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Original Article

Occlusion therapy in older children with amblyopia

V. Kavitha, S. Chaitra, Mallikarjun M. Heralgi

Background: Occlusion therapy is effective in older children with amblyopia. **Objective:** To evaluate and compare visual outcomes in older children aged between 9 and 18 years with unilateral refractive amblyopia after treatment with patching and/or optical correction. **Settings and Design:** Prospective randomized controlled study. **Materials and Methods:** Sixty children (9–18 years) with unilateral refractive amblyopia (anisometropic/meridional) with best-corrected visual acuity (BCVA) ≤6/12 (0.3 logMAR) in the worse eye were 1:1 randomized into nonocclusion and occlusion group. Both treatment groups underwent 4 weeks refractive adaptation period (RAP) and three follow-up visits at 6 weeks interval. After RAP, the better eye in the occlusion group was patched for 6 h daily, while the nonocclusion group children continued to wear spectacles for 18 weeks. BCVA (logMAR) at each visit was compared with the baseline reading. **Statistical Analysis Used:** Descriptive and inferential statistical analyses were used. Student's *t*-test and Chi-square/Fisher exact test was used to calculate the *P* value. **Results:** There was a significant improvement in BCVA from baseline to 18 weeks after RAP within both treatment groups ($P < 0.001$) and significant higher proportion of children in occlusion group showed three lines of improvement compared with nonocclusion group ($P = 0.011$). Improvement in BCVA from baseline to 18 weeks was noted irrespective of the severity of amblyopia and age of the participants more so in occlusion group. **Conclusion:** Occlusion therapy is an effective and better treatment than only spectacle correction in children aged between 9 and18 years, with unilateral refractive amblyopia.

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Amblyopia is reduced visual acuity (VA) caused by abnormal binocular interaction or visual deprivation during a sensitive period of visual development in early childhood.[1] It has been estimated to affect 2–5% of the population,[2] and the incidence in India is between 1.1 and 12.3%.[3] The causes are strabismus (about 50%), anisometropia (about 17%) or strabismus and anisometropia (about 30%), and visual deprivation (about 3%).[4] Amblyopic patients have poor spatial acuity, low contrast sensitivity, and reduced sensitivity to motion.[5]

In 1979, Von Noorden and Crawford suggested <8 years as an ideal age for amblyopia treatment; >8 years was considered as the end of the critical period for visual development in children.[6] Various published literature supported age to be a common crucial factor for amblyopia treatment.[7-12] However, in 2007, the American Academy of Ophthalmology recommended that amblyopia treatment should be given to all children, regardless of their age.[13] Treatment of amblyopia includes surgery, refractive error correction (optical), force use of the amblyopic eye by limiting use of the better eye (penalization of the better eye [defocusing the better eye using atropine/homatropine/cyclopentolate or by altering the power of spectacle lens to cause decreased vision in the better eye] or occlusion of the better eye [patching]),[4,14] and pharmacological therapy (levodopa, carbidopa, and citicoline).[15-17] Cambridge stimulator and pleoptics were used earlier in the treatment of amblyopia. However, occlusion of the nonamblyopic eye is still the mainstay of treatment.[1]

A previously published literature reported that daily patching of a better eye along with optical correction significantly improved amblyopia in children aged 3–7 years compared to optical correction using spectacles only.[18] PEDIG in amblyopia treatment study 3 evaluated the effectiveness of optical correction alone versus 2–6 h/day of patching combined with near visual activities plus atropine sulfate in older children aged 7–17 years.[19] However, there is a paucity of Indian literature regarding the adjuvant use of patching with optical correction for amblyopia treatment in older age group.

Hence, the present study was planned with an objective to evaluate and compare visual outcomes in children (aged 9–18 years) with amblyopia after treatment with patching and/or optical correction.

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Materials and Methods

This was a prospective randomized control study of 60 amblyopic children attending the outpatient department between June 2013 and March 2014. Informed consent was obtained from parents of all 60 children. Inclusion criteria included males and females of age 9–18 years with unilateral refractive amblyopia (anisometropic/meridional) and best-corrected VA (BCVA) ≤6/12 (0.3 logMAR) in the worse eye. Children with visual deprivation, strabismus, bilateral refractive amblyopia, history of previous amblyopia treatment within 1 year of enrollment, or who underwent prior intraocular/extraocular surgery with known skin reaction/s to patch or bandage adhesive were excluded from the study. The study adhered to all the principles mentioned in the Declaration of Helsinki 2000.

All patients underwent a detailed ophthalmologic examination at baseline. Following parameters/visual outcomes were assessed-uncorrected VA and BCVA (logMAR chart for distance and Snellen's chart for near), ocular alignment and fixation by cover and alternate cover test, slit lamp examination, fundus examination (with indirect ophthalmoscopy using + 20 D condensing lens or slit lamp biomicroscopy using + 90 diopter (D) lens), cycloplegic refraction (1% cyclopentolate eye drops) with streak retinoscope, and subjective correction (3 days later). All children who fulfilled the inclusion and exclusion criteria were included in the study and spectacles were prescribed. A 4 weeks gap of refractive adaptation period (RAP)[20] was allowed for each child to wear glasses constantly. Each child was then assigned with equal probability by simple random allocation using randomization table to either optical correction only (nonocclusion group) optical correction plus patching (occlusion group). Following the RAP, patching of the better eye was done 6 h daily in occlusion group and were advised to perform near activities such as reading, writing (homework), drawing, computer work, and playing mobile games.[21,22] Children in nonocclusion group continued to wear spectacles. Both the treatment groups underwent three follow-up visits at a 6-week interval. Parents of occlusion group were thoroughly counseled to daily record the number of hours of the patch which helped the physician to record occlusion compliance rate (total number of hours patched in a month/total number of hours of patch prescribed per month × 100%).[2] The compliance was classified as good if % compliance rate >90%, fair if 70–90%, and poor if <70%. Children were followed thrice at 6-week interval, and BCVA was recorded at each visit using the logMAR chart. The BCVA recording at follow-up visits was compared with the baseline reading.

Statistical analyses

Data were analyzed using SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0, and R environment version 2.11.1. (IBM) Descriptive and inferential statistical analyses were carried out. Student's *t*-test (two-tailed, independent) and Chi-square/Fisher exact test was used to calculate the *P* value. A significance level of 5% was used and the power was set to 90%.

Results

Out of 60 (males: 34; females: 26) children, 39 were aged 10–13 years and 21 children were aged 14–17 years. The higher proportion of children in both treatment groups had amblyopia in the right eye with severe amblyopia in 30% of children in nonocclusion group and 46.6% in occlusion group. The demographic and all baseline characteristics were comparable between the treatment groups [Table 1]. Fifty-three percent of the children had fair, 33% had good, and 13% had poor occlusion compliance rate.

There was a significant improvement in BCVA from baseline to 18 weeks after RAP within both treatment groups ($P < 0.001$; Table 2) and significant higher proportion of children in occlusion group showed 3 lines of improvement compared to nonocclusion group ($P = 0.011$) [Table 3].

Table 1: Children characteristics at baseline

Parameter	Nonocclusion group (*n*=30), *n* (%)	Occlusion group (*n*=30), *n* (%)
Age		
10-13	22 (73.3)	17 (56.6)
14-17	8 (26.6)	13 (43.3)
Mean±SD	12.47±2.50	12.30±2.17
Gender		
Male	15 (50.0)	19 (63.3)
Female	15 (50.0)	11 (36.7)
Amblyopic eyes		
Left	11 (36.7)	10 (33.3)
Right	19 (63.3)	20 (66.7)
Severity of amblyopia		
Mild-moderate (0.3-0.6 logMAR)	21 (70.0)	16 (53.3)
Severe (≤0.7 logMAR)	9 (30.0)	14 (46.6)
Diagnosis		
Compound myopic astigmatism	10 (33.3)	14 (46.6)
Mixed astigmatism	9 (30.0)	5 (16.6)
Hypermetropia	4 (13.3)	2 (6.6)
Simple myopic astigmatism	4 (13.3)	4 (13.3)
Simple hypermetropic astigmatism	0	1 (3.3)
Compound hypermetropic astigmatism	2 (6.6)	1 (3.3)
Myopia	1 (3.3)	3 (10)
Baseline UCVA (logMAR)		
0-0.3	0	0
0.4-0.6	10 (33.3)	7 (23.3)
0.7-1.0	9 (30.0)	11 (36.7)
<1.0	11 (36.7)	12 (40.0)

UCVA: Uncorrected visual acuity, logMAR: logarithm of the minimum angle of resolution, SD: Standard deviation

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There was an improvement in BCVA from baseline to 18 weeks in both these groups irrespective of the severity of amblyopia and age of the participants and more so in occlusion group [Table 4].

Discussion

The rationale for treatment of unilateral amblyopia is to optimize visual function and binocular vision, to maximize employment opportunities and to try to provide a useful "spare eye" in the event of trauma or pathology in the normal eye.

Table 2: Best-corrected visual acuity in amblyopic eye: A comparative evaluation between two groups

Study visits	BCVA (logMAR), mean±SD	
	Nonocclusion group (*n*=30)	Occlusion group (*n*=30)
Baseline	0.59±0.23	0.67±0.22
BCVA after RAP	0.57±0.24**	0.66±0.21
1st follow-up BCVA (6 weeks after RAP)	0.55±0.24**	0.61±0.23**
2nd follow-up BCVA (12 weeks after RAP)	0.53±0.24**	0.57±0.24**
3rd follow-up BCVA (18 weeks after RAP)	0.51±0.24**	0.53±0.25**

**Statistically significant (*P*<0.001). BCVA: Best-corrected visual acuity, RAP: Refractive adaptive period, SD: Standard deviation, logMAR: logarithm of the minimum angle of resolution

Table 3: Improvement of best-corrected visual acuity

Improvement of BCVA in amblyopic eye	Nonocclusion group (*n*=30), *n* (%)	Occlusion group (*n*=30), *n* (%)
No improvement	12 (40.0)	6 (20.0)
Improvement	18 (60.0)	24 (80.0)
1 line	14 (46.7)	11 (36.7)
2 lines	4 (13.3)	6 (20.0)
3 lines	0	7 (23.3*)

*Statistically significant (*P*<0.011). BCVA: Best-corrected visual acuity

There have been controversial debates on the concept that success of amblyopia treatment depends on patient's age at initiation of the treatment.[1,10,23] Various studies have favored amblyopia treatment at age <6–7 years[9,10,12] but few studies have reported better outcomes in older children.[7,18,19,24,25] Our study results are also in concordance to the published literature where visual outcomes were independent of patient's age; suggesting that amblyopia can be treated successfully beyond the age that is considered to be the critical period for the visual development.

In 2010, Carlton and Czoski-Murray.[20] reported vision improvement 4–12 weeks after optical treatment and within 3–6 months following occlusion.[26] Consistent to the published literature, 4-week RAP was followed by 18-week occlusion.

The study reported 3 line of significant improvement from baseline to 18 weeks occlusion period after RAP in the occlusion group compared to the nonocclusion group;

VA improvement by ≥1 line, in occlusion group, was seen in 43.3% children with mild to moderate amblyopia and 36.6% with severe amblyopia as compared to 40% and 20%, respectively in nonocclusion group. However, 3 lines of improvement were seen only in the occlusion group.

BCVA improvement ≥1 line was seen in both the age groups, 10–13 years and 14–17 years and in both the occlusion and nonocclusion groups (15 and 9 children in occlusion group; 12 and 6 children in nonocclusion group), respectively. However, 3 lines of improvement were seen in only in occlusion group and in both the age groups.

This implies the importance of occlusion therapy in visual improvement in amblyopic eyes. The reason for better visual outcomes in the occlusion group may be due to the performance of near activities as suggested in the previous literature[18] and/or due to high (86% fair to good) occlusion compliance rate as compliance to occlusion is one of the vital factors to achieve better visual outcomes.[7,25,27]

Table 4: Improvement in best-corrected visual acuity in amblyopic eye with respect to severity and age

Improvement in BCVA	Nonocclusion group (*n*=30), *n* (%)		Occlusion group (*n*=30), *n* (%)	
Amblyopia based on severity	Mild-moderate	Severe	Mild-moderate	Severe
No improvement	9 (30.0)	3 (10.0)	3 (10.0)	3 (10.0)
1 line improvement	10 (33.3)	4 (13.3)	6 (20.0)	5 (16.7)
2 lines improvement	2 (6.6)	2 (6.6)	2 (6.6)	4 (13.3)
3 lines improvement	0	0	5 (16.7)	2 (6.6)
Amblyopia based on age	10-13 years	14-17 years	10-13 years	14-17 years
No improvement	10 (33.3)	2 (6.6)	2 (6.6)	4 (13.3)
1 line improvement	10 (33.3)	4 (13.3)	5 (16.7)	6 (20.0)
2 lines improvement	2 (6.6)	2 (6.6)	5 (16.7)	1 (3.3)
3 lines improvement	0	0	5 (16.7)	2 (6.6)

BCVA: Best-corrected visual acuity

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Conclusion

Occlusion therapy is an effective and better treatment than only spectacle correction in children, aged 9–18 years, with unilateral refractive amblyopia.

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Conflicts of interest

There are no conflicts of interest.

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