

Acceptance Date: 27th June, 2023

Published Date: 30th June, 2023

ABSTRACT

Anisometropic amblyopia is amblyopia due to difference of ≥1 D refractive error between two eyes. **Objectives:** To determine effect of optometric phototherapy on Visual Acuity and Contrast Sensitivity in older children with anisometropic amblyopia and to assess frequency of different degrees of amblyopia. **Methods:** A Quasi Experimental study was carried at Madinah Teaching Hospital and DHQ, Faisalabad. A total of anisometropic amblyopia subjects of both gender with age ranging from 8 to 18 years who had undergone refractive adaptation were included in the study. Other types of amblyopia and subjects who previously got treated for amblyopia were excluded. Subjects were given optometric photo-therapy for 4 weeks with red amber filter and post assessment was recorded. Descriptive and Paired sample t test statistical analysis was done with SPSS version 27.0. **Results:** 64% of the subjects had moderate amblyopia, 20% had mild amblyopia while only 16% had severe amblyopia. Visual Acuity improved from .4944 ± .19040 to .3552 ± .20390 ($p<0.001$) while Contrast Sensitivity improved from 1.3980 ± .21529 to 1.5480 ± .21960 ($p<0.001$) in optometric photo-therapy. **Conclusions:** Moderate amblyopia had more prevalence in comparison to both mild and severe amblyopia and Optometric Photo-therapy showed improvement of both visual acuity and contrast sensitivity in anisometropic amblyopia.

INTRODUCTION

Amblyopia is a neurodevelopmental disorder of Visual system. It can be defined as reduction in visual acuity (VA) that is either monocular or binocular in the absence of an evident organic cause [1]. Amblyopia occurs during the critical period of visual development and is the leading cause of visual impairment in children as well as in adults. The estimated numbers of amblyopia patients in 2019 were 99.2 million worldwide which can increase up to 221.9 million by 2040 [2]. The prevalence of amblyopia in Pakistan can vary anywhere up to 6.7% [3]. Amblyopia is commonly classified into anisometropia amblyopia, strabismic amblyopia, mixed amblyopia and form deprivation amblyopia [4]. Anisometropic Amblyopia is the most prevalent type [5] and is defined as amblyopia due to difference of ≥1 D refractive error between two eyes. In Anisometropic Amblyopia as there is difference in power between both eyes, the eye which provide clearer image to brain becomes dominant one and other eye has blur image, this whole process concludes into atypical development of visual system [6]. Anisometropic amblyopia is 4.7% prevalent among children and could be myopic, hyperopic or astigmatic [7]. According to visual acuity, degrees of amblyopia can be distributed into three types; mild, moderate and severe amblyopia. Mild amblyopia ranges from 6/9 to 6/12, moderate amblyopia ranges from less than 6/12 to 6/36 while worse than 6/36 is known as severe amblyopia [8]. Spectacle correction of refractive error is primordial in amblyopes for clear retinal images [9].

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Restoration of vision is main focus in the recovery of amblyopia, the major goal is to achieve maximum vision, once that is achieved the other goal is to prevent reoccurrence of amblyopia. Regardless the cause of amblyopia, the first step for treating amblyopia is correction of the refractive error which is either known as refractive trial or optical treatment. Spectacle correction before any treatment is referred as optical correction or elaborately as refractive adaptation. It is currently in practice and is an important isolated period in clinical correction of amblyopia that carries on for suitable duration before other corrective measure, so accurate interpretation of improved VA could be done. It is usually last from 4 weeks to 18 weeks [10]. Correction of amblyopia with refractive trial is possible for moderate amblyopia while for severe amblyopia it reduces the following amblyopia load on therapies. Primary treatment of amblyopia include; treatment of underlying cause and stimulation of the worse eye. Treating it involves forcing the brain to utilize weaker eye for focusing images as it strengthens the eye [11]. The mainstay of treatment is patching of better eye since last several decades. Various randomized controlled trials RCT's has provided verifications of effective patching hours in young and older children but compliance of patching has always been an integral issue [12-14]. Compliance to occlusion therapy is particularly small and tends to decrease over the time. Optometric phototherapy is therapeutic enactment of selective wavelength lights on visual system to treat amblyopia. Its principle hypothesizes that short wavelength light stimulate parasympathetic system and long wavelength light stimulates sympathetic systems. The presumed mechanism of action is synchronization among molecular composition of definite neuropeptides and frequencies of light which can be regulated via autonomic or endocrine systems [15]. Amblyopia in optometric phototherapy is treated using red amber light (620 nm) which enhances synaptogenesis and influence neural plasticity. Red Amber light increases cell membrane magnitude of electron charge before release that would enhance charge of nerve cell and would disrupt synaptic resistance ultimately conquering amblyopia [16]. Optometric photo-therapy doesn't have prolonged time duration treatment unlike conventional treatment options of amblyopia. Also, unlike conventional therapies it can be advised to older children with amblyopia. This therapy had no effect on cosmetic appearance and was also facile for the patients to perform.

METHODS

A Quasi Experimental Study was conducted on gaining approval from the Ethical institutional review board. The study was conducted from December 2022 to April 2023 at the Ophthalmology Department of Madinah Teaching Hospital and DHQ, Faisalabad. 25 Anisometropic amblyopes sample size was calculated through Reosoft Formula and non-probability purposive sampling technique was used. Anisometropic Amblyopes of both genders with age ranging from 8 to 18 years who had undergone refractive trial period of minimum 4 weeks were included. Amblyopes with strabismic amblyopia, deprivation amblyopia and mixed amblyopia were excluded. Anisometropic amblyopes who had undergone any other amblyopia therapy were also excluded. A total of 25 Anisometropia amblyopia patients were included in the study. After taking both verbal and written consent from patient's parents or guardian, detailed history was taken. With appropriate testing the patient status of anisometropic amblyopia was confirmed. Complete ophthalmic examination, Cycloplegic Refraction, Subjective plus objective refraction and fundus examination was done to confirm anisometropic amblyopia. Either patients with ongoing refractive adaptation were selected or patients were given refractive adaptation trial of 4 weeks. Visual acuity and Contrast sensitivity were tested. VA was tested by using Log MAR chart at 4-meter distance. Contrast sensitivity was tested by using Pelli Robson chart at the distance of 1 meter. After initial assessment, subjects were given 20 sessions of optometric photo-therapy with red amber filter. These sessions were distributed over the duration of 4 weeks. Each session lasted 20 minutes as red-amber filter provided eyes with 620 nm light. In session patient wearing red amber filter view a light source at 50 cm providing 1.4 lux unfiltered to eye. Post assessment of Visual acuity and Contrast Sensitivity of subjects were recorded after 4 weeks and data were analyzed using descriptive statistics and paired sample t test in SPSS version 27.0.

RESULTS

A total of 25 subjects having anisometropic amblyopia were included in study, Subjects were given optometric photo-therapy with red amber filter for 4 weeks. Mean age of Optometric Photo-therapy subjects was 12.2800 ± 2.86531 (Table 1).

Table 1: Mean of amblyopia patients according to age

Age of subjects	N	Minimum	Maximum	Mean ± SD	
	25	8.00	18.00	12.2800	2.86531

Among subjects 44% (N=11) were male and 56% (N=14) were female (Table 2)(Figure 1).

Table 2: Frequency and percentage of amblyopic subjects according to gender

Gender	Frequency	Valid Percent	Cumulative percent
Male	11(44)	44.0	44.0
Female	14(56)	56.0	100.0
Total	25(100)	100.0	

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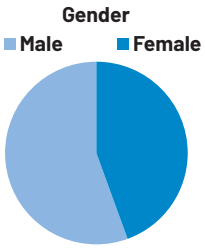

Figure 1: Percentage of amblyopic subjects according to gender

Among anisometropic amblyopic subjects given optometric photo-therapy (N=5) 20% had Mild Amblyopia, (N=16) 64% had Moderate Amblyopia and (N=4) 16 % had Severe Amblyopia(Table 3)(Figure 2).

Table 3: Degrees of Amblyopia in Subjects

Degrees	Frequency	Valid Percent	Cumulative percent
	5(20)	20.0	20.0
Moderate	16(64)	64.0	84.0
Severe	4(16)	16.0	100.0
Total	25(100)	100.0	

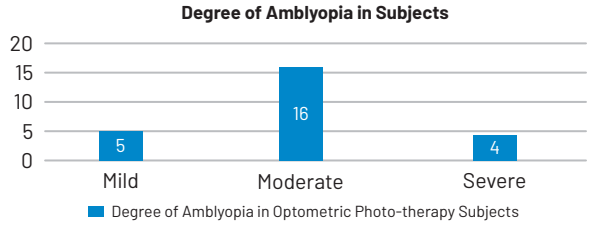

Figure 2: Degrees of Amblyopia in Subjects

On application of normality test, Shapiro test was p>0.05. So Paired sample T testing was used.

The mean value of Visual Acuity in anisometropic amblyopia patient before optometric photo-therapy was .4944 ± .19040 and after was .3552 ± .20390. There was statistically significant improvement of 0.1392 LogMAR value in visual acuity as p<0.05(p<0.001)(Table 4)(Figure 3).

Table 4: Visual Acuity before and after therapy in anisometropic amblyopia

Paired Samples Test								
Visual Acuity	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
VA Before optometric phototherapy- VA After optometric phototherapy	.13920	.03718	.00744	.12385	.15455	18.718	24	<.001

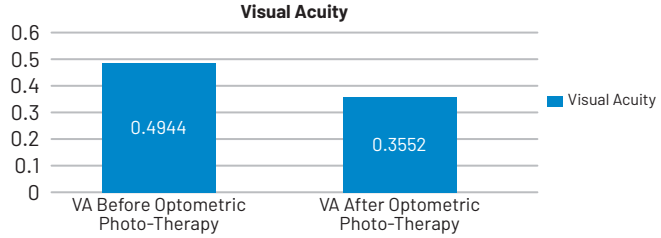

Figure 3: Visual Acuity before and after therapy in anisometropic amblyopia

The mean value of Contrast Sensitivity before optometric therapy was 1.3980 ± .21529 and after was 1.5480 ± .21960. There was statistically significant improvement of Contrast Sensitivity by -0.15 with optometric photo-therapy as p<0.05(p<0.001)(Table 5)(Figure 4).

Table 5: Contrast Sensitivity before and after therapy in anisometropic amblyopia

Paired Samples Test								
Contrast Sensitivity	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
CS Before optometric phototherapy- CS After optometric phototherapy	-.15000	.06124	.01225	-.17528	-.12472	-12.247	24	<.001

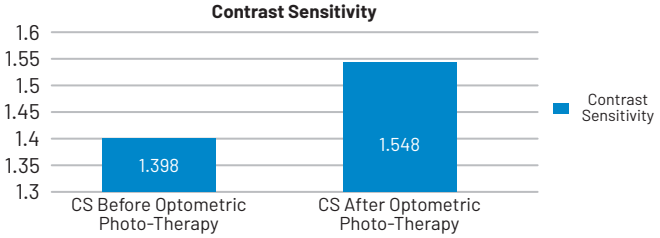

Figure 4: Contrast Sensitivity before and after therapy in anisometropic amblyopia

DISCUSSION

Patching therapy has been the gold standard for treating amblyopia. For decades, it was believed that amblyopia treatment was possible only during the development of critical period but recent updates state that neural plasticity diminishes by the age of 50 years [17], thus increasing the age limit for treatment of amblyopia. However, the recommended prolonged patching hours are impractical. This study was carried out to assess effectiveness of optometric photo-therapy in amblyopia. Photo-therapy showed significant improvement in visual acuity and contrast sensitivity with 20 sessions only (p<0.001, p<0.001). A previously conducted study by Abbas *et al.*, in 2022 in Pakistan included treatment of anisometropic and strabismic amblyopes with syntonic phototherapy for 4 weeks. Results showed mean visual acuity improved by 0.22 LogMAR value. Our study also revealed statistically valid improvement in visual acuity with optometric photo-therapy as it was improved by 0.1392 (p<0.001). Subjects treated with syntonic phototherapy also showed valid results in contrast sensitivity as it improved by -0.200 [18]. Our study also showed significant improvement by -.15000 in contrast sensitivity. A previous study in 2021 by Pandey *et al.*, included treatment of form deprivation adult strabismic amblyopia and nystagmus using syntonic photo-therapy

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with alpha-delta and mu-delta filter. Visual acuity improved from 6/60 at baseline to 6/18 with 50 sessions using alpha-delta and mu-delta filter while our study showed visual acuity improved by 0.1392 LogMAR value ($p<0.001$) with 20 sessions of optometric photo-therapy with red amber filter [19]. Zahir *et al.*, conducted a study in 2023 in Pakistan which showed 48.4% had moderate amblyopia, 33.5% had mild amblyopia while only 18% had severe amblyopia. Similarly, the current study showed that 64% of the subjects had moderate amblyopia, 20% had mild amblyopia while only 16% had severe amblyopia [20].

CONCLUSIONS

This study concluded that moderate anisometropia amblyopia is more prevalent than mild anisometropic amblyopia and mild anisometropic amblyopia is more prevalent than severe anisometropic amblyopia. The study also concluded that Optometric photo-therapy showed improvement in both Visual acuity and Contrast sensitivity in 4 weeks.

Authors Contribution

Conceptualization: MY, KN
Methodology: SA, MMN, AI, AB, MA
Formal analysis: SA, AB
Writing-review and editing: MY, MMN, AI, KN, AB, MA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

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