

State of contrast sensitivity in anisometropic amblyopic eye after occlusion therapy

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Abstract

Background: Amblyopia is defined as unocular or binocular decreased best corrected visual acuity without any identifiable pathology in the eye or visual pathway. Occlusion therapy is the main stay of treatment in these cases. Visual acuity is often improved if the disease is detected at earlier age and if the patient is well compliant to therapy. It is observed that there is some compromised contrast sensitivity in some patients even after improvement of visual acuity which renders this patients unsatisfactory. **Objective:** To assess the status of contrast sensitivity after occlusion therapy in patients of anisometropic amblyopia. **Methodology:** This prospective observational study was conducted over 50 diagnosed patients of anisometropic amblyopia in the department of Paediatric Ophthalmology in National Institute of Ophthalmology & Hospital from January, 2021 to December, 2022. Patients fulfilling the selection criteria were enrolled in the study. Selected patients underwent detail ophthalmic and systemic evaluation as well as relevant investigation. Visual acuity was assessed with special emphasis which includes unaided, with pinhole and after refraction. Visual acuity was recorded in Snellen's chart and converted into Log MAR unit. Contrast sensitivity was tested monocularly on both eyes in all the study subjects by Pelli-Robson chart. Occlusion of better eye was done in all patients. Duration of occlusion depends on presenting best corrected visual acuity (Worse than 6/60:6 waking hours, 6/60-6/24:4 waking hours and 6/18-6/12:2 waking hours). They were followed up 1 months after starting occlusion therapy. Occlusion therapy was continued when there is stable vision for 6 months or vision improves better than 6/12. Data were collected 1 month, 3 months and 6 months after starting occlusion therapy. Mean score of visual acuity (Log MAR unit) was taken from available data at that time and was compared with the baseline data. Contrast acuity was assessed in all patients by Pelli-Robson chart during final follow-up. Mean value of the contrast acuity was compared between before and after occlusion therapy. All the relevant data were recorded in pre-designed data collection sheet and analyzed by window software SPSS ver.21. **Results:** In this study the mean age of the study subjects were 8 ± 1.72 years, out of them, 23 were male and 27 were female. Baseline mean best-corrected visual acuity in Log MAR unit was 0.70 ± 0.15 (SD). It was 0.55 ± 0.13 (SD), 0.49 ± 0.09 (SD) and 0.37 ± 0.11 (SD) in 1st month, 3rd month and 6th month respectively. Contrast sensitivity by Pelli-Robson chart of the study subjects. The base line contrast sensitivity was 1.19 ± 0.20 (SD) and it was 1.18 ± 0.20 (SD) during final follow-up. **Conclusions:** Quantitative assessment and comparison of mean contrast acuity after occlusion therapy with presenting acuity showed that there was no significant changes in contrast acuity after occlusion therapy though the improvement of mean visual acuity.

Keywords : Contrast sensitivity, Occlusion therapy, VA.

Introduction

Amblyopia has traditionally defined as a decrease of visual acuity caused by pattern vision deprivation or abnormal binocular interaction for which no causes can be detected by the physical examination of the eye and which in appropriate

cases may be reversible by therapeutic measures.^[1] Amblyopia is estimated to afflict 1-4% of children^[2] with recent large population studies falling in the range of 1.6-3.6% and^[2] with evidence that the rate is even higher in medically under served populations. Family income

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influences prevalence of amblyogenic risk factors and health care delivery pattern following preschool vision screening. Various studies have found to be the leading cause of visual impairment in adults various age distribution.

Amblyopia has been traditionally divided into three classes- anisometropic, derivational and strabismic. Anisometropic amblyopia involves both deprivation and abnormal binocular interaction.^[1]

Amblyopia has a cortical and lateral geniculate basis^[1,3,4] The disorder is caused by any condition abnormal or inadequate visual input during infancy or childhood. These conditions can an imbalance in the positioning of the eyes such as strabismus, in which the eyes are crossed inward (esotropia) or outward (exotropia) Amblyopia also can result from a major difference in refractive error between the two eyes, such as myopia, hypermetropia or astigmatism, Less common causes of amblyopia are cornea and lens diseases and injury to the eye of a young child^[5,6,7]

Treatment methods of amblyopia includes a) refractive correction- some cases of nonstrabismic anisometropic amblyopia can be partially or completely treated by refractive correction alone,^[8,9,10] occlusion- the traditional and still most widely used method of amblyopia treatment to occlude the better eye, c) penalization- glass lens based optical penalization has generally been advocated for mild amblyopia (visual acuity in amblyopic eye 20/60 or better) and pharmacological penalization or mild to moderate amblyopia (20/100 or better)^[11,12]. Diffuse based optical penalization has been used for mild to moderate amblyopia as well.^[13]

Contrast sensitivity is the visual ability to distinguish an object from its background; it is not the same as visual acuity. The objects within our visual field are of varying size, color and brightness; some things are close, some are far; some things consist of a myriad of details while other things are almost monotone. When all of these images enter the pupil in the form of light waves, the cells in our retina must begin to make

sense of them, and the images sent to the brain are interpreted as the world in front of us.

The Pelli–Robson contrast sensitivity chart is a standard method of assessing contrast sensitivity. A segment of the chart is reproduced here. Individuals are asked to read as many letters as possible. The letters are presented such that, when descending the page, the level of contrast between the letter and the background decreases until the letters are no longer legible.

It has been observed in some studies as well as personal clinical experiences that after occlusion therapy in patients with anisometropic amblyopia though the level of visual acuity is improved in significant number of patients but the contrast sensitivity is not improved significant to that much extent.

This study was done to explore the state of contrast acuity in patients with anisometropic amblyopia after occlusion therapy in Bangladeshi clinical setting.

Materials and Methods

This prospective observational study was carried out in the Department of Paediatric Ophthalmology, National Institute of Ophthalmology & Hospital.

from 1st January 2021 to 31st December 2022 on 50 anisometropic amblyopia child patients age between 5- 11 years. The protocol of this study was approved by Departmental Ethical committee. Patients of anisometropic amblyopia attended in Paediatric Ophthalmology outdoor, National Institute of Ophthalmology & Hospital , Dhaka. Subject with associated with strabismus, amblyopia treatment in past 6 months ,current vision therapy or orthoptics, ocular cause of reduced visual acuity(e.g. corneal opacity ,cataract, pathological myopia) ,prior intraocular or refractive surgery were excluded from this study. After selection of subject the purpose and procedure of study were explained to each subject with a cordial attitude giving emphasis of the benefit they would obtain from the study.

Detail history was taken from all the selected

patients and they underwent detail ophthalmic examination by slit lamp bio microscope and indirect ophthalmoscope. Visual acuity were assessed by Log MAR chart at a 6 meter testing distance and cover test were conducted with child fixing both near and distance targets. Contrast sensitivity was measured by Pelli Robson contrast sensitivity chart at a 1 meter with the best distance correction. Refraction was done after cycloplegia with topical 1% cyclopentolate in every patient. Occlusion therapy was applied to each patient and was followed-up after one week per year of age at presentation. Cycloplegic refraction was done in each visit. Follow-up was done up-to attainment of 0.3 Log MAR unit or stable vision for two consecutive visit. Contrast sensitivity was assessed during final follow-up. All the relevant informations were recorded in a pre-designed data collection sheet, data were analyzed by window software SPSS ver.20 and were displayed by appropriate table and figure. Results

The age distribution of the study subjects in Table-1 and figure-1

Table-1: Age distribution of the subjects

Age group	Frequency	Percentage
5-7 years	09	18
7-9 years	29	58
9-11 years	12	24
Total	50	100
Mean±SD	8±1.72 Years	

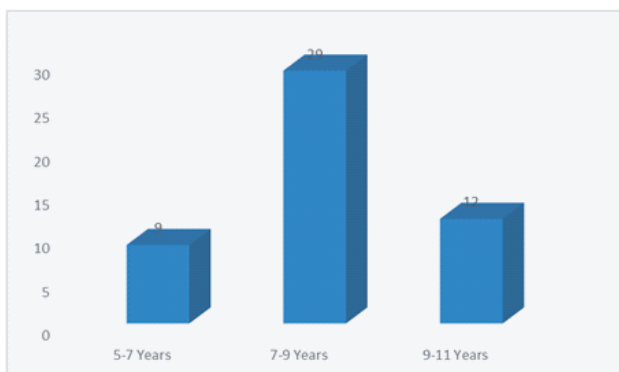


Figure-I: Bar diagram showing age distribution of the study subjects

Table-2: Gender distribution of subject in Table-2 and figure- II

Gender	Frequency	Percentage(%)
Male	23	46
Female	27	54
Total	50	100

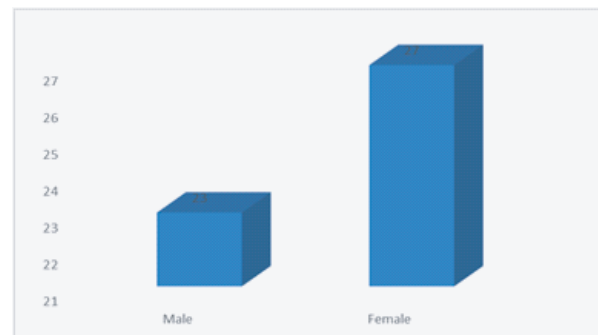


Figure II: Bar diagram showing gender distribution of the study subjects

Table 2 and figure II shows the gender distribution of the study subjects. Out of 50 patients, 23 were male and 27 were female.

Table-3: Distribution of best corrected visual acuity during follow-up periods

Follow-up periods	Contrast sensitivity	t value/p value
Baseline	1.19±0.20 (SD)
6 th month	1.18±0.20 (SD)	1.769/0.83 ^{ns}

Bar diagram

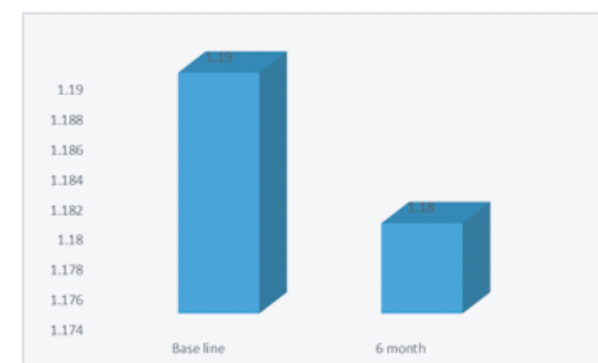


Figure-: III- Line chart showing distribution of best corrected visual acuity in Log MAR unit of study subjects

Table-3 and figure- III shows the distribution of best corrected visual acuity in Log MAR unit of the study subjects in baseline and follow-up periods. Mean best-corrected visual acuity in Log MAR unit was 0.70 ± 0.15 (SD). It was 0.55 ± 0.13 (SD), 0.49 ± 0.09 (SD) and 0.37 ± 0.11 (SD) in 1st month, 3rd month and 6th month respectively.

Table-4: Distribution of contrast sensitivity

Follow-up periods	BCVA (Log MAR unit)	t value/ p value
Baseline	0.70 ± 0.15 (SD)	-----
1 st month	0.55 ± 0.13 (SD)	12.476/.000 ^s
3 rd month	0.49 ± 0.09 (SD)	13.405/.000 ^s
6 th month	0.37 ± 0.11 (SD)	14.845/.000 ^s

s=significant

Line Chart

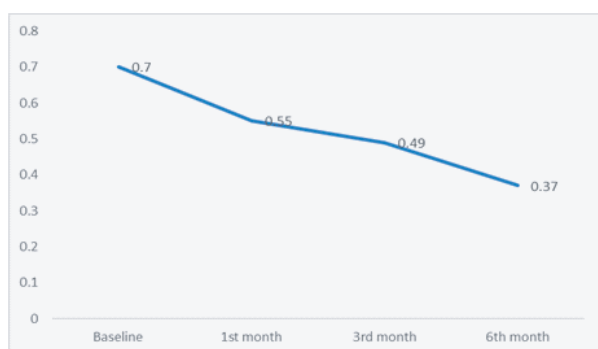


Table-4 and figure- IV shows the distribution of contrast sensitivity by Pelli-Robson chart of the study subjects. The base line contrast sensitivity was 1.19 ± 0.20 (SD) and it was 1.18 ± 0.20 (SD) during final follow-up

Discussion

Amblyopia is defined as an optically uncorrected loss of vision, usually monocular, without demonstrable pathology in the posterior pole of the eye. Amblyopia develops in early childhood and it affects a considerable number of population. Among different types of amblyopia, it most commonly associated with strabismus and anisometropia. Occlusion of the good eye remains the main stay of therapy for amblyopia management. Daily duration of occlusion of amblyopia therapy depends on the existing best corrected vision in the affected eye and follow

schedule depends on age of the patient at presentation. During occlusion therapy best corrected visual acuity of the affected eye is measured in every visit.

Contrast sensitivity is defined as the threshold between the visible and invisible. There are three variables in the measurement of contrast sensitivity: average amount of light reflected depends on illumination of paper and darkness of ink, degree of blackness in relation to the white background, i.e. contrast and the distance between the grating periods or cycles per degree of visual angle. Though there is enough evidence of improvement of visual acuity after occlusion therapy but the status of contrast sensitivity is not improved significantly from that of presentation. This study was conducted over 50 diagnosed patients of anisometropic amblyopia patients to assess the status of contrast sensitivity after occlusion therapy.

In this study, the mean age of the study subjects were 8 years with a standard deviation of 1.72. Study done by^[20] showed that the mean age of the subjects were 7.67 years with a standard deviation of 1.50. These findings very much consistent with the present study.

In the present study, 46% of the study subjects were male and 54% were female. Study done by [14] showed in their study that 53% were male and 47% were female. The minimum disparity in the findings may be due to fact that in the present study, data were collected purposively and the female patients were more during sample selection.

In this study the mean presenting visual acuity (VA) in amblyopic eye was 0.70 ± 0.15 it was 0.55 ± 0.13 , 0.49 ± 0.09 , 0.37 ± 0.11 during 1st month, 3rd months and 6th months follow up respectively. Changes in visual acuity from baseline was significant in every follow-up ($p<0.001$). Study done by^[15] that mean pre-treatment visual acuity was Log MAR 0.51 ± 0.23 it was improved to Log MAR 0.0 in 75.86% of cases, Log MAR 0.1 in 17.86% of cases and Log MAR 0.3 in 3.45% after mean period of occlusion therapy of 4.79 ± 3.35 months.

Improvement of visual acuity after occlusion

therapy in amblyopic patient is proven by many other studies in the different parts of the world. Amount and rate of improvement varies depending on the type, depth of amblyopia and also to the compliance to therapy. The current study findings also suggest the existing findings.

The mean contrast sensitivity was 1.19 ± 0.20 by Pelli-Robson chart and at the end of the study was $1:18 \pm 0.20$.^[14] that there is significant effect of amblyopia in contrast sensitivity, though they measure in separate unit.^[16] there is significant decrease in contrast sensitivity after occlusion therapy in amblyopia patients.^[17]

Contrast sensitivity and visual acuity has linear relationship in amblyopia patients. Contrast sensitivity is not improved even the visual acuity attained to 0.0 Log MAR unit after occlusion therapy.

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Conclusion

Contrast sensitivity in the threshold between visible and invisible which has significance on basic and clinical optics of vision. The current trends of treatment of amblyopia is to occlude the eye having better vision. Though after occlusion therapy visual acuity improves but patients are not satisfied with their vision is mostly due to low contrast sensitivity. Quantitative analysis of the contrast sensitivity of the patients of anisometropic amblyopia patients after occlusion therapy done in this study also supports this fact

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