

An audit of atropine penalisation as a primary treatment for amblyopia

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Abstract

Background: Amblyopia is defined as defective visual acuity in one or both eyes which persists after correction of refractive error and removal of pathological obstacles to vision. Pharmacological treatment for amblyopia is an alternative treatment but until recently tended to be prescribed less frequently than conventional occlusion. Pharmacological penalisation involves the instillation of a cycloplegic agent, such as atropine, into the non-amblyopic eye.

Methods: In 2005 a new departmental policy was introduced to allow for the use of atropine as first-line treatment for amblyopia. At diagnosis parents are offered the choice of treatment: atropine or conventional occlusion. This retrospective audit analysed the final visual acuity results of children treated with atropine under the new protocol.

Results: Sixty-five patients were included. Starting average visual acuity was 0.645 logMAR (SD = 0.288). Final average visual acuity achieved at the immediate cessation of treatment was 0.366 logMAR (SD = 0.277). Average duration of treatment was 3.6 months (range 6 weeks to 6 months). Adverse events were documented in 8 cases (12%). Two year follow-up data are available for 62 patients. Twenty-one (33%) patients required additional treatment to maintain the vision improvement. At 2 years post-treatment the visual acuity in the treated amblyopic eye was 0.378 logMAR (SD = 0.373).

Conclusion: This audit has reconfirmed the efficacy of atropine, with 50% of patients ($n = 32$) achieving a cure result (0.250 or better) and 34% a satisfactory outcome (0.275–0.500). Visual acuity change in the amblyopic eye did not have a statistically significant dependence on type of amblyopia ($p = 0.46$).

Key words: Amblyopia, Atropine penalisation, Re-occurrence of amblyopia

Introduction

Amblyopia is defined as defective visual acuity in one or both eyes which persists after correction of any

refractive error and removal of pathological obstacles to vision. Although amblyopia therapy is thought to be most effective in childhood, some authors have reported some benefits in older patients.^{1–3} Estimates of the prevalence of amblyopia vary depending on the population studied and the definition used. It is widely accepted that in the general population the incidence is approximately 2.0–2.5%.⁴

Until recently the mainstay treatment for amblyopia has generally been occlusion of the non-amblyopic eye.⁴ However, several randomised control trials have tried to establish the most effective regime of occlusion for varying severities of amblyopia^{5,6} and the level of amblyopia that warrants intervention.⁷ Pharmacological treatment for amblyopia is seen as an alternative treatment but until recently tended to be prescribed less frequently than occlusion.

Pharmacological penalisation involves the instillation of a cycloplegic agent, such as atropine, into the non-amblyopic eye. This prevents accommodation and blurs visual acuity for near activities. This treatment is carried out with refractive correction in place. Recent research has proven the use of atropine to be as effective as occlusion therapy.^{8,9} The regime of atropine used, whether daily or intermittent, gives the same effective result.^{10,11}

Following on from this research and audits within the ophthalmology department at Royal Victoria Infirmary, our policy for the treatment of amblyopia was altered to allow atropine to be used as a first-line treatment.

Methods

In 2005 a new atropine policy was introduced into the department to allow for the use of atropine as first-line treatment for amblyopia (see Fig. 1 for the atropine protocol). At diagnosis parents are offered the choice of treatment: atropine or conventional occlusion. Written information is given to parents prior to making a decision regarding treatment. The information given contains instructions on use of both treatments, possible side effects or allergies, and dose of treatment.

To assess the effectiveness of this protocol and the adherence to treatment, visual acuity outcomes were monitored at 6 weeks, 3 months and 6 months from commencing treatment. The protocol states that any child over 3 years of age with any type or level of amblyopia can be offered atropine as a first-line treatment. Amblyopia therapy is offered only after a period

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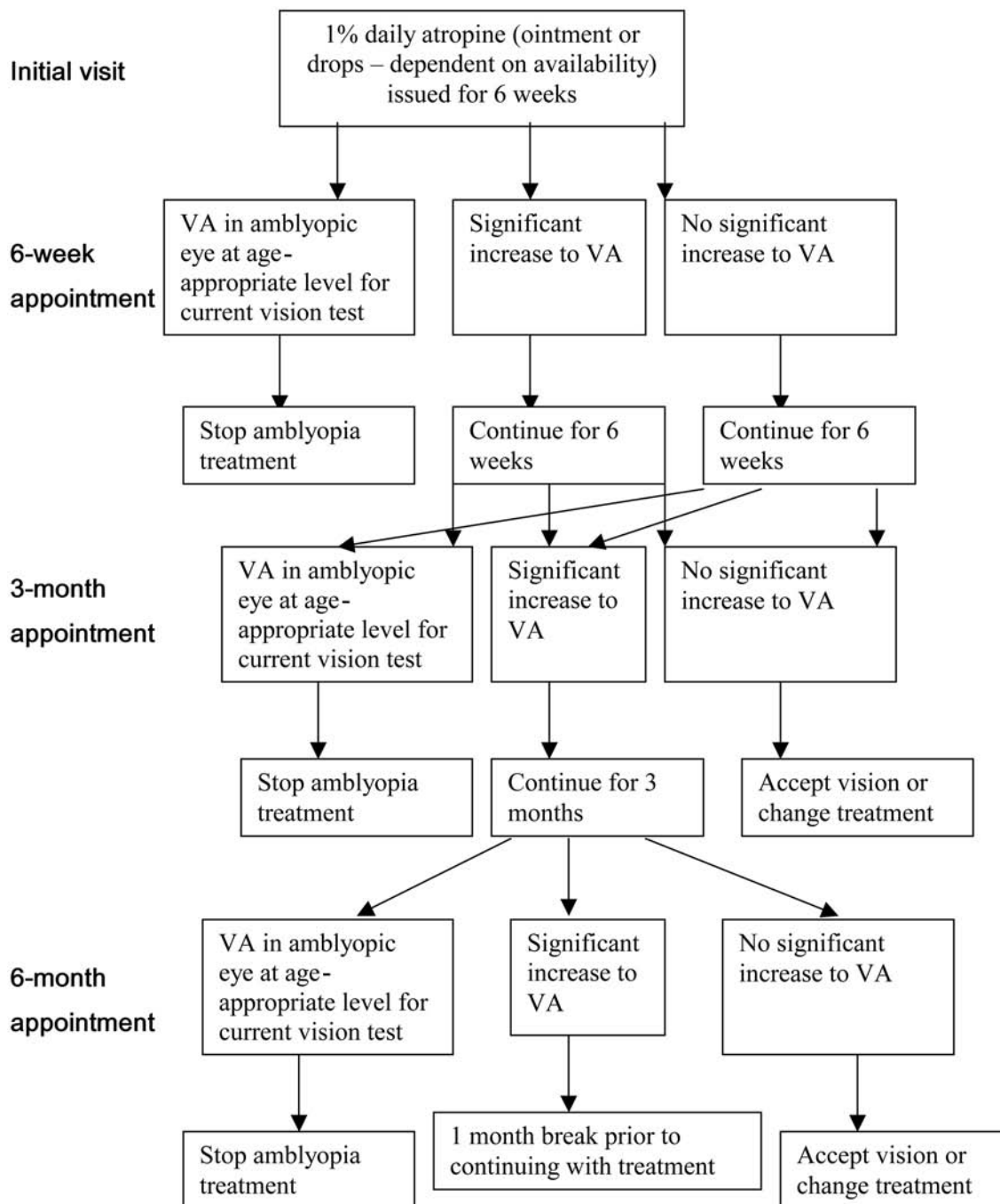


Fig. 1. Flow chart of the atropine protocol.

of wearing optimal refractive correction (allowance for cyclopentolate removed from full prescription) full time until there is no further improvement in the vision of the amblyopic eye for two consecutive visits (minimum 12 weeks). At each visit visual acuity is documented on an age-appropriate logMAR test (single Kay's pictures, Crowded Kay's pictures, Keeler Uncrowded logMAR or Keeler Crowded logMAR). Other outcome measures recorded include compliance with treatment, adverse events to treatment (stated in results) and near vision (if possible). If at any visit visual acuity in the non-amblyopic eye is reduced to worse than 0.300, visual

acuity is rechecked with the full optical prescription in place (without allowance for cyclopentolate). If visual acuity improves to 0.300 or better treatment is continued. If, however, visual acuity is still reduced in the non-amblyopic eye, treatment is discontinued.

At each visit patients are prescribed 1% atropine ointment or atropine drops (dependent upon availability) to use daily until the next visit. Prescribed atropine is only available from the hospital pharmacy with no instruction for the family general practitioner to continue treatment. Repeat prescriptions can only be issued from the department. Daily atropine is used continuously until

Table 1. Immediate post-treatment visual outcomes

	Mean post-treatment vision	Range	Cure rate
Anisometropic amblyopia	0.310 (0.227 SD)	0.125–1.000	52%
Strabismic amblyopia	0.350 (0.292 SD)	0.125–1.300	54%
Mixed amblyopia	0.425 (0.314 SD)	0.175–1.000	39%

normal visual acuity is achieved, an adverse event prevents continuation of treatment or parents wish to stop treatment. If at 3 months no significant improvement in baseline visual acuity has been achieved (minimum 0.1 logMAR improvement), treatment must be altered by means of the addition of optical penalisation or partial occlusion or changing to conventional occlusion. At 6 months, atropine must be discontinued and patients given a minimum of 1 month break prior to treatment being restarted. If an allergy to atropine occurs, treatment is changed to occlusion therapy.

Vision outcome measures were pre-defined: 'cure' was defined as reaching a visual acuity of 0.250 or better, 'satisfactory' as a visual acuity range of 0.275–0.500 and 'unsatisfactory' a visual outcome worse than 0.500. These standards are set within the department and are used for all internal audits.

Results

Retrospective inspection of case notes demonstrated that atropine prescription for amblyopia treatment increased from 26% to 42% following the introduction of the new protocol.

In total 65 eligible patients were included; 24 of these were diagnosed with strabismic amblyopia, 23 with anisometropic amblyopia and 18 with mixed amblyopia. The initial mean visual acuity for patients with strabismic amblyopia was 0.707 log units (range

0.300–1.300, SD = 0.331), for patients with anisometropic amblyopia was 0.530 log units (range 0.300–1.000, SD = 0.217) and for patients with mixed amblyopia was 0.708 log units (range 0.275–1.300, SD = 0.277). Overall starting visual acuity was 0.645 (SD = 0.288).

At the cessation of treatment, 50% ($n = 32$) of patients achieved a 'cure' as defined previously. A satisfactory outcome was achieved in a further 34% ($n = 22$). The final mean visual acuity achieved at the immediate cessation of treatment was 0.366 (SD = 0.277), mean improvement 2.79 lines. Overall final visual outcomes achieved are shown in Table 1. Pre-treatment, immediate post-treatment and 2 years post-treatment visual acuity data for anisometropic, strabismic and mixed amblyopia are shown in Figs. 2, 3 and 4. Insufficient near vision data were collected for meaningful analysis.

Atropine only

At the initial visit, atropine was prescribed to all 65 patients for 6 weeks. During treatment, 10 patients (15%) changed treatment for a variety of reasons: 5 were unable to instil atropine, 3 had severe allergic reactions, 1 had reversal of deviation, and in 1 the reason was unknown. At the 3-month visit, 7 (11%) patients were prescribed a supplement to atropine treatment. Therefore, 48 (78%) patients were prescribed atropine exclusively for the duration of their treatment. Final acuity at the end of treatment was 0.302 (SD = 0.237) and 56% of these patients achieved a cure result.

Supplements to atropine treatment

Seven patients (11%) required an addition to the prescribed atropine. In all cases this supplement was given at 3 months. In all cases except one the supplement given was a fine frosting (Blenderm) to their glasses to further blur the vision in the non-amblyopic eye. One patient was prescribed 3 hours of conventional occlusion

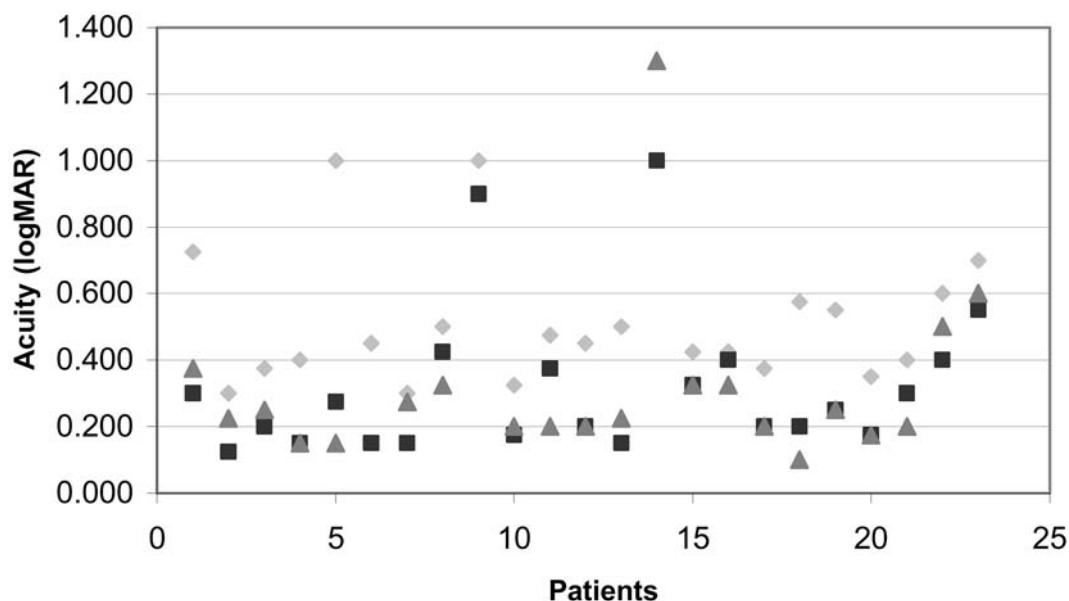


Fig. 2. Visual acuity of the amblyopic eye for patients with anisometropic amblyopia. Diamonds, before treatment; squares, after treatment; triangles, 2 years after treatment.

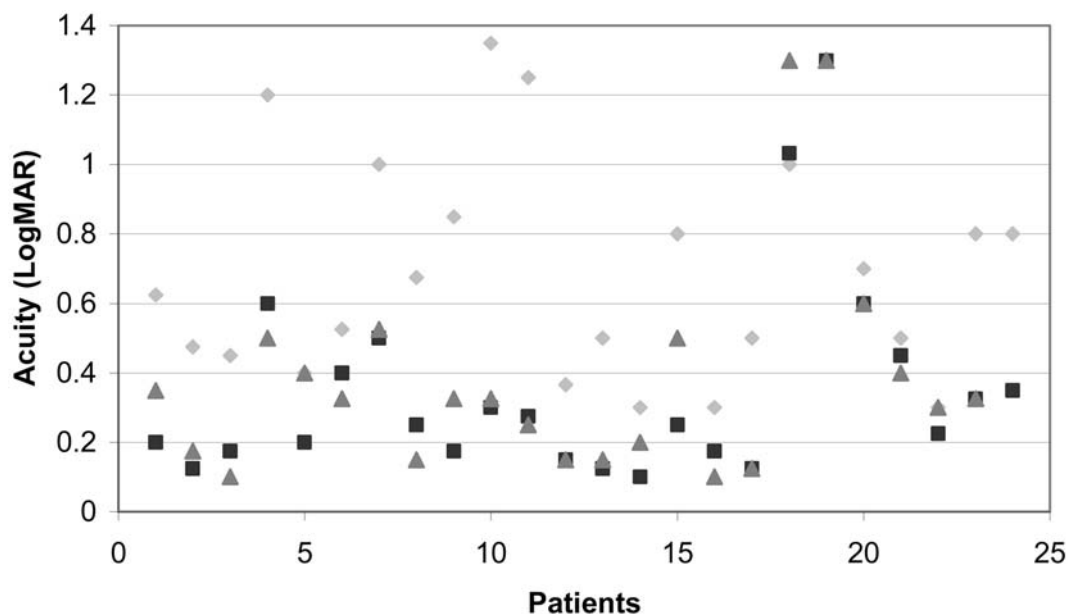


Fig. 3. Visual acuity of the amblyopic eye for patients with strabismic amblyopia. Diamonds, before treatment; squares, after treatment; triangles, 2 years after treatment.

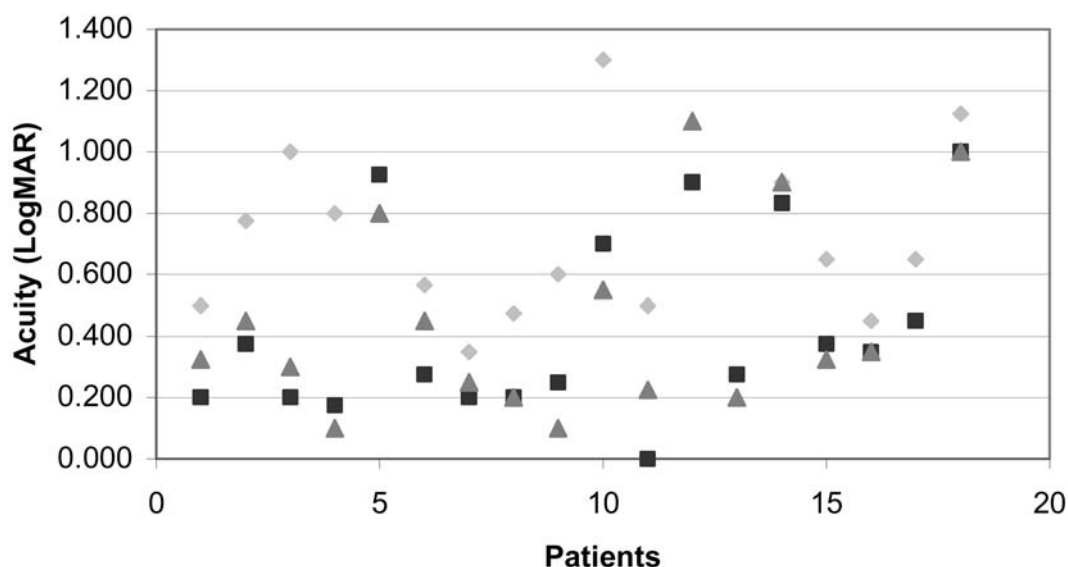


Fig. 4. Visual acuity of the amblyopic eye for patients with mixed amblyopia. Diamonds, before treatment; squares, after treatment; triangles, 2 years after treatment.

daily in addition to daily atropine. Initial starting acuity in the amblyopic eye for this group was 0.579 (SD = 0.357). Final acuity at the end of treatment was 0.321 (SD = 0.191) and 66% of these patients achieved a cure result.

Duration of treatment

Average duration of treatment was 3.6 months (range 6 weeks to 6 months). In patients with worse starting acuity (0.500 or worse) the average duration of treatment increased slightly to 4 months.

Adverse events

Adverse events to treatment were documented at every

visit. The outcomes were divided into mild or severe. A mild reaction was defined as either reduction in the visual acuity of the atropinised eye (0.300 or worse) not requiring treatment or mild allergic reaction. A severe reaction was defined as either a reduction in visual acuity of the atropinised eye requiring treatment or a severe allergic reaction (swollen lids, red face and rash or decompensating heterophoria).

An adverse event was documented in 8 patients (12%):

- 3 severe allergic reactions,
- 3 with mild reduction in the visual acuity of the non-amblyopic eye (0.300 or worse),
- 2 mild allergic reactions.

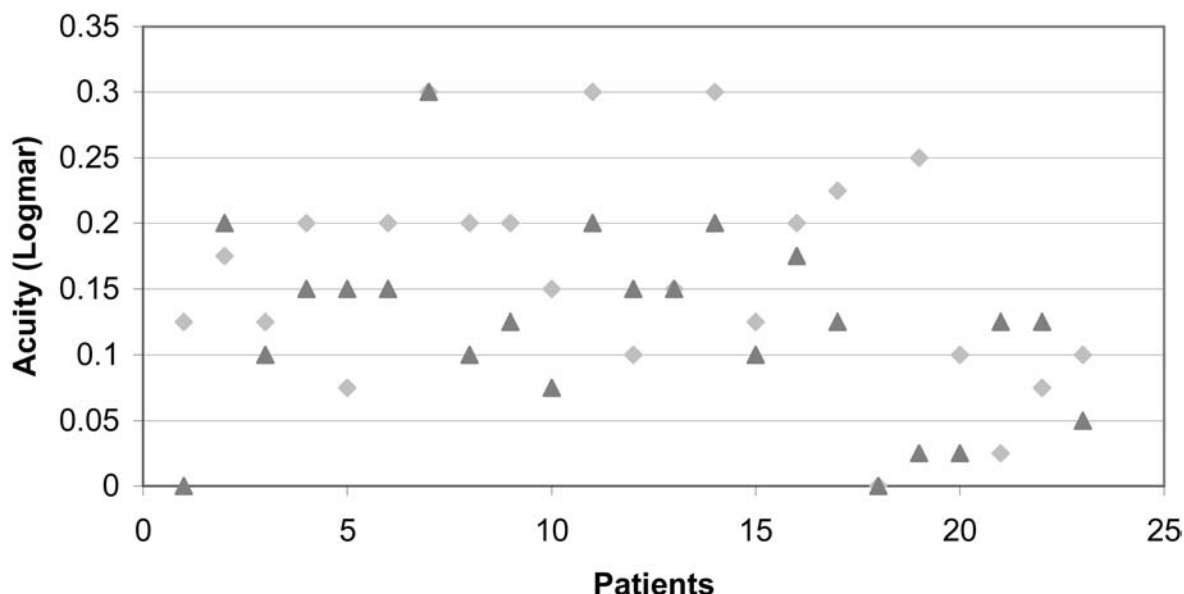


Fig. 5. Visual acuity of the non-amblyopic eye for patients with anisometropic amblyopia. Diamonds, before treatment; triangles, 2 years after treatment.

No patient had an increase in a manifest squint or a heterophoria that decompensated. One patient had reversal of manifest deviation noted by parents who were unwilling to continue with treatment following this. All 3 patients with severe allergic reactions had their treatment changed and were prescribed conventional occlusion. Five patients with mild adverse events all continued with atropine therapy.

Adherence to and tolerance of treatment

From parental reports, instillation of atropine was well tolerated. Sixty-four patients were documented by the orthoptist as having excellent compliance to treatment as assessed by parental reports of treatment and examination of pupils. There were no documented reports of photophobia or discomfort.

Acceptability of treatment

Seven patients (11%) chose to change treatment from atropine to conventional occlusion once treatment was under way. The reason for changing was difficulty instilling atropine in 5 cases and reversal of deviation in 1 case; and in 1 case the reason was unknown.

Attendance rate

Five patients (8%) consistently failed to attend for appointments (2 or more appointments). No patient failed to attend after the initial prescription of treatment and all patients have been included in the analysis of results. The patients who failed to attend appointments all had a starting acuity of 0.550 or worse.

Effect of starting acuity on final vision achieved

Thirty-three patients had a starting acuity of 0.500 or worse at the start of treatment. Seven of these were diagnosed with anisometropic amblyopia, 12 with mixed amblyopia and 14 with strabismic amblyopia. Mean

starting acuity in this group was 0.867 (SD = 0.235). Final visual acuity achieved was 0.506 (SD = 0.321), 24% of patients within this group achieving the cure rate of 0.250 or better.

Thirty-two patients had an acuity of between 0.275 and 0.475 at the start of treatment. Mean starting acuity for this moderate group was 0.414 (SD = 0.079). Final visual acuity achieved by this group of patients was 0.213 (SD = 0.102); 24 patients (75%) achieved the pre-defined cure rate of 0.250 or better.

Reoccurrence of amblyopia and the long-term stability of visual acuity

At the cessation of treatment, patients were kept under review to monitor any reoccurrence of amblyopia. Long-term data are available for 62 patients (95%). In 21 cases (33%) amblyopia reoccurred in an average of 6.67 months (range 2–15 months). The age range of these patients was 3–7 years. Seven patients were treated with conventional occlusion therapy and 14 patients with further atropine therapy. The average duration of this second treatment was 2.57 months with atropine and 3.71 months with occlusion. At 2 years post-treatment visual acuity in the treated amblyopic eye was 0.378 (SD = 0.373).

Effect of atropine on the non-amblyopic eye

Initial starting acuity of the non-amblyopic eye was documented in all 65 patients. Mean starting acuity was 0.137 (SD = 0.081). At the immediate cessation of treatment visual acuity data for the non-amblyopic eye were available for 63 patients (97%). Visual acuity in all 63 cases was documented with atropine instilled. Average acuity was recorded as 0.187 (SD = 0.095; range 0.000–0.400). At 2 years post-treatment the average visual acuity had remained stable at 0.101 (SD = 0.082). Figs. 5, 6 and 7 show the effect of

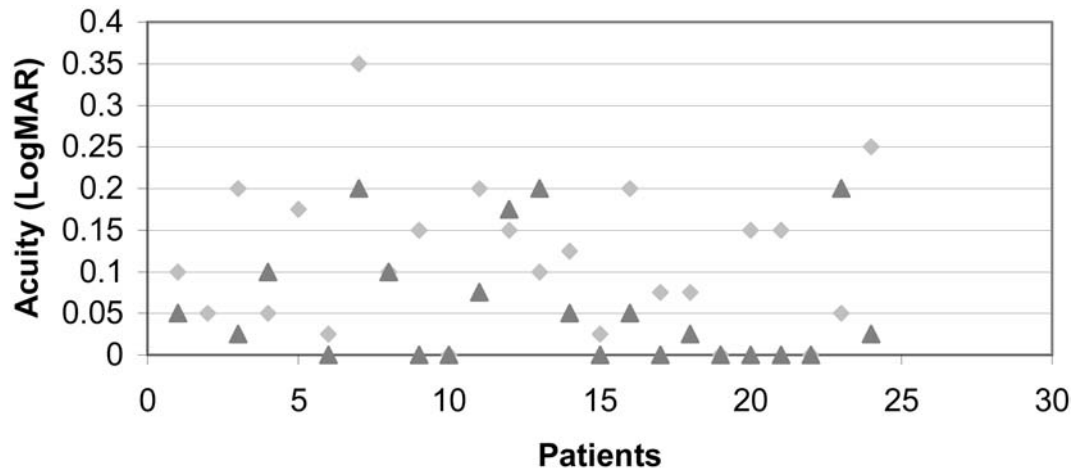


Fig. 6. Visual acuity of the non-amblyopic eye for patients with strabismic amblyopia. Diamonds, before treatment; triangles, 2 years after treatment.

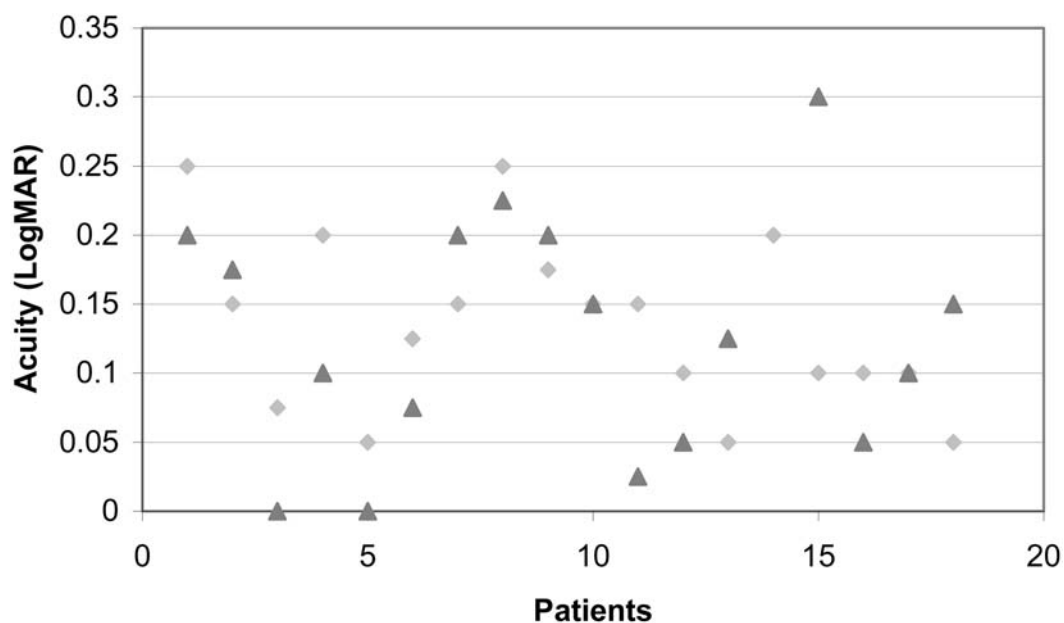


Fig. 7. Visual acuity of the non-amblyopic eye for patients with mixed amblyopia. Diamonds, before treatment; triangles, 2 years after treatment.

treatment on the non-amblyopic eye for each type of amblyopia. Acuity before treatment and at 2 years post-treatment are given.

Discussion

We have reported the results of a departmental audit assessing visual acuity outcomes for children treated with atropine penalisation as a primary treatment for amblyopia. This audit has reconfirmed the efficacy of atropine, with 50% of patients ($n = 32$) achieving a cure result and a further 34% achieving a satisfactory outcome (0.275–0.500) in the amblyopic eye. Visual acuity change in the amblyopic eye was not statistically significant ($p = 0.46$), depending on the type of amblyopia (anisometropic 0.310 ± 0.05 ; strabismic

0.350 ± 0.09 ; mixed 0.425 ± 0.09). The average improvement of 2.79 lines matches that in published data (2.84 lines).⁸

Low rates of adverse events were documented ($n = 8$, 12%). This compares well with previously published data (18%) and published expected side-effects of atropine.⁸ No children in our study had a severe reduction in vision of the non-amblyopic eye which required further treatment, or decompensation of a previously controlled heterophoria, thus reaffirming the safe use of this treatment for amblyopia.

The rate of reoccurrence of amblyopia in our patients was 21/65 (33%). This compares favourably with published data on the rate of reoccurrence of amblyopia following the cessation of atropine occlusion (40% reoccurrence rate for daily atropine).¹² The maintenance

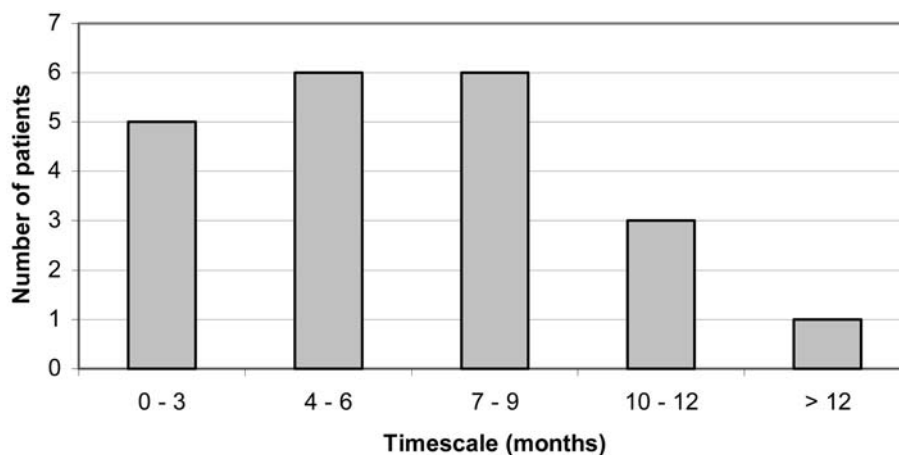


Fig. 8. Timescale of reoccurrence of amblyopia.

of the treatment effect is an important factor when considering successful treatment for amblyopia. Our figure also compares favourably with published rates for reoccurrence of amblyopia following occlusion therapy (24%).¹² From a clinician's perspective it is important to note the time period of amblyopia reoccurrence (average of 6.67 months; range 2–15 months) in order to plan long-term management strategies for patient with treated amblyopia. Fig. 8 shows the time of reoccurrence of amblyopia for each patient. If vision remains stable throughout this time period then it may be possible for some children to be discharged from the hospital eye service at an earlier time, saving resources. No identifiable risk factor for reoccurrence of amblyopia could be established.

Due to recent supply difficulties with atropine, our policy has recently been altered to administer atropine minims twice weekly. It is hoped that once this protocol has been in effect for a substantial time period the results can be audited and compared to ensure that twice-weekly administration of atropine is as effective as daily. Recent randomised control trials have provided evidence to suggest that weekend atropine provides a similar level of improvement to daily atropine for moderate levels of amblyopia (0.300–0.600).¹¹

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