

Visual outcome after full refractive correction of anisometropic amblyopia among 5-15 years old children

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Abstract

Anisometropic amblyopia is the most common cause of visual morbidity in childhood which is characterized by reduced spatial vision due to refractive error. This study was planned to determine the visual outcome after full refractive correction of anisometropic amblyopia among 5-15 years old children. The Cross sectional interventional study was conducted in the Departments of Community Ophthalmology and Ophthalmology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from March 2017 to August 2019. Children (5-15 years) having myopic, hypermetropic & astigmatic refractive error between two eyes will be minimum 1.0 D difference after refraction and didn't get any treatment for this problem yet were the study population. Total 52 untreated children were included in the study. 3 children did not attend the follow up visit. The mean age of the subjects of our study was 9.47 years, range of age was 5-15 years. 44 (89.8%) patients were bilateral & 5 (10.2%) were unilateral. After full correction of refractive error with spectacles alone improved anisometropic amblyopic eyes visual acuity an average of 2.3 lines in snellen's chart. Visual acuity improved from baseline by 2 or more lines (95% CI) in 85% of the patients and by 3 or more lines in 49.3%. This improvement is statistically significant ($P < 0.0001$). Additionally, amblyopia resolved in 7 of 49 (15%) patients with residual amblyopia who continued to be treated with spectacles even after completion of follow up plan. Improvement of visual acuity continued beyond the initial 12 weeks of spectacle wearing for 37 (75.5%) of the 49 patients completing the initial 12 week visit, after completing 24 weeks, it was 26 (53.1%). The mean VA of the right eyes at baseline was 0.45 Log MAR unit. In 2nd visit shows the mean of VA is 0.34 log MAR unit and in 3rd visit mean is 0.23 log MAR unit. Total improvement in right eye was 0.22 logMAR unit. The mean VA of the left eyes at baseline was 0.51 LogMAR unit. In 2nd visit shows the mean of VA is 0.37 logMAR unit and in 3rd visit VA mean is 0.30 logMAR unit. Total improvement in right eye was 0.21 logMAR unit. Average improvement in both eyes 0.215 logMAR unit. So, results shows that refractive correction is a powerful treatment modality for young children with anisometropic amblyopia. If we can detect them earlier then we should have given these children a better vision & prosperous life.

Keywords: Anisometropia, Amblyopia, Refraction, Cycloplegia.

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Introduction

Amblyopia is the unilateral, or bilateral, decrease in the BCVA caused from vision deprivation and/or abnormal binocular interaction, for which there is no identifiable pathology of the eye or visual pathways. There are 5 types of amblyopia; Anisometropic; Strabismic; Stimulus deprivation; bilateral ametropia and Meridional amblyopia.¹ Anisometropic amblyopia is common type of amblyopia in children, occurring twice as frequently as strabismic amblyopia. Anisometropia is when vision in one doesn't correspond with the fellow eye. The refractive status of two eyes will be different. Anisometropic amblyopia means development of of amblyopia in any eye due to refractive error difference in two eyes. On other words,

Amblyopia, it is called lazy eye, is a developmental neurological abnormal condition. Here, one eye becomes dominant while the other becomes lazy and the brain starts to ignore the signals from the lazy eye and favors the signals from one eye may lead to visual impairment or, in some case complete blindness, or from one eye it is called mono ocular blindness.² When the total refraction of two eyes is unequal or different, this condition is called Anisometropia.³ In case of anisometropia, a disparity of more than 1D in Hypermetropic patient is enough to cause amblyopia of more hypertrophic eye. For near vision, the more hypermetropic eye is therefore remaining out of focus. In case of myopia more than 2.5D has a higher chance of amblyopia.³ The prevalence anisometropic amblyopia in patients of amblyopia is 25% to 60%. Hence, not all patients with anisometropia develop amblyopia.⁴ Anisometropic amblyopia may be produced due to loss of foveal resolution in the less focused eye, by localized mechanisms of foveal inhibition or development of a suppression scotoma or by loss of binocular function (perhaps caused by loss of resolution or by a suppression scotoma). Risk factors of anisometropic amblyopia can be divided into ocular and non-ocular risk factors. It is associated with refractive error, strabismus, or anisometropia, congenital nasolacrimal duct obstruction. One-third of the population will present a refractive error (myopia, hyperopia, astigmatism). In total 5.8–11.6% of the United States, Western European and Australian population suffer from hyperopia and 16.4–26.6% from myopia.⁵ Different studies investigating perinatal, socioeconomic and demographic risks identified non-ocular factors associated with anisometropic amblyopia such as maternal smoking during pregnancy, prematurity and neonatal intensive care unit hospitalization.

Anisometropia causes highest number of amblyopia among children throughout the world. Early detection of amblyopia associated with anisometropia and treatment of any refractive error, can reduce the overall prevalence of anisometropic amblyopia in our country. It's a preventable & modifiable disease. Various researchers of different countries reported about the improvement after full refractive correction in anisometropic amblyopia. Great emphasis should be given on creating awareness through

campaigns in day care centers, pre-schools, schools for teachers and among parents that early visual assessment of a child lead to early detection, prompt diagnosis and treatment of amblyopia in this group.

Method and materials

A cross sectional interventional study was done on Children (5-15 years) who will attend in the OPD of community ophthalmology and department of ophthalmology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka during period of time march 2017 to august 2019. After obtaining permission from institutional review board (IRB), 49 were included for the study. Data collection sheet was designed according to the objective of the study with clinical examination form.

Sampling Technique: A random sampling technique was used to collect the sample from study population as per inclusion and exclusion criteria.

Data collection procedure:

Patients attending at Out Patient Department of Ophthalmology and Community Ophthalmology, Bangabandhu Sheikh Mujib Medical University. The written informed consent was obtained from all participants before enrollment in the study at the time of first screening. The complete clinical evaluation including history, physical examination, relevant ocular examinations- best corrected visual acuity (BCVA), Hirschberg's Test to determine the presence or absence of strabismus, Cover- uncover test to confirm the diagnosis if strabismus present, Ocular motility test, Examination of anterior segment by slit lamp to detect cataract, congenital anomalies like anophthalmos, microphthalmos, large corneas and evidence of previous eye surgery, Cycloplegic (1% cyclopentolate eye drop) refraction using streak retinoscopy, fundoscopy with Direct Ophthalmoscope to rule out any retinal pathology. All findings were recorded in the data collection sheet. A baseline examination was performed in 1st visit. Within 3 month of the first visit when the child began spectacle correction and worn full time. Follow-up visits were scheduled at 3 and 6 months. The visits involved an orthoptic examination as described at the first visit, but VA testing was performed with

the prescribed spectacles. The visits at 6 months included a detailed ophthalmologic examination as described at the first visit. During the study, the children's glasses were changed if needed. Resolution of amblyopia was defined as a VA difference of 1 line or less between the eyes.

Statistical analysis:

Data were processed and analyzed using SPSS, version 22.0 for Windows. The results were presented in tables and figures.

Total 52 children with previously untreated anisometropic amblyopia and considerable refraction error were selected. Three children were dropped out. Among them anisometropic amblyopia associated with myopia 8 children, Myopic astigmatism 15 children, hyperopia 13 children, hypermetropic astigmatism 9 children, & mixed astigmatism 4 children. The mean age at presentation was 9.47 years. Below tables shows distribution of VA of both eyes at 1st visit among boys and girls-

Results

Table-1 : Distribution of visual acuity of right eye among children at 1st visit by sex

Visual acuity	Boys		Girls		All	
	#	%	#	%	#	%
6/6	3	15.0	0	0.0	3	6.1
6/9	0	0.0	2	6.9	2	4.1
6/12	1	5.0	2	6.9	3	6.1
6/18	4	20.0	7	24.1	11	22.4
6/24	0	0.0	3	10.3	3	6.1
6/36	7	35.0	8	27.6	15	30.6
6/60	5	25.0	4	13.8	9	18.4
2/60	0	0.0	1	3.4	1	2.0
4/60	0	0.0	1	3.4	1	2.0
5/60	0	0.0	1	3.4	1	2.0
Total	20	100.0	29	100.0	49	100.0

p=.272

Table 1 shows frequency of refractive error (RE) among boys, maximum visual acuity was 6/36 for 7 children (35%), 6/60 for 5 (25%) & among girls 8 children had 6/36 (27.6%), & 7 girls for 6/18 (24.1%). Above all maximum visual acuity 6/36 group retains 15 children (30.6%), 6/18 (22.4%) group & 6/60 (18.4%) accordingly

Table-2: Distribution of visual acuity of left eye among children at 1st visit by sex

Visual acuity	Boys		Girls		All	
	#	%	#	%	#	%
6/6	2	10.0	1	3.4	3	6.1
6/9	1	5.0	0	0.0	1	2.0
6/12	2	10.0	3	10.3	5	10.2
6/18	3	15.0	2	6.9	5	10.2
6/24	0	0.0	5	17.2	5	10.2
6/36	8	40.0	5	17.2	13	26.5
6/60	3	15.0	7	24.1	10	20.4
5/60	0	0.0	0	0.0	0	0.0
4/60	1	5.0	2	6.9	3	6.1
3/60	0	0.0	2	6.9	2	4.1
2/60	0	0.0	2	6.9	2	4.1
Total	20	100.0	29	100.0	49	100.0

p=.207

Table 2 shows the frequency of refractive error of left eyes among boys, maximum visual acuity 6/36 for 8 children (40%), 6/60 for 3 (15%) & among girls 7 children had 6/60 (24.1%), & 5 girls for 6/36 (17.2%). visual acuity 6/36 group retains 13 children (26.5%), 10 children have 6/60 (20.4%) accordingly.

Table-3: Distribution of visual acuity of right eye among children 2nd visit by sex

Right eye	Boys		Girls		All	
	#	%	#	%	#	%
6/18	3	15.0	8	27.6	11	22.4
6/36	2	10.0	1	3.4	3	6.1
6/60	0	0.0	0	0.0	0	0.0
6/9	3	15.0	7	24.1	10	20.4
6/6	3	15.0	1	3.4	4	8.2
6/12	1	5.0	4	13.8	5	10.2
6/24	8	40.0	7	24.1	15	30.6
2/60	0	0.0	1	3.4	1	2.0
Total	20	100.0	29	100.0	49	100.0

p = .355

Table 3 shows the frequency of refractive error among boys in 2nd visit, among boys maximum refractive error were 6/24 for 8 children (40%), among girls, 6/18 for 8 children (27.6%) & above all maximum complaints were 6/24, 16 subjects (30.6%) in right eye.

Table-4: Distribution of study participants left eye status at 2nd visit by sex

Left Eye	Boys		Girls		All	
	#	%	#	%	#	%
6/18 (1)	4	20.0	6	20.7	10	20.4
6/36 (2)	1	5.0	2	6.9	3	6.1
6/60 (3)	3	15.0	2	6.9	5	10.2
6/9 (4)	4	20.0	4	13.8	8	16.3
6/6 (5)	2	10.0	2	6.9	4	8.2
6/12 (6)	2	10.0	3	10.3	5	10.2
6/24 (7)	4	20.0	9	31.0	13	26.5
2/60 (8)	0	0.0	0	0.0	0	0.0
4/60 (9)	0	0.0	1	3.4	1	2.0
Total	20	100.0	29	100.0	49	100.0

p = .928

Table 4 shows frequency of refractive error of left eyes in 2nd visit, among boys, maximum visual acuity was 6/24 for children (20%), 6/60 for 3 (15%) & among girls 7 children had 6/24 (31%), & 6 girls for 6/18 (20.7%). Above all maximum VA 6/24 group retains 13 children (26.5%), 10 children have 6/18 (20.4%) accordingly.

Table=5: Right and Left Visual acuity status at three visit						
Right Eye	Right Eye			Left Eye		
	First	Second	Third	First	Second	Third
6/18 (1)	11	15	4	12	12	10
6/36 (2)	3	0	0	3	3	1
6/60 (3)	0	0	1	5	1	0
6/9 (4)	10	10	16	8	7	14
6/6 (5)	4	7	14	4	9	15
6/12 (6)	5	13	14	5	10	8
6/24 (7)	15	3	0	13	5	3
2/60 (8)	1	0	0	0	0	0
4/60 (9)	0	1	0	1	0	0

Table 5 shows improvement of line in snellen’s chart, in case of right eye, 1st visit, 4 patients were 6/6 vision, in 3rd visit its 14, it indicates improvement, 15 patients have 6/24 vision, in 3rd visit there is no 6/24 vision. In Left eye, 6/6 was in 4 patients, in 3rd visit 16, 6/24 in 13 patients, in 3rd visit there only 3 left with 6/24 vision. The improvement is statistically significant.

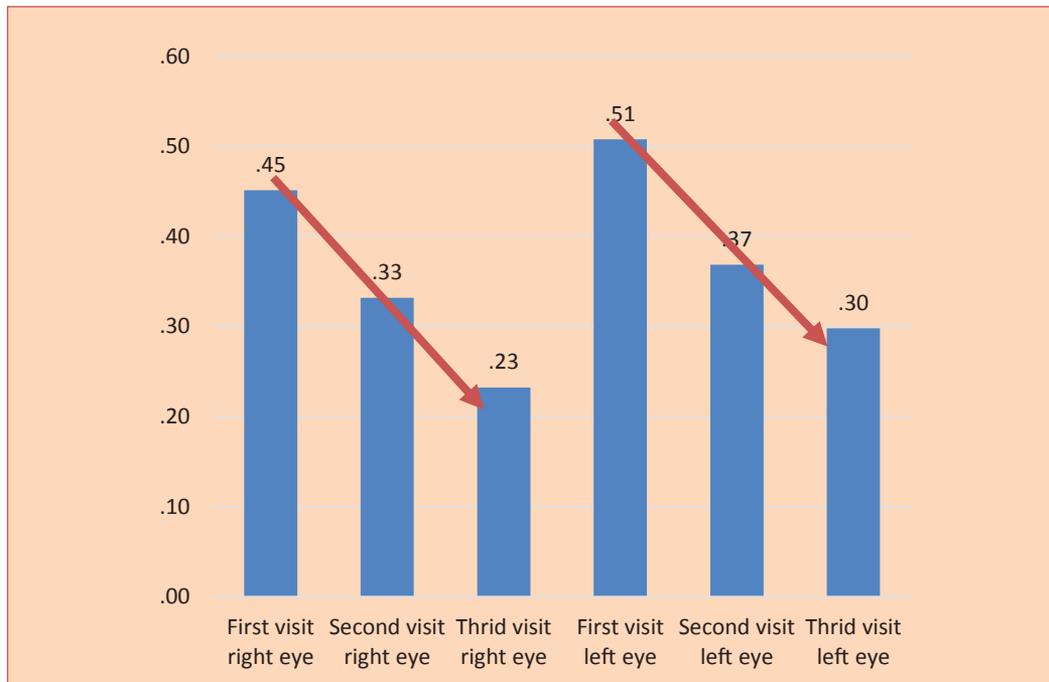


Figure 1: This Bar chart shows the improvement of refractive status of right eye. In 1st visit mean was 0.45 logMAR unit & in 3rd visit 0.23 logMAR unit, in Left eye visual acuity mean changed from 0.51 logMAR unit to & 0.30 logMAR unit on 3rd visit.

Table 6: SD mean of improvement in logMAR unit , visits of both eyes

Variable	Mean	P<
Right eye		
First visit	.45141±.2243	.0001
Second visit	.3318±.20190	.0001
Third visit	.2322 ±.18142	.0001
Left eye		
First visit	.5078±.27757	.0001
Second visit	.3686±.23791	.0001
Third visit	.2980±.20266	.0001

Table 6 shows SD mean of visual improvement in LogMAR unit from 1st visit to 3rd visit in right eye logMAR 0.45 to 0.23 & in left eye 1st visit to 3rd visit it is 0.51 to 0.29logMARunit, in all cases it is statistically significant (P<0.0001)

Table 7: Line improvement in snellen's chart from First to second visit and second to third visit of both eyes

Eye	Mean (SD)	P<
Second visit Right Eye	1.17 ±.36	.0001
Second visit Left Eye	1.12 ±.69	.0001
Third visit Right Eye	2.02 ±.59	.0001
Third visit Left Eye	1.98 ±.75	.0001

Table 7 shows SD mean of improvement of lines in snellen's chart from 1st Visit to 3rd visit in Right was 2.02 ±.59lines &in Left eye; from 1st to 3rd visit, improvement was 1.98 ±.75 lines, in all cases it was statistically significant (P<0.0001).

Table-8 : Distribution of laterality of affected eyes pattern of children by sex

Eye	Boys		Girls		All	
	#	%	#	%	#	%
Both eye	16	80.0	28	96.6	44	89.8
Left eye only	3	15.0	0	0.0	3	6.1
Right only	1	5.0	1	3.4	2	4.1
Total	20	100.0	29	100.0	49	100.0

p=.092

Table 8 shows the distribution of refractive error improvement after 6 months. Among, boys 18 children (90%), girls 24 children (82.7%) & over all 42 children (85.7%) achieved the desired level.

Discussion

These results shows that refractive correction is a powerful anisometropic amblyopia treatment modality for young children with anisometropic amblyopia. Children aged 5 to 15 years, who had untreated anisometropic amblyopia with visual acuity that ranged from 6/9 to 4/60. All of our participants were selected as having anisometropic amblyopia without strabismus or any other disease. In this study we found that after full correction of refractive error with spectacles, improved anisometropic amblyopic eyes visual acuity an average of 2.3 lines in snellen's chart. Visual acuity improved from baseline by 2 or more lines (95% CI) in 85% of the patients and by 3 or more lines in 49.3%. This improvement is statistically significant ($P<0.0001$). Additionally, amblyopia resolved in 7 of 49 (15%) patients with residual amblyopia who continued to be treated with spectacles even after completion of follow up plan. Wallace et al. (2007) showed in their study that one year mean improvement, 3.9 lines (95% CI). The Mean improvement at one year for the 84 children with baseline binocular acuity was 3.4 lines (95%CI).⁶ Our study period was 6 months. So, our improvement is similar to the previous study. The mean anisometropia of this study around 2.45 diopters (D) were detected. Chen et al. (2007) studied 60 children with a mean age of 5.3 years and mean anisometropia of 2.95 diopters (D) were included.⁷ So, there is similarity in dioptic value of anoisometropia in this two studies. Improvement of visual acuity continued beyond the initial 12 weeks of spectacle wearing for 37 (75.5%) of the 49 patients completing the initial 12 week visit, after completing 24 weeks, it was 26 (53.1%). Chen et al. also showed the improvement in VA in the amblyopic eye was

good at 4 to 12 weeks then reached a plateau, after which it improved only slowly.⁷ Stewart et al.(2005) showed improvement of 6 patients occurred with an average of 16 weeks in their subgroup of the patients with anisometropic amblyopia.⁸ So, there is a similarity in both eyes of time duration for improvement of anisometropic amblyopia with above mentioned studies. Afsari et al. (2013) studied the improvement in anisometropic amblyopia 3.9 ± 0.9 for the spectacles group throughout a year. ⁹ The study of the Paediatric eye disease investigator group; conducted a study with 84 untreated anisometropic amblyopic patient ranging amblyopia improved with optical correction by 2 or more than 2 lines in 74% of the patients and resolved in 26%.¹⁰ This result is similar to that study & the improvement is significant ($P<0.001$).

Conclusion

Anisometropic amblyopia have a significant clinical meaning as they can be the cause of low visual acuity or even blindness. Many studies have took place to observe the improvement of anisometropic amblyopia after full refractive correction. Reduced vision because of anisometropic amblyopia is an important public health problem in young children in our country. If we can detect them earlier then we should have given these children a better vision & prosperous life.

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