

Evaluating the Results of Amblyopia Treatment in Children Under 9 Years Using Full-Time Eye Closing with a Gradual Time Reduction (1370-1392)

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ABSTRACT

BACKGROUND AND OBJECTIVE: Amblyopia is almost an incurable vision loss after 9 years old. There are several ways to treat, the aim of this study is to treat amblyopia before 9 years old with full-time closing of healthy eye with gradual reduction of eye closure.

METHODS: This cross sectional study was done on children less than 9 years old referred to eye clinic of Babol with amblyopia. Visual acuity was recorded with the best glasses and treatment was carried out using full-time closing of healthy eye, then 6, 4, 2 and after 1-hour conservative treatment until 9 years old. Gender, age, order in treatment, cause of amblyopia, and relapse were recorded. Success was defined as an increase in visual acuity of at least 2 lines of Snellen chart.

FINDINGS: Improvement of visual acuity in the amblyopic eye at the end of treatment was 3.42 ± 2.51 Snellen lines, which was statistically significant ($p < 0.001$). There was a reverse moderate correlation between age and the rate of affected eye improvement ($r = 0.395$, $p < 0.001$). In general, the success rate and failure in treatment of 87 amblyopic eye were 74.4% and 25.3%, respectively.

CONCLUSION: The results showed that full-time eye closure by gradually reducing the time improving amblyopia. This method regardless of gender and cause of amblyopia have led to improvement of amblyopia. Improvement of visual acuity had an inverse relationship with age, therefore screening is recommended for children at a younger age.

KEY WORDS: Amblyopia, Eye Closure, Treatment, Children.

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Introduction

Amblyopia is usually loss in one or sometimes two-way of visual acuity less than 10.7 in best correction (B.C.V.A) that cannot be directly attributed to the abnormal structure of eye or posterior visual ways (1, 2). Amblyopia is abnormal vision in the early years of life due to strabismus, anisometropia, bilateral severe refractive error, visual deprivation (3, 2). The most common cause of unilateral visual loss in childhood is amblyopia. Loss of vision caused by amblyopia are preventable or reversible in many cases with proper intervention and early detection. With increasing age and evolution of the visual system the response to treatment decreases and the best age to identify and treat this disorder is 5 to 10 years (1, 2). The prevalence of amblyopia is estimated to be 1-4% (6-4, 2).

Amblyopia treatment principles include: removing any vision obstacle such as cataract, correction of any significant refractive error, use of weak eye through restricting the use of healthy eyes. There are two method to use the weak eye. The first method is occlusion therapy that include: full time or closing the healthy eye all waking hours and part time or closing the healthy eye for 1-6 hours a day. The second method is penalization or blurring of healthy eye by use of drugs or glasses encouraging to use the affected eye (2). The time required to complete the treatment depends on a variety of factors including type of amblyopia, the choice of treatment method and the patient's age (2).

Until recently, the closing of eye was determined personally. Some investigations recommended the closing the eye all the time and some other recommended at least three times a week for each year of age. A group preferred the use of blindfolded with less intensity (hours per day) that can make longer the course of therapy but in addition to effectiveness also is associated with less disorder (7).

It has been reported that two-hour closing the eyes improve moderate to severe lazy eye in children of 7-3 years of age (8). Noting that the identification and early treatment of this disease plays a very important role in reducing visual impairment, screening and treatment is essential before 9 years old. There are many ways to treat this disorder. One of these is full time patching with a gradual decrease in time. The aim of this study was to evaluate the effect of full time patching therapy with a gradual decrease in time in order to evaluate to the success or lack of success in

treatment and to be introduced as one of the effective methods.

Methods

This retrospective cross-sectional study was done on 75 children referred to eye clinic in Babol with diagnosis of amblyopia between 1991-2013 years. Children less than 9 years with at least one lazy eye were enrolled. Patients who had incomplete information on their records and patients who had other pathologic lesions were excluded from this study. In the first visit, patient's medical history was taken and clinical examination and measurement of visual acuity was conducted by a physician using Snellen chart. Further examinations such as examination with slit lamp, ophthalmoscopy, and cyclo refraction were performed and recorded to rule out any pathological lesions and strabismus and finally led to the diagnosis of amblyopia in one or both eyes.

Visual acuity was measured using best correction. Range of visual acuity (Visual Acuity = V.A) was considered 0.1 to 1.2. After obtaining written consent from the parents, treatment of amblyopia was done by full time patching the healthy eye and gradually reducing the time. Patching the eye was design based on the patient's age, for one week per year (eg 3 weeks for children 3 years old). First full day (except half hour in morning and evening), then 6 hours, 4 hours and 2 hours in the same period of time (one week per year of age) and maintenance treatment of 1 hour was done until the age of 9 years old.

The patient's parents were advised to induce the child doing close work such as writing and drawing at the time of patching the healthy eyes. The visual acuity of patients was measured in the fourth turn including at the end of each treatment period and also at 9 years old. Success in treatment was defined as increase of at least 2 Snellen chart line after a full course of treatment (10, 9).

Then findings regarding the outcomes and the improvement of patients (increased visibility) were recorded in the case file. Patients had regular treatment and closed properly the healthy eye one week per year of age and at the end of each period referred to measure visual acuity. Only a few patients had irregular treatment and they did not comply experimental method. In case of failure in the treatment or relapse of amblyopia or irregular refer, the treatment protocol was repeated (repeated patching). In

the case of children who has bilateral amblyopic eye, part time patching Alternative was done instead of full time patching and one day the right eye and then left eye were patched less than 6 hours a day. In this study, ethical points such as providing the necessary explanations for patients and informed consent to participate in the research, avoiding to disclose the secrets of patients and maintaining the privacy and obtained data from patient and presentation of results and personal information as anonymous were considered.

Demographic characteristics and basic information of patients were entered into the computer. Related information to visual acuity including initial visual acuity, duration of patching, cause of amblyopia, treatment acceptance and final visual acuity was recorded. Then, using SPSS software version 18, descriptive statistics (Mean \pm SD) and analytical tests (T-Test, Friedman, repeated measurement) were analyzed and $p<0.05$ was considered significant.

Results

Of 75 children, 12 and 63 cases had unilateral amblyopic eye bilateral amblyopic eye, respectively. On the other hand, a total of 87 amblyopic eye were studied. The average age of patients was 6.3 years old (between 3 and 9 years old). 42 eye in the boys (48.3%) and 45 eyes (45.7%) in girls were amblyopic. The cause of amblyopia were 48 eyes due to anisometropia (55.17%), 22 eyes due to strabismus (25.28%), 11 eyes due to visual deprivation (12.64%) and 6 eyes because of ametropia (6.89%). 20 cases were amblyopic in the right eye that average of visual acuity (V.A) in the right eye at the beginning of the study was 5.60 ± 2.43 and at the end of the study was 8.80 ± 2.80 indicating a significant improvement ($p<0.001$) and the left eye (the healthy eye) had no visual loss despite the full time patching and occlusion amblyopia did not happen. 43 cases were amblyopic in the left eye that average of visual acuity (V.A) in the left eye at the beginning of the study was 6.30 ± 2.51 and at the end of the study was 9.84 ± 2.52 indicating a significant improvement ($p<0.001$) and the right eye (the healthy eye) had no visual loss despite the full time patching and occlusion amblyopia did not happen. 12 patients had bilateral amblyopia, in which patients only underwent Part time Patching method (one day right eye and one day the left eye). The average of visual acuity (V.A) in the right eye at the beginning of

the study was 6.08 ± 2.46 and at the end of the study was 10.83 ± 1.85 indicating a significant improvement ($p<0.001$) and the average of visual acuity (V.A) in the left eye at the beginning of the study was 7.17 ± 2.12 and at the end of the study was 10.42 ± 1.62 indicating a significant improvement ($p<0.001$). Overall, the mean improvement in V.A in 87 eyes at the end of the study was 3.42 ± 2.51 line ($p<0.001$) (Fig 1). 15 patients (19 eyes) with a course of treatment did not significantly improve and the course of treatment was repeated. Most of patients in this group had not significant improvements despite the relative improvement (table1).

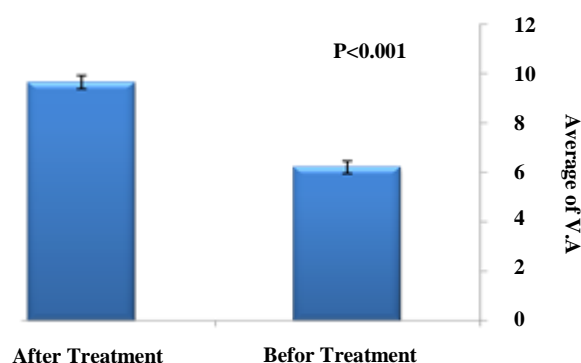


Figure 1. The improvement of amblyopic eye visual acuity based on Snellen chart line after treatment at the end of the study

Table 1. Comparing the progress of visual acuity in terms of Snellen chart line in patients who need to repetitive treatment.

Study	Beginning	End	P-value
Right amblyopic eye (n=5)	6.8 \pm 2.16	9.20 \pm 1.92	0.06
Left amblyopic eye(n=6)	6.17 \pm 2.78	8.5 \pm 1.87	0.02
Both amblyopic eyes	Right(n=4) 8.26 \pm 3.30	10.75 \pm 2.5	0.10
	Left(n=4) 7 \pm 4.39	10.25 \pm 2.36	0.28

The visual acuity of defective eye in both boys and girls were significantly improved, the mean V.A in boys at the beginning of the study was 6.02 ± 2.27 and at the end of the study was 11.76 ± 0.65 ($p<0.001$) and the mean V.A in the girls at the beginning of the study was 6.42 ± 2.59 and at the end was 11.16 ± 1.46 ($p<0.001$). Although the visual acuity of amblyopic eye was improved in boys than girls, but the difference was not statistically significant (3.92 and 3.26 line in boys and girls, respectively $p=0.63$). Percentage of success in boys was 78.6% and in girls was 73.3%. This difference was not statistically significant. 48 amblyopic eye with regular treatment had improved

visual acuity of 4.01 line (primary V.A of the study was 6.37 ± 1.78 and at the end of the study was 10.39 ± 0.9) and 39 amblyopic eye with irregular treatment had improved visual acuity of 3.04 line. (Primary V.A of the study was 6.05 ± 2.05 and at the end of the study was 9.22 ± 2.25) ($p=0.07$). The correlation between age and visual improvement in the amblyopic eye was inverse and intermediate ($p<0.001$, $r=0.395$). Visual acuity of amblyopic eye significantly improved during the study regardless of its cause, except in cases with visual deprivation (table 2). Success rate of treatment in patients who had one amblyopic eye was 77.05% and in patients with bilateral amblyopic eye was 66.7%. Overall, among the 87 amblyopic eyes, 65 eyes (74.7%) responded to treatment. 11 patients who did not cooperate with patching method, they were only wearing glasses, 6 patients with an amblyopic eye after a few months of using eyeglasses and follow-up had improvement of visual acuity (V.A) which was not statistically significant. In 5 patients with bilateral amblyopic eye wearing glasses, both of eyes significantly improved in visual acuity (V.A) ($p=0.04$).

Table 2. Changes in visual acuity in the amblyopic eye based on Snellen chart line and its cause

Cause	Anisometropia (n=48)	Strabismus (n=22)	Visual deprivation (n=11)	Ametropia (n=6)
Time of Study				
Beginning	6.29 ± 2.41	5.95 ± 2.66	5.73 ± 2.10	7.67 ± 2.42
Last visit	9.69 ± 2.47	10.54 ± 1.89	7.09 ± 2.84	10.83 ± 1.33
P-value	<0.001	<0.001	0.07	0.04

Discussion

The findings of this study showed that among the 87 amblyopic eye has been treated by this method, V . A at the end of the study compared to beginning of the study has been a significant improvement. This result found by other authors confirm this with a slight discrepancy (9-15). In this study, no amblyopia caused by occlusion amblyopia in normal eye indicating the successive examination of the child. The study of Tang and colleagues also mentioned the same reason (11). In this study, we applied conservative treatment (Maintenance patching) until age of 9 years old that prevented from recurrence of disease. Similar to our results, Tang and colleagues have indicated the same results (11). In patients with bilateral amblyopic eye, the treatment method was slightly different and alternative part time patching was used (one day right

eye and one day left eye less than six hours) that improvement of V.A at the end of the study compared the beginning of the study had a significant difference ($p<0.001$).

19 eyes were not significantly improved after a period of treatment and a period of re-treatment was performed (Repeat patching). At the end of repeated treatment, partial remission and changes of V.A in 6 eyes was significant and in 13 eyes was not significant that this indicates that these patients are resistant to treatment (for example, some children with bilateral amblyopic eye, derivative amblyopia , lack of cooperation in the treatment). Comparing the improvement of visual acuity between girls and boys showed that sex was not effective in improvement of V.A. The improvement of patients who had regular treatment was higher than patients with irregular treatment, but the difference was not significant. Thus, the cooperation of parents may be helpful in regular treatment of patients.

Improvement of V.A was inversely related to age. The study of Pang and colleagues also shows the same result (12). Therefore, screening and treatment of patients should be performed at younger ages. The prevalence of amblyopia in terms of order due to anisometropia was 55.7%, strabismus was 25.28%, deprivation of vision was 12.64% and ametropia was 6.89%, which is similar to results of Erdem et al with the order of anisometropia 57.45%, strabismus 25.45% and 17% combination of them (9). In the study of Khambhiphant and colleagues, refractive error, strabismus and visual deprivation were 75%, 75.18% and 25.6%, respectively (13).

In this study it was shown that improvement of V.A in anisometropia and strabismus was remarkable and had a significant difference at the beginning and end of the study. In the vision deprivation V.A increased but was not significant. Therefore, this study shows that visual acuity (V.A) increased regardless of the cause, the study of Khambhiphant and colleagues showed that there was no relationship between the cause of amblyopia and treatment outcomes (13) that is similar to this study. In this study, the overall success rate in the treatment of amblyopia was 74.7% (65 eyes) and failure to treatment was 25.3% (22 eyes), respectively. In patients who had bilateral amblyopia treatment success rate was less than unilateral amblyopic eye (66.7%), which indicates that patients with bilateral amblyopic eyes are more resistant to treatment. Medghalchi and colleagues reported the

success rate in eye patching group 76% and in atropine group 74% (10) which is similar to our study. In the study of Khambhiphant, the treatment success rate was reported 43.75% (13).

Tang and colleagues reported the success rate in children with moderate amblyopia and in children with severe amblyopia and generally 74%, 55% and 62%, respectively (11). Repka and colleagues to compare the short-term closure (2 hours or more) and full time closure (6 hours or more) conducted a study on 189 children at the end of four months. Visual acuity of 4.2 lines was reported in both groups (14). Kane and colleagues reported no significant difference in visual acuity between two methods (16).

Improved visual acuity in our study was 3.42 line showing an increased improvement in visual acuity which seems to be related to the closure of all time and is maintenance treatment for up to 9 years old. Aghazadeh and colleagues also showed that there was no significant different in visual acuity between two groups (full-time and part-time patching methods), But the average length of treatment in the part-time method was almost two times more than full-time method (17). Kaur and colleagues compared the treatment of strabismus and refractive amblyopia using eye closure method on 28 patients.

The obtained results showed that treatment of patients for 4 months had 3 lines and 1 line improvement in strabismus group and refractive amblyopia based on the logMAR chart, respectively. Therefore, the outcome of treatment in strabismus group was more than refractive group (15), whereas in our study the results in these two groups were not statistically significant. Medghalchi and colleagues in a study to compare two methods of eye patching and penalization (with atropine) in the treatment of amblyopia on 120 children showed that in the group used eye patching method, visual acuity was improved from baseline to 3.8 lines and visual acuity in the atropine group was improved to the 3.6 line which was not statistically significant (10).

In the present study, those who did not tolerate the eye patching and used penalization method were low and therefore were excluded. In the present study and some other studies, including Pang and colleagues (12) demonstrated that improvement of amblyopia is inversely related to age and most researchers believe that the treatment is effective until to 9 years old, but Erdem et al (9) in their study indicated that treatment amblyopia is possible in patients above the 9 years old.

These researchers were performed eye patching method for 6 days a week for 3 month in 47 patients aged 10-16 years.

Before treatment, mean visual acuity was 0.48 logMAR and after 3 months of treatment was 0.20 LogMAR and 80.9% of patients had improvement more than 2 Snellen lines. Near vision activities during eye closure period are very effective in the improvement of visual acuity of amblyopic eye. Pang and colleagues treated 17 children with amblyopic myopia anisometropia after refractive error correction and eye patching and near vision activities.

The primary visual acuity was 0.96 logMAR that after refractive error correction and post-closure near vision activities reached to 0.84 and 0.71 LogMAR, respectively (12). In the present study, the patients were advised to perform near vision activities such as writing or painting at the time of closing the eyes which can lead to more application of the amblyopic eye. Agervi and colleagues compared two methods of eye patching as every other day and 6 days in a week for a year and they concluded that the eye patching method as every other day was significantly more effective than eye patching method for 6 days in a week(18).

The results of this study showed that full time closing the eyes with gradually time reduction and conservative treatment until age of 9 years old and near vision activities significantly improved amblyopic eye regardless of its cause and treatment success rates was 74.7%.25% failure was due to its resistance to treatment in some patients including patients with bilateral amblyopic eye. In this method there was no recurrence because of continuous treatment until age of 9 years old and amblyopia caused by the eye closure was not observed due to early and early diagnosis.

Sex was not effective in improvement but had a reverse relationship. Therefore, screening is recommended at a younger age. Nowadays, according to PEDIG studies full time patching therapy is not done.

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References

1. Arbabi SH, Mohtaram R, Nili-Ahmadabadi M, Shorooghi M, Ebrahim-Soltani A, Goudarzi M, et al. Effect of occlusion effect of occlusion therapy on visual acuity, contrast sensitivity and stereopsis in amblyopia. *Sci J Eye Bank I.R. Iran*. 2008;14(2):135-9.[In Persian]
2. Thomas J, Gregory L, Louis B. Photoablation in refractive surgery. *Laser procedures for refractive correction*. San Francisco: American Academy of Ophthalmology; 2005.p. 120-135.
3. Masumi R, Ojaghi H, Masumi N, Jafarzadeh S. Prevalence and causes of amblyopia among middle school students in ardabil city during 2004. *J Ardebil Univ Med Sci*. 2011;11(1):67-74.[In Persian].
4. Yekta A1, Fotouhi A, Hashemi H, Dehghani C, Ostadimoghaddam H, Heravian J, et al. The prevalence of anisometropia, amblyopia and strabismus in schoolchildren of Shiraz, Iran. *Strabismus*. 2010;18(3):104-10.
5. Simons K. Amblyopia characterization, treatment, and prophylaxis. *Surv ophthalmol*. 2005;50(2):123-66.
6. Cleary M. Efficacy of occlusion for strabismic amblyopia: can an optimal duration be identified?. *Brit J Ophthalmol*. 2000;84(6):572-8.
7. Holmes JM, Clarke MP. Amblyopia. *Lancet*. 2006;367(9519):1343-51.
8. Group PEDI. A randomized trial of atropine vs patching for treatment of moderate amblyopia in children. *Arch ophthalmol*. 2002;120(3):268-78.
9. Erdem E, Cinar GY, Somer D, Demir N, Burcu A, Örneş F. Eye patching as a treatment for amblyopia in children aged 10–16 years. *Jpn J Ophthalmol*. 2011;55(4):389-95.
10. Medghalchi A, Dalili S. A randomized trial of atropine vs patching for treatment of moderate amblyopia. *Iran. Red. Crescent Med J*. 2011;13(8):578-81.
11. Tang EW, Li BC, Yeung IY, Li KK. Occlusion therapy in amblyopia: an experience from Hong Kong. *Hong Kong Med J*. 2014;20(1):32-6.
12. Pang Y, Allison C, Frantz KA, Block S, Goodfellow GW. A prospective pilot study of treatment outcomes for amblyopia associated with myopic anisometropia. *Arch Ophthalmol*. 2012;130(5):579-84.
13. Khambhaphant B, Srisuwanwattana W. A one-year review of amblyopia treatment for literate patients at King Chulalongkorn Memorial Hospital. *J Med Assoc Thai*. 2012;95(10):1302-5.
14. Repka MX1, Beck RW, Holmes JM, Birch EE, Chandler DL, Cotter SA, et al. A randomized trial of patching regimens for treatment of moderate amblyopia in children. *Arch Ophthalmol*. 2003;121(5):603-11.
15. Kaur Sh, Azwa W, Fadzil NM, Ariffin AE. Patching therapy in patients with strabismic amblyopia and refractive amblyopia. *Sains Malaysiana*. 2011;40(11):1325-9.
16. Kane J, Biernacki R, Fraine L, Fukuda N, Haskins K, Morrison DG. Patching Compliance with Full-Time vs. Part-Time Occlusion Therapy. *Am Orthop J*. 2013;63(1):19-23.
17. Aghazadeh-Amiri M, Ghorbanian N, Ghasemi-Broumand M, Akbarzadeh-Baghdan A. Comparison of the effect of full time and part time patch (in nonstrabismic & moderate amblyopia) in 3-7 years old children. *J Rehabil Med*. 2014;2(4):15-21.[In Persian]
18. Agervi P, Kugelberg U, Kugelberg M, Zetterström C. Two-year follow-up of a randomized trial of spectacles alone or combined with Bangerter filters for treating anisometropic amblyopia. *Acta Ophthalmol*. 2013;91(1):71-7.