Occlusion therapy in amblyopia: an experience from Hong Kong

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A B S T R A C T

Objectives: To review the results of patching for amblyopia management in Hong Kong.

Design: Retrospective case series.

Setting: Regional hospital, Hong Kong.

Patients: Records of all patients attending Paediatric Ophthalmology Clinic at United Christian Hospital, Hong Kong from 1 January 2009 to 31 March 2009 were retrospectively reviewed. Records of all children who underwent patching for amblyopia in the study period were evaluated.

Results: The mean age of 50 children (50 eyes) was 4 (standard deviation, 1; range, 2-7) years and mean pretreatment visual acuity was 0.35 (0.15; 0.02-0.63) [~20/60]. The values for mean, standard deviation, and range of treatment duration were 27, 16, 4-67 months respectively, and corresponding values for prescribed patching per day were 4, 1, 2-8 hours. The mean, standard deviation, and range of visual acuity at final post-treatment assessment were 0.66, 0.16, 0.1-1.0 (~20/30), respectively. The overall success rate (ie final visual acuity >0.7 or 20/30) was 62%. Children with moderate amblyopia (20/40-20/80) and severe amblyopia (20/100-20/400) had success rates of 74% and 55%, respectively. The mean visual acuity improvements for moderate and severely amblyopic children were 2.3 lines and 5.8 lines, respectively. The mean, standard deviation, and range of patching prescriptions for moderate and severely amblyopic children were 5, 1, 2-7 hours and 5, 1, 3-6 hours, respectively. Recurrence ensued in 7% of the children with moderate amblyopia and 46% of those with severe amblyopia. Reported compliance was good (>75% of the time) in 68% of the children.

Conclusion: Occlusion therapy is the mainstay of treatment in Hong Kong. The overall success rate was comparable to that achieved in the Amblyopia Treatment Study. Recurrence was more common in patients with severe amblyopia, for whom maintenance therapy may reduce the risk of recurrence. The duration of treatment was much longer in our locality than in western countries. Reported compliance was suspicious possibly due to traditional cultural contexts. It is important to emphasise compliance to all parents.

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New knowledge added by this study

- The Amblyopia Treatment Study (ATS) result cannot be directly applied to Hong Kong children. Heavier dosage for moderate amblyopia and longer treatment for both moderate and severe amblyopia appear necessary for successful treatment of affected Hong Kong children.

Implications for clinical practice or policy

- The current practice for occlusion therapy in Hong Kong should not be changed to ATS recommendations; maintenance therapy should be considered with a view to reducing recurrences in children with severe amblyopia (visual acuity 20/100 to 20/400).

Introduction

Amblyopia is the most common cause of monocular visual impairment in both children and young adults.[1,2] Since year 2002, the Pediatric Eye Disease Investigator Group has undertaken various randomised controlled trials, known as the Amblyopia Treatment Study (ATS). The ATS has provided insights into how amblyopia can be most effectively managed with respect to aspects such as dose response, the required amount of prescribed occlusion, compliance with treatment, use of atropine, and the upper age limit for treatment.[3-6]

Despite recent research on amblyopia treatment, studies show that the uptake of ATS guidelines and their results into clinical practice are sporadic and incomplete in both the UK and the US.[7] Apparently, one third of paediatric ophthalmologists have made no changes whatsoever to their practice.

Other studies found that 55% of paediatric ophthalmologists had decreased their prescribed patching regimens, which was contrary to ATS recommendations.[8,9]

In Hong Kong, patching is still the mainstay of treatment for unilateral amblyopia. Yet, the impact of the ATS guidelines on clinical practice is also inadequate. In our locality, prescriptions for patching are usually based on the age of the child. The duration and subsequent dosages are tapered or adjusted according to the individual child's response and visual acuity (VA) improvement. Our study therefore aimed to compare current amblyopia management and results of patching at a government hospital in Hong Kong against the guidelines and results reported in the ATS.

弱視遮眼治療的香港經驗

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目的：回顧香港以遮眼法治療弱視眼的結果。

設計：回顧病例系列。

安排：香港一所分區醫院。

患者：回顧分析2009年1月1日至3月31日期間於香港基督教聯合醫院小兒眼科診所的求診紀錄，並對於研究期間接受遮眼治療以鍛鍊弱視眼的病例進行評估。

結果：50名兒童（50對眼）的平均年齡為4歲（標準差1歲；介乎2-7歲）。他們治療前的視力平均為0.35（標準差0.15；介乎0.02-0.63）〔約20/60〕。治療期平均為27個月（標準差16個月；介乎4-67個月）；每天遮眼的時間平均為4小時（標準差1小時；介乎2-8小時）。完成治療後，最終視力評估結果平均為0.66（標準差0.16；介乎0.1-1.0）〔約20/30〕。總成功率（即最終視力大於0.7或20/30）為62%。中度弱視的兒童（即視力20/40-20/80）和嚴重弱視的兒童（即視力20/100-20/400）分別有74%和55%的成功率，而他們的平均視力改善分別為2.3行和5.8行。每天遮眼的平均時間、標準差和範圍方面，中度弱視的兒童為5、1和2-7小時，而嚴重弱視的兒童則為5、1和3-6小時。中度弱視兒童的復發率為7%，嚴重弱視者為46%。有68%的兒童依從治療方法（即超過75%的時間）。

結論：遮眼治療是香港治療弱視眼的主要方法，總成功率可媲美美國弱視治療研究的結果。嚴重弱視的兒童會有較高復發率，對他們來說接受維持治療可能會降低復發的風險。與西方國家相比，我們的治療期相對較長，而且依從治療方法的比率值得商榷，原因可能是受傳統文化背景影響。向所有家長強調依從治療方法是重要的。

Methods

This was a retrospective case series study, for which approval was obtained from the local research ethics committee. Records of all children attending the Paediatric Ophthalmology Clinic at the United Christian Hospital, Hong Kong from 1 January 2009 to 31 March 2009 were reviewed. All children who had received patching for amblyopia were identified. Two patients with structural abnormalities due to cataract and retinal pathologies, one with bilateral amblyopia warranting alternating patching, and three others with incomplete data or follow-up of less than 3 months were excluded. In all, 50 patients (50 eyes) were therefore identified and relevant demographic data were obtained.

Patching protocol

Visual acuity was measured using Sheridan Gardiner test for patients aged under 4 years and Snellen charts for those 4 years old or older. Optical correction was provided for all patients before commencement of patching. Refraction with or without cycloplegia was performed for the optical correction, which followed our departmental guidelines, at the discretion of the attending optometrist. Children were deemed to require cycloplegic refraction if they had unreliable retinoscopy or autorefraction readings (the very young, the uncooperative, or having pseudomyopia); accommodative esotropia; extreme refractive errors (especially myopia); anisometropia (>2 dioptres); or suspected amblyopia with >3 lines of difference in VA.

Prescription of patching was based on the age of the child, and the number of hours per day corresponded to the age. For instance, 3 hours per day for a 3-year-old and 5 hours per day for a 5-year-old. Patching duration was titrated according to the patient's response and improvement of VA. Patching therapy was stopped when the best-corrected visual acuity (BCVA) of the amblyopic eye caught up or equalled that of the fellow eye, or when the patient reached 8 years old. Maintenance therapy was given to patients with severe pretreatment amblyopia after successful patching therapy and those with recurrent amblyopia. Such prescriptions were for 2 hours per day for around 6 to 8 months. Patients were regularly reviewed every 3 to 4 months to monitor treatment response including VA, refractive errors, compliance, recurrence, and occurrence of occlusion amblyopia.

Outcome and statistical analysis

Demographic and baseline characteristics of the 50 patients were collected and analysed. Data relating to BCVA before and after patching, duration and intensity of patching, and compliance (percentage subjectively reported by parents) were collected and analysed.

Snellen VA was converted to equivalent logMAR vision for statistical analysis. Treatment success was defined as a BCVA of 20/30 (0.7) or better. Improved VA in both the moderate and severe amblyopia groups were compared with the corresponding ATS 2B and ATS 2A study groups, respectively. All statistical analysis was performed

TABLE 1. Demographic data and treatment results of children with unilateral amblyopia attending Paediatric Ophthalmology Clinic in United Christian Hospital between January 2009 and March 2009

Demographics / treatment results	Data*
Gender (M:F)	22:28 (44%:56%)
Laterality (R:L)	23:27 (46%:54%)
Ocular alignment (straight:ET:XT:SOP)	14:22:13:1 (28%:44%:26%:2%)
Anisometropia (>2 dioptres SE difference)†	12 (24%)
Age (years) at presentation	4 ± 1 (2-7)
Treatment duration (months)	27 ± 16 (4-67)
Prescription (No. of hours of patching per day)	4 ± 1 (2-8)
Pretreatment Snellen VA score	0.35 ± 0.15 (0.02-0.63) [~20/60]
Snellen VA score at 4 months	0.51 ± 0.17 (0.02-0.8)
Final best-corrected VA	0.66 ± 0.16 (0.1-1.0) [~20/30]

Abbreviations: M = male; F = female; R = right; L = left; ET = esotropia; XT = exotropia; SOP = superior oblique palsy; SE = spherical equivalent; VA = visual acuity

* Data are shown as No. (%) of cases or mean ± standard deviation (range)

† Anisometropia (>2 dioptres SE) includes "myopic", "hyperopic", and "astigmatic". We obtained SE by dividing astigmatic dioptres by 2 added to the myopic or hyperopic dioptres

TABLE 2. Visual outcomes in relation to compliance in patients with moderate and severe amblyopia

	Moderate amblyopia (20/40-20/80)*	Severe amblyopia (20/100-20/400)*
Occlusion amblyopia	0	0
Compliance		
Good (>75% of time)	23 (74%)	6 (55%)
Fair (50-75% of time)	5 (16%)	4 (36%)
Poor (<50% of time)	3 (10%)	1 (9%)
Recurrence	2/31 (7%)	5/11 (46%)
Final mean VA improvement†	P=0.012[a]	P=0.912[b]
Good	2.61 Lines	5.84 Lines
Fair-to-poor	1.40 Lines	5.61 Lines

Abbreviation: VA = visual acuity

* Snellen VA

† Visual acuities are converted to logMAR for statistical calculation and comparison. Differences between the 2 groups were assessed by [a]independent *t* test / [b]Mann-Whitney *U* test for quantitative data

using statistical software (Statistical Package for the Social Sciences; Windows version 16.0; SPSS Inc, Chicago [IL], US). The paired *t* test, independent *t* test and Mann-Whitney *U* test were used as appropriate, and a P value of less than 0.05 was considered significant.

Results

The demographic data and treatment results of the 50 patients are shown in Table 1. There were 42 patients with moderate (20/40-20/80) and severe amblyopia (20/100-20/400) as defined by the ATS. The overall success rate (ie final VA >0.7 or 20/30) was 62% (31/50); respective success rates in those with moderate (20/40-20/80) and severe amblyopia (20/100-20/400) were 74% (23/31) and 55% (6/11). The mean VA improvement at 4 months for moderate and severe amblyopia children was 1.0 lines and 6.0 lines, respectively. The mean final VA improvement for the moderately and severely amblyopic children was 2.3 and 5.8 lines, respectively. The respective mean ± standard deviation of moderately and severely amblyopic children for the following outcome measures were: patching prescription, 5 ± 1 (range, 2-7) hours/day and 5 ± 1 (range, 3-6) hours/day; and patching duration, 23 ± 13 (range, 6-57) months and 38 ± 15 (range, 19-66) months. Reported compliance was good (>75% of the time) in 68% (n=34), fair (50-75% of the time) in 22% (n=11), and poor (<50% of the time) in 18% (n=5) of the children. Visual outcomes in relation to patient compliance in patients with moderate and severe amblyopia are shown in Table 2.

Subgroup comparisons

There were no significant differences in mean VA improvement between children (i) aged <4 (n=16) and ≥4 (n=34) years; (ii) having good (n=34) and fair-to-poor (n=16) compliance; and (iii) with straight (n=14) and squint (n=36) eyes (Table 3).

Regarding subgroup comparison for anisometropia (n=12) and non-anisometropia (n=38) groups, the former achieved significantly better mean VA improvements (4.9 vs 2.7 lines, P=0.060). There was no difference in the duration of treatment in the two groups (Table 4).

Discussion

Amblyopia is a common condition in paediatric ophthalmology, which is potentially reversible if early treatment is given. It is an important condition warranting efforts to maximise children's visual potential during their age of visual plasticity. In our locality, the first-line treatment after refractive correction is patching. Although ATS showed similar results with patching as with atropine treatment,[10,11] most parents in Hong Kong regard patching more acceptable than atropine, because the latter usually causes visual blurring and may affect the academic performance. This is an important consideration for Hong Kong children who are often busy with schoolwork, including ample near work. Adverse reactions to atropine (flushing and fever) are also common in this locality which also make this form of treatment less popular.

Notably, the children in our series received much longer durations of patching treatment than those in ATS (27 vs 4 months), though the final VA improvements were similar (Table 4). In those with severe amblyopia, the mean VA

TABLE 3. Subgroup patient comparisons according to age, compliance, ocular alignment, and presence of anisometropia*

Surgery type	Age			Compliance			Ocular alignment			Anisometropia		
	<4 Years (n=16)	≥4 Years (n=34)	P value†	Good (n=34)	Fair-to-poor (n=16)	P value†	Straight (n=14)	Squint (n=36)	P value†	Yes (n=12)	No (n=38)	P value†
PreTx VA‡	0.32 ± 0.18	0.36 ± 0.14	0.407[b]	0.36 ± 0.15	0.32 ± 0.17	0.343[a]	0.41 ± 0.13	0.33 ± 0.16	0.097[a]	0.24 ± 0.14	0.38 ± 0.14	0.005[a]
PostTx VA‡	0.59 ± 0.21	0.69 ± 0.13	0.108[b]	0.68 ± 0.14	0.60 ± 0.20	0.108[b]	0.66 ± 0.08	0.65 ± 0.19	0.902[b]	0.59 ± 0.15	0.68 ± 0.16	0.089[b]
Mean VA improvement§	3.0 Lines	3.3 Lines	0.312[b]	3.3 Lines	3.1 Lines	0.588[b]	2.4 Lines	3.5 Lines	0.213[b]	4.9 Lines	2.7 Lines	0.060[a]
Time of occlusion (hours per day)	3.5 ± 1.0	4.8 ± 1.3	0.001[b]	4.3 ± 1.4	4.7 ± 1.3	0.332[b]	5.0 ± 1.2	4.2 ± 1.4	0.035[b]	5.2 ± 1.5	4.2 ± 1.2	0.043[b]
Duration of Tx (months)	30.3 ± 17.4	24.8 ± 14.4	0.215[b]	25.7 ± 16.0	28.4 ± 14.6	0.333[b]	29.9 ± 12.8	25.3 ± 16.4	0.198[b]	33.6 ± 16.6	24.4 ± 14.7	0.069[b]

Abbreviations: Tx = treatment; VA = visual acuity

* Data are shown in mean ± standard deviation (range), unless otherwise stated

† Differences between the 2 groups were assessed by [a]independent *t* test / [b]Mann-Whitney *U* test for quantitative data

‡ Snellen visual acuity

§ Visual acuities are converted to logMAR for statistical calculation and comparison

TABLE 4. Treatment duration and Snellen visual acuity outcomes with reference to the Amblyopia Treatment Study 2 (for children aged 3 to 7 years)*

	Moderate amblyopia (20/40-20/80)	ATS 2B	Severe amblyopia (20/100-20/400)	ATS 2A
No. of cases	31	189	11	175
Duration of treatment (months)	23 ± 13 (6-57)	4	38 ± 15 (19-66)	4
Duration of occlusion (hours/day)	5 ± 1 (2-7)	2 vs 6	5 ± 1 (3-6)	6 vs Full-time
Pretreatment VA†	0.41 ± 0.09		0.15 ± 0.05	
VA at 4 months†	0.57 ± 0.17		0.48 ± 0.16	
Post-treatment VA†	0.70 ± 0.13		0.61 ± 0.20	
VA improvement at 4 months‡	1.0 Lines (P<0.001)	2.4	6.0 Lines (P<0.001)	6 Hours (4.8 lines)
Final VA improvement‡	2.3 Lines (P<0.001)		5.8 Lines (P<0.001)	Full time (4.7 lines)

Abbreviations: ATS = Amblyopia Treatment Study; VA = visual acuity

* Data are shown in mean ± standard deviation (range), unless otherwise stated

† Snellen visual acuity

‡ Visual acuities are converted to logMAR for statistical calculation and comparison

improvement at 4 months was slightly greater than the final improvement. For severe amblyopia, 45% of the children (5/11) were assessed by the Sheridan Gardiner test (suitable for children <4 years old) at 4 months instead of Snellen Acuity charts, though the latter are considered more accurate. All 11 children were using Snellen Acuity charts during the final VA assessment. Maintenance therapy might have extended the treatment duration in certain cases. Assuming Caucasian and Asian eyes as well as environmental visual stimuli were similar, poor compliance could be why longer patching therapy was used to achieve similar VA improvements, even after exclusion of structural abnormalities and correction of refractive errors. In fact, the reported compliance for occlusion therapy has been found to be poor in other studies.[12,13] The reported compliance in our case series (68%) was good but suspicious. Due to cultural reason, over-reporting of good compliance was possible in our society. Traditionally, the Chinese regard modest lies more positively than immodest truths.[14] Hence, some parents may have overstated the hours of occlusion. A similar situation prevails when we deal with the compliance to anti-glaucomatous eyedrops, in which the reasons for medication non-adherence are complex and may be societal rather than only medical.[15,16] Objective measurement of patching compliance and risk factors analysis might be preferable for future studies. Emphasis on compliance to patching is important to communicate when commencing treatment and at every subsequent follow-up visit.

Notably, recurrence was much more common in patients with severe amblyopia (46%) than in those in whom it was moderate (7%). This was consistent with the ATS 2C results.[6] Tapering of patching to maintain therapy instead of abrupt termination may help to reduce the risk of recurrence.

There was a concern about overtreatment, as our dosages were much higher than those in ATS 2B (5 hours/day vs 2 hours/day) for moderate amblyopia. Yet, no occlusion amblyopia was observed in our case series. We believe vigilant and close monitoring of the VA can avoid overtreatment.

Since this was a retrospective study, our case series had several limitations, which included small sample size, non-standardised treatment protocol, heterogeneity of case mix, and lack of a control arm. Nonetheless, this study supports the effectiveness of the current Hong Kong practice for amblyopia treatment by patching.

Conclusion

Our study showed treatment success rates comparable to those of ATS for moderate amblyopia (74% vs 79% in ATS 2B) and in all children (62% vs 62% in ATS 1). However, larger dosages for moderate amblyopia and longer treatments for both moderate and severe amblyopia appeared necessary for successful treatment in Hong Kong children. Early treatment is important. Maintenance therapy may help to reduce recurrences in children with severe amblyopia. It seems that ATS result cannot be directly applied to Hong Kong children. It is important to emphasise compliance to all parents.

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