Treatment of Anisometropic Amblyopia in children with refractive correction

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Abstract

Background: The main purpose of the study is to determine the effectiveness of spectacles alone in the treatment of anisometropia in paediatric population.

Methods: A hospital based prospective study was conducted on twenty children (involving twenty-six eyes) with freshly diagnosed anisometropic amblyopia of mild to moderate grade. Optimal refractive correction was provided with spectacles alone and was followed at every 3 weeks until amblyopia resolved.

Results: The mean line of improvement in visual acuity in 3 weeks was 0.85 ± 0.65 snellen lines. The mean line improvement in second follow up was 0.80 ± 0.70 lines. There was statistically significant (p=0.04) decrease in inter-ocular acuity (IOD) for anisometropia of 1 to 2.0D. The IOD improvement was associated with age (1.53 snellen lines in more than 8 years) in first follow up (p=0.001). IOD also decreased in children of more than 8 yrs.

Conclusions: As in nearly half of the participants, especially who has minimal interocular acuity difference, anisometropic amblyopia resolved to normal acuity within first three weeks, we can conclud that the early improvement of visual acuity is related to lesser amount of anisometropia, age and sex.

Key words: Anisometropic amblyopia, amblyopia resolution, inter-ocular difference (IOD), refractive correction

Introduction

Anisometropia is one of the most common causes of amblyopia. Anisometropia is considered to exist when the spherical equivalent refraction of the two eyes differs by 1.0 D or more.[1] Many researchers have suggested that functional amblyopia can be defined as visual acuity poorer than 20/20 in the underlying structural or pathological anomalies but with at least one of its causes occurring before age six.[2] It is preferred to prescribe any necessary correction and then wait for at least 6 weeks to re-evaluate the acuity. As long as the acuity improves, it is reasonable to continue just glasses before prescribing additional therapy. There is active inhibition of fovea in anisometropic amblyopia, the purpose of inhibition is to eliminate sensory interference caused by superimposition of focused and defocused image from fixation point (abnormal binocular interaction).[3]

There are several studies which suggest that mild to moderate grade of amblyopia treatment can be done with refractive correction alone. However, patching or pharmacological treatment is often prescribed simultaneously or soon after refractive correction.[4] Patching therapy creates some adverse psychological effects; emotional distress and prohibition of child's activities. Risk of amblyopia recurrence is higher in occlusion therapy than that in treatment with spectacle alone.[5] Since denser levels of amblyopia have been reported to be associated with poorer treatment compliance, children should be motivated to wear glasses initially and later make them adapt to

patching therapy. Strabismus and amblyopia is the third major cause of paediatric eye problem and significant number of cases are being managed by refractive and occlusion therapy since the starting of the treatment.* (Annual report of B. P. K. Lions Centre for Ophthalmic Studies; 2005/06) However, recent studies have suggested that improvement of visual acuity with refractive correction is significant. This study was intended to provide baseline data for similar kind of studies in the future with the objectives to; evaluate the visual acuity improvement in children with refractive correction in anisometropic amblyopia, to find out the time course of visual acuity improvement, the outcome of treatment in reference to amount of anisometropia and the outcome of treatment with regards to age and sex.

Materials and Methods:

This was a hospital based prospective study conducted at the B.P. Koirala Lions Centre for Ophthalmic studies (BPKLCOS), Institute of Medicine (IOM), Tribhuvan University (TU), Kathmandu, Nepal for a year August 1, 2006 to July 31, 2007.

Inclusion Criteria:

· Patients of age 3 to 15 years with history of untreated anisometropic amblyopia

· Anisometropia of e" 1 .0D of spherical equivalent

· Spectacles corrected amblyopic eye's visual acuity to be between 6/9 and 6/60.

Exclusion Criteria:

· Patients with measurable heterotopias in primary gaze at distance or near fixation in their prescribed spectacles or with a documented history of strabismus.

· Pathological ocular causes for reduced visual acuity.

A brief history was taken from patient/parents to exclude strabismus and those with prior refractive or amblyopic therapy. Visual acuity was taken with self illuminated multiple optotype Snellen chart. Uncorrected visual acuity, best corrected acuity and pinhole acuity were taken. Anterior segment was examined with Slit lamp Bimicroscopy (Topcon SL-3C). Posterior segment was examined by direct ophthalmoscope (Heine-Beta 200) to rule out any ocular pathology.

Extra Ocular Motility (EOM), Cover test and Convergence were done to rule out any manifestation of heterotropias.

Cycloplegic refraction was done in every patient during the study. Cycloplegia was achieved by instilling cyclopentolae

1% drop three times in interval of 10 minutes. Refractive error was identified and Post Mydriatic Test (PMT) was done after three days of cycloplegic retinoscopy. Best corrected visual acuity was obtained with optimum refractive correction.

All patients were called for follow-up after 3 weeks of final subjective refraction. At every follow-up, visual acuity was taken. Detail project proforma was developed to collect all relevant data.

For the purpose of analysis, resolution of amblyopia was defined as improvement of amblyopic eye acuity to normal (snellen acuity 6/6). Non improvement of amblyopia was defined as visual acuity of amblyopic-eye in first follow up which was same as the acuity at the time of enrollment. Partial improvement was defined as improvement of amblyopic-eye acuity but not up to the normal level.

Variation in baseline visual acuity, amount of anisometropia and age and sex with maximum improvement were assessed with Anova single factor test. Resolution of amblyopia was assessed with x^2 test of association.

Useful data were entered in database for statistical analysis; Microsoft Excel, Windows XP 2003. A value of $p < 0.05$ was considered significant.

Results

A total of 20 patients (40 eyes) with mean age 11.2 ± 2.72 years were included in the study. There were 10 males (50%) and 10 females (50%). (Table 1) Among these, 14 (76%) had unilateral amblyopia and 6(24%) had bilateral amblyopia. All together 26 eyes were reported to have amblyopia.

The mean spherical equivalent refractive error of the normal eyes was -0.09 ± 0.48D whereas for the amblyopic eye was -1.25 ± 0.99D.

Improvement of visual acuity

First follow up was done at 3weeks. The mean line of improvement in visual acuity in 3 weeks was 0.85 ± 0.65 lines. (Figure 1) Maximum improvement was of 1 line in 14 cases (54%). No statistical (p=0.31) improvement in acuity line was observed in both groups: e"6/18 (0.90 ± 0.53), <6/18 (0.80 ± 0.58).
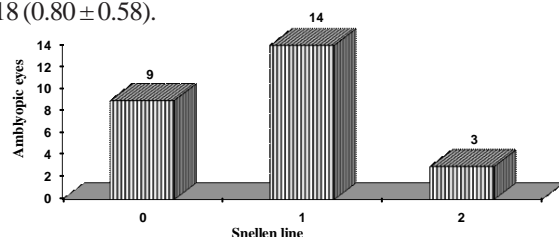

Fig.1. Improvement of visual acuity

Table 1. Baseline demographic and clinical characteristics

Gender (N=20)	Number
Male	10 (50%)
Female	10 (50%)
Age (yrs) N=20	
≤8	2 (10%)
>8	18 (90%)
Mean age (SD)	11.2 ± 2.72
Best corrected distance visual acuity in amblyopic eye (N=26)	
≥6/18	18 (69%)
<6/18	8 (31%)
Best corrected distance visual acuity in sound eye (N=14)	
6/6	14 (100%)
Refractive error in amblyopic eye (N=26)	
≥ -4.0D	4 (15%)
0 to -4.0D	17 (65%)
0 to +2.0D	0 (0%)
+2.0 to +4.0D	4 (16%)
≥ +4.0D	1 (4%)
Mean (SD)	-1.25 ± 0.99 (R: +6.00 to -7.25)
Refractive error in sound eye (N=14)	
-1.0 to 0	5 (36%)
0 to +1.0 D	9 (64%)
Mean (SD)	-0.09 ± 0.48 (R: 0.50 to -1.25)
Anisometropia (calculated difference in spherical equivalent) at enrollment (N=20)	
1.0 to 2.0D	12 (60%)
2.0 to 3.0D	2 (10%)
3.0 to 4.0D	4 (20%)
e" 4.0D	2 (10%)

Second follow up was done at 6 weeks. The mean line improvement in second follow up was 0.8 ± 70. The improvement in visual acuity did not associate with baseline visual acuity (p=0.89).

Among five eyes those followed-up in second visit, only one eye showed remarkable improvement in visual acuity (3 lines).

Time course of amblyopia resolution

In 12 (46%) eyes, resolution of amblyopia took place in first 3 weeks. (Table 3) One patient (25%) showed resolution of amblyopia in six weeks. The resolution of amblyopia showed no significant association with time duration (p>0.1).

Table 3. Time course of amblyopia resolution

Follow up	Resolved	Non resolved
1st 3 weeks(N=6)	12 (46.51%)	14 (53.49%)
6 weeks	1 (25%)	4 (75%)
$X^2 = 0.35$, df = 1; p>0.10		

Improvement of visual acuity related to amount of anisometropia

The inter-ocular acuity difference in pre-treatment (p=0.08) first follow up (p=0.43) and second follow (p=0.83) was not statistically significant across the anisometropic range. (Table 4) There was statistically significant (p=0.04) decrease in IOD for the range: 1.0 to 2.0D of anisometropia, however, decreases in IOD for the range 2.0 to 3.0 D group was not statistically significant (p=0.056).

Improvement of visual acuity related to age

The IOD of two eyes in pre-treatment and first follow up was associated with age (p<0.001, 0.001 respectively).

Table 4. Improvement of visual acuity related to amount of anisometropia

Range (D)	Pre treatment		1st follow up		2nd follow up	P
	IOD N_p=20	<6/6 N =26	IOD N_p=20	<6/6 N = 14*	IOD N_p = 5	<6/6 N=5**
1.0 to 2.0	1.8 ± 1.6	13	0.54±0.52	6	0	1 p#=0.04
2.0 to 3.0	4.0 ± 1.7	3	0.33±0.27	2	1	1 p#=0.056
3.0 to 4.0	1.2±0.45	8	0.8±0.44	4	0.66± 1.15	2 p#=NS
>4.0	1.0± NS	2	0	2	X	0 p#= NS
P	p= 0.08		p=0.43		P=0.83	

· IOD: Inter-ocular difference, P# = Variance for IOD, N = Total no of amblyopic eyes, N_p = Total no of participants, *Resolution = 12, Non improvement (n=9) + partial improvement (n=5) = 14, ** Resolution from partial improvement= 1, Non improvement = 4

Table 5. Improvement of visual acuity related to age

Range(yrs)	Pre treatment		1st follow up		2nd follow up		p
	IOD	<6/6	IOD	<6/6	IOD	<6/6	
	N_p=20	N =26	N_p=20	N = 14*	N_p= 5	N=5**	
≤8	1.0	2(8%)	X	0	X	0	**p <0.001**
>8	2.21	24	0.68	14	1.08	4	
	±0.58	(92%)	±0.58	(100%)	±0.63		**p 0.001**
	p= 0.001		**p= 0.001**		p= NS		

- X: No subjects, IOD: Inter ocular difference, N = Total no of amblyopic eyes, N_p =Total no of participants,* Non resolved =14,** Resolution from partial improvement = 1, Non improvement = 4,P# = Variance for IOD

(Table 5) But this was not comparable with second follow up because of different sample size.

The IOD improvement (1.53 lines) in first follow up was statistically significant (p<0.001) in >8 years' age group.

Improvement of visual acuity related to sex

The amount of IOD in pre-treatment and first follow up was significant in both gender (p=0.002 for males, 0.001 for females) but this was non-significant in second follow up (p=0.17). There was significant (p=0.03) improvement of IOD for males in first follow up. Non-significant (p=0.17) improvement of visual acuity was found in second follow up with respect to sex.

Discussion

Total 20 patients of age 3 to 15 years, mean age of 11.2±2.72, were taken for the study. Male and female were equal in number. Patients below 8 yrs of age (sensitive age) are very less (10%).Susan A Cotter et a1 included mean age of 5.2±0.9 yrs, Chen PL et al included mean age of 5.3 years and Hussein MA et al did study in patients between 3 and 8 years. [6, 7, 8]

Among the 40 eyes, amblyopic eyes were 26. Two third (65%) of the eyes had refractive error of < - 4.0 D. Refractive error > +4.0 D was 4% only. Few high hyperopic cases were found associated with strabismus. Among the 14 sound eyes, 64% eyes were found to have hyperopia of less than +1.0D. Large proportion of myopic error may be because of calculation of refractive error by spherical equivalent method in mixed astigmatism.

In first follow-up more than 54% improved by one line and 11% improved by two lines, where as e"2 lines improvement in 77% of patients in Susan A Cotter et al.[6] study ,two or more log MAR lines by Chen PL et al[7] study and 4 line improvement in 93% by David B. Garnet et al study[9].

Non improvement (35%) in acuity in 1st follow up was not included for the second follow-up. In 2nd follow-up, among

the five eyes, only one eye resolved to normal acuity (6/6). Improvement in acuity was less in second follow up (25%). But this not comparable to first follow up as the number of eyes were not same.

Improvement of visual acuity was related to lesser amount (1.0 to 2.0D) of amblyopia (p=0.04) and near significant (p=0.056) for 2.0 to 3.0D range. This is similar to findings of Susan A et al, Chen PL et al (<4.0D), Cobb CJ et al[10], but contrast to the findings of Kutschke PJ et al[11] and Hussein MA et al. About 60% of eyes were in the range of 1.0 to 2.0 D of anisometropia.

The treatment outcome (interocular difference as well as acuity <6/6) was related to age; more in >8years group. Hussein MA et al study had reflected below 6 years have good improvement in acuity. Studies by Susan A et al, Steele AL[5] and Cobb CJ[10] found no relation of age with the outcome of the treatment. About 90% participants were >8 yrs in this study.

IOD was significantly high in males at pretreatment and at 1st follow up even though participants having acuity below 6/6 were equal in both genders. This was not significant in 2nd follow up as number of males and females were not equal. Male showed significant rate of acuity improvement in first follow up. This finding could not be supported by other studies. Though our study has some limitations, we can make few reasonable recomendations (Table 6-7).

Table 6: Limitations

Number of study population was not large.
Consideration of amblyopia even for one line difference in acuity of two eyes
Spherical equivalent, though easy to calculate it does not give the accurate results in astigmatism especially of mixed type.
Microtropia test was not performed. Non improvement in visual acuity may be the cause this.
Crowding phenomenon and stereopsis was not tested.

Table 6: Recommendations

There is need of other additional therapy for the complete resolution.

Refractive correction can be prescribed for the older male children having lower anisometropic amblyopia initially.

Refractive wear should be continued till there is improvement in visual acuity.

A larger sample size multi-centre study is recommended to support the findings of this study.

Conclusion

Nearly half of (46%) anisometropic amblyopia resolved to normal acuity within first 3 weeks.

Visual acuity improves and IOD decreases in anisometropic group with low dioptres of refractive error.

Improvement in acuity occurs in higher age group children and interocular difference also decreases rapidly, especially for low grade of anisometropia.

Visual acuity significantly improves and interocular difference decreases significantly in males. (p<0.03)

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