An Overview of Amblyopia Practice
Approved by
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Contributions from
Paediatric Sub-committee, Royal College of Ophthalmology

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About this document
The original author of this document is Kelly MacKenzie, to whom we extend our thanks.

We also thank the following for allowing the inclusion of their resources and papers:
Jane Hanley, Dr Sarah Shea and Dr Helen Griffiths
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Section 1: Introduction

The aim of this document is to communicate and support a consistent evidence-based amblyopia treatment guide for Orthoptists across the UK and Ireland. This review does not override clinical judgement in individual cases.

Definition of Amblyopia

Amblyopia is present if despite optical correction and good compliance with glasses wear (if worn), and in the absence of ocular pathology, there is a clinically significant difference in acuity for test used / age (Appendix I), in the ‘affected eye’ which has not improved significantly over 2 successive visits and refraction indicates there is no change in refractive error.

Aim

The overall aim of amblyopia therapy is to achieve maximum visual acuity in the affected eye(s) when it falls below the age-related normal range.
Section 2: Principal method

- All patients to have undergone pupil check, cycloplegic refraction, fundus and media examination on initial presentation. This must be repeated at least annually after commencement of treatment.

- LogMAR or the equivalent tests of vision should be used where possible.

- In cases where acuity cannot be quantified, for example in pre-verbal infants or children with additional needs, the presence of a unilateral strabismus and the quality of fixation in the non-fixing eye should be used as an indicator of the presence of amblyopia (Appendix I). Occlusion should be commenced and continued until the deviation alternates or acuity is quantified.

- In cases of stimulus deprivation amblyopia (SDA) the causative factor e.g. cataract may need to be dealt with before amblyopia treatment can be initiated. However, lamellar or partial cataracts, or partial corneal opacities are often managed conservatively by accurate refraction and occlusion alone.

- Although there is less robust evidence of the effectiveness of occlusion in cases of stimulus deprivation amblyopia, patients with SDA usually need more aggressive occlusion regardless of age.

- Significant refractive errors should be corrected however the practice of prescribing does vary between clinicians. The Royal College of Ophthalmologists has indicated the degree of refractive error that is thought capable of inducing amblyopia (Table 1 below). Therefore, even in the presence of normal visual acuity consideration should be given to prescribing.

Table 1

<table>
<thead>
<tr>
<th>Type of Error</th>
<th>Subtype</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anisometropia</td>
<td>Hyperopia</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Astigmatism</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Myopia</td>
<td>2.00</td>
</tr>
<tr>
<td>Symmetrical</td>
<td>Hyperopia</td>
<td>4.50</td>
</tr>
<tr>
<td></td>
<td>Myopia</td>
<td>3.00</td>
</tr>
</tbody>
</table>
• Refractive adaptation phase (Optical treatment): Amblyopia treatment should not be commenced until there is no further improvement in acuity following full time (all day) wear of refractive correction for a minimum of two consecutive visits. This may take 16 – 22 weeks although improvements have been noted in some cases up to 30 weeks. 4-10

• The glasses prescription should be checked and documented in the notes after each new prescription has been issued and instructions regarding wear recorded.

• Parents should be offered the choice of atropine or total occlusion (in appropriate cases) as first line treatment and the child reviewed every 6-8 weeks to assess progress. However, atropine is not suitable for aphakic / pseudoaphakic children, patients with Down’s syndrome or those with a known history of cardiac disorders, raised IOP, narrow angles or known hypersensitivity to atropine or any component of the preparation ( Appendix III and IV).

• If compliance with treatment remains limited it may be due to a variety of reasons, for example, child not tolerating treatment, parental willingness to undertake the treatment, social issues, educational concerns. In this instance efforts should be made to support the family ensuring adequate explanation and information on treatment, strategies to aid compliance and parents offered an alternative treatment option where appropriate. 11

• Penalisation with 1% atropine has been shown to be as effective as occlusion in moderate (0.30-0.70 LogMAR, 6/12-6/24 Snellens) and severe (0.80-1.30 LogMAR, 6/30-6/120 Snellens) amblyopia in children aged 3-7. 12-18
  o Atropine (1%) can only be prescribed by a doctor. Orthoptist can supply and administer atropine according to either an agreed Trust Group Directive (PGD) or following the completion of a Health and Care Professions Concil (HCPC) approved training programme.
  o Weekend atropine is comparable to daily installation. 16,17
  o Fixation swap is not required in cases of strabismic amblyopia for atropine to be effective. 18
  o Pupil responses should be checked to ensure the correct eye has been dilated.
All parents or guardians to be given verbal and written information regarding the use and side effects atropine drops / ointment and a copy of the atropine information leaflet (Appendix IV). A copy may also be issued for the child's school.

Any patient experiencing an adverse reaction to atropine should be seen by a doctor, the event recorded in the notes with any unexpected effects being reported to the Medicines and Healthcare products Regulatory Agency (MHRA) via the Yellow Card Scheme immediately.

- 2 hours patching per day is effective for acuities worse than 0.3 – 0.6 LogMAR (6/12 – 6/24 Snellens) in children aged 3-7.19

- 6 hours patching per day is effective for acuities worse than 0.60 LogMAR (6/24 – 6/120 Snellens).20

- Most children need between 150 and 250 hours of amblyopia treatment for 2 line gain, with older children needing higher dosages.21, 22

- The addition of near activities to a portion of the occlusion time does not significantly improve visual outcomes.23

- Amblyopia therapy has been effective in patients with strabismus amblyopia both with and without anisometropia up to 17 years of age; therefore age should not be a barrier to treatment in cases who have never been treated.24, 25

- All patients aged 6 and above with no motor fusion should be evaluated with Sbisa bar or Bagolini filter bar prior to amblyopia treatment and monitored closely. If diplopia occurs then treatment should be stopped immediately. It should be noted that the Bagolini filter bar (filters 1-16) and Sbisa bar (filters 1-17) are not equivalent.26 Monitoring of suppression should be undertaken using the same bar at each visit.

  - There is no conclusive evidence to define the age at which testing should commence or the specific density of suppression that indicates treatment should be stopped.

  - Assessment and interpretation of risk of intractable diplopia remains unclear, but in UK clinical practice assessment most commonly...
commences from age 6 years and filter 7 is most often used as the point at which treatment is stopped.\textsuperscript{27}

- Amblyopia treatment should be tapered once optimum level has been reached to reduce the risk of recurrence.\textsuperscript{28-30}

- Failure to improve, or deterioration of acuity, within 4-6 months of the commencement of amblyopia therapy (when compliance is good), should prompt re-refraction and re-examination of fundus and possible further investigations.
Section 3: Factors to consider

• Compliance
  o Written information regarding amblyopia, critical period and treatment can improve compliance.  

• Follow-up visits
  o Regular supervision / contact with orthoptist improves compliance and may shorten treatment phase.

  o Refractive adaptation phase: review within 3 months of prescribing glasses to establish full-time glasses compliance and improvement in visual acuity.

  o Occlusion / penalisation phase: review every 6-8 weeks after commencement of treatment to monitor improvement and / or adjust the prescribed hours of occlusion. If acuity fails to improve by at least 4 letters each visit the occlusion dose should be increased i.e. from 2 to 4 to 6 hours.

  o Total treatment time is a factor of daily dose rate, but normally minimum of 6 months.

• Indications to accept visual acuity and cease treatment
  o Equal vision obtained or no significant inter ocular difference is present with reference to expected normal levels of acuity and IAD for age / test.

  o No significant improvement in the amblyopic eye when occlusion dosage increased after 2 consecutive visits with full compliance with treatment and no change in refraction and fundus exam.

  o Complaints of binocular diplopia.

  o Hypersensitivity to atropine or any component of the preparation. These may include:
i) **locally:** irritation, photophobia, transient stinging, hyperaemia, oedema, conjunctivitis, raised IOP.

ii) **systemically:** ataxia, restlessness, hallucinations, dry mouth, difficulty swallowing or talking, flushing and dry skin, irregular heartbeat, palpitations, urinary urgency and retention, constipation, confusion, nausea, vomiting, giddiness. Systemic effects are more likely with drops than ointment.  

  o If after every effort of parents/guardian/carer and medical staff attempts at occlusion therapy have achieved no improvement in acuity then, if agreed by all parties after discussion, occlusion attempts may be discontinued.
Section 4: References

32. Regulatory Medicines and Medical Devices (MHRA) Medicines Information: Product characteristics (SPC) and patient information leaflet (PIL) for Atropine Sulphate. [www.mhra.gov.uk/spc-pil/?prodName=Atropineeyedrops](http://www.mhra.gov.uk/spc-pil/?prodName=Atropineeyedrops)
Appendix I: Normative visual acuity data for test / age, Courtesy of S Shea and H Griffiths

When deciding the need for amblyopia therapy it is necessary to consider the normal visual acuity values and confidence limits, for the acuity test used. Normative visual acuity values and ranges are age dependant and, normative data will not directly translate from one test to another.

**Preferential Looking**
The pattern of development is shown below and should be used to determine if the acuity obtained is within normal limits for the child's age, ability and cooperation.\(^1\) Consideration of several studies suggested the average intra-observer reliability for preferential looking grating acuity to be 1 octave or better.\(^2,3\)

**Cardiff Cards**
Expected acuity values for Cardiff Cards\(^4,5\) are:

<table>
<thead>
<tr>
<th>Age</th>
<th>Binocular</th>
<th>Monocular</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 23 months</td>
<td>6/24 – 6/7.5</td>
<td>6/30 – 6/7.5</td>
</tr>
<tr>
<td>24 – 29 months</td>
<td>6/15 – 6/7.5</td>
<td>6/19 – 6/7.5</td>
</tr>
<tr>
<td>30 – 36 months</td>
<td>6/12 – 6/6</td>
<td>6/12 – 6/6</td>
</tr>
</tbody>
</table>
Kays Crowded logMAR Pictures
Range of normative (uncorrected) monocular acuity reported for Kays Crowded logMAR pictures:

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>Normal Range</th>
<th>significant IAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;4 years</td>
<td>0.100</td>
<td>0.100 - 0.200</td>
<td>≥0.150</td>
</tr>
<tr>
<td>3 – 4 years</td>
<td>0.108</td>
<td>0.096 – 0.120</td>
<td></td>
</tr>
<tr>
<td>4 – 5 years</td>
<td>-0.100</td>
<td>-0.100 to 0.100</td>
<td></td>
</tr>
</tbody>
</table>

A sub-normal acuity would be a one-scale increment (i.e. one picture value 0.025) or more above the upper limit of the normal range.

A study that compared acuity scores gained with Keeler Crowded logMAR and Kays Crowded Pictures reported that Kays gives a higher acuity value – mean difference 0.080 log units, mean age of subjects was 4.3 years (range 2.5 to 16 years).8

Keeler Crowded logMAR
Normative (uncorrected) monocular acuity data reported for Keeler Crowded logMAR:

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>Normal Range</th>
<th>Sub-normal acuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 years</td>
<td>0.200</td>
<td>0.020 – 0.375</td>
<td>≥0.400</td>
</tr>
<tr>
<td>4 years</td>
<td>0.140</td>
<td>-0.020 – 0.300</td>
<td>≥0.325</td>
</tr>
<tr>
<td>5 years</td>
<td>0.100</td>
<td>-0.100 – 0.300</td>
<td>≥0.325</td>
</tr>
</tbody>
</table>

A sub-normal acuity would be a one-scale increment (i.e. one letter value 0.025) or more above the upper limit of the normal range.

Keeler Crowded logMAR Inter-ocular Acuity Difference
Normative (uncorrected) inter-ocular acuity data reported for Keeler Crowded logMAR:

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>Normal Range</th>
<th>Significant IAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 years</td>
<td>0.030</td>
<td>-0.09 – 0.150</td>
<td>≥0.175</td>
</tr>
<tr>
<td>4 years</td>
<td>0.030</td>
<td>-0.05 – 0.110</td>
<td>≥0.150</td>
</tr>
<tr>
<td>5 years</td>
<td>0.040</td>
<td>-0.100 – 0.300</td>
<td>≥0.250</td>
</tr>
</tbody>
</table>
**Test - Retest Data**
Data reported on test-retest reliability to determine clinically significant change in acuity score:

<table>
<thead>
<tr>
<th>Test waved</th>
<th>Age</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kay pictures (screening population)(^7)</td>
<td>3 – 4 years</td>
<td>≥0.125</td>
</tr>
<tr>
<td>Keeler Crowded (screening population)(^{10})</td>
<td>5 years</td>
<td>≥0.225</td>
</tr>
<tr>
<td>Keeler Crowded (with refractive correction)(^{11})</td>
<td>5 years</td>
<td>≥0.125</td>
</tr>
</tbody>
</table>

**Sonkson logMAR test**
Normative data monocular data with percentiles for children aged between 2 and 8 years of age has been reported\(^{12}\)

**References**
Appendix II: Assessing Amblyopia in Pre-verbal children, courtesy of S Shea and H Griffiths

Assessment of acuity is by preferential looking or Cardiff acuity cards. However, preferential looking and Cardiff cards have limitations in the detection of amblyopia.\(^1,2\) When considering the presence or absence of amblyopia it is necessary to evaluate the nature of the clinical condition in conjunction with the acuity value obtained. This is because retinal, neural and optical defects have a differential effect on the acuity score.\(^1,3\) For example, a normal grating acuity but reduced recognition acuity may be obtained in a case of strabismus, whereas in anisometropia grating acuity and recognition acuity may be equally affected.\(^1\)

In cases of strabismus, fixation preference (FP) can help to determine the presence or likely absence of amblyopia.\(^4,5,6,7\) FP will identify those subjects at risk of amblyopia but it can over-estimate the incidence of amblyopia.\(^7\) Consequently a graded assessment of FP\(^4\) is advised as follows:

1. alternation or no switch following a blink.
2. fixation switch coincident with a blink.
3. fixation switch before a blink.
4. immediate fixation switch i.e. not holding fixation with deviating eye.

FP grade 1 is likely to accurately indicate the absence of amblyopia.\(^4\)
FP grade 4 is likely to accurately indicate the presence of amblyopia.\(^4\)
On the basis of data reported \(^4\) there is approximately a 50% chance that a subject with FP grade 2 or 3 would be erroneously diagnosed as amblyopic on the basis of FP alone.\(^1\) The relationship between alternate fixation and visual acuity is not evident in children older than 3 years; whilst equal acuity may be obtained with treatment it is unlikely that alternate fixation will also be gained.\(^8\)

In small angle deviations fixation preference and the 10\(^\circ\) vertical prism fixation test may aid in the detection of amblyopia.\(^6\)

In cases of anisometropia the presence and quality of BSV may provide additional information.
References
### Appendix III: Atropine Occlusion Checklist, Courtesy of J Hanley

*(Must be completed and filed in Patient Record prior to commencing Atropine TX)*

**Patient details:** (attach sticker)

Please ensure the following checklist is completed and filed in the patient record:

<table>
<thead>
<tr>
<th>Task</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documented fundus, media, disc</td>
<td></td>
</tr>
<tr>
<td>Refractive adaptation completed</td>
<td></td>
</tr>
<tr>
<td>Management options discussed with parent/guardian</td>
<td></td>
</tr>
<tr>
<td>Risks &amp; benefits of atropine discussed</td>
<td></td>
</tr>
<tr>
<td>Patient information leaflet provided</td>
<td></td>
</tr>
<tr>
<td>Greater than 3 years old</td>
<td></td>
</tr>
<tr>
<td>Crowded logMAR vision achieved</td>
<td></td>
</tr>
<tr>
<td>Near VA recorded</td>
<td></td>
</tr>
<tr>
<td>Not on antihistamines</td>
<td></td>
</tr>
<tr>
<td>Not on ADHD/ASD medication (including tricylics)</td>
<td></td>
</tr>
<tr>
<td>Not a poor attender</td>
<td></td>
</tr>
<tr>
<td>No ocular pathology other than amblyopia</td>
<td></td>
</tr>
<tr>
<td>No communication barrier</td>
<td></td>
</tr>
<tr>
<td>No cardiac problems (including children with Down's syndrome)</td>
<td></td>
</tr>
<tr>
<td>No glaucoma</td>
<td></td>
</tr>
<tr>
<td>Review appointment made</td>
<td></td>
</tr>
<tr>
<td>GP informed by letter re: commencement of atropine treatment</td>
<td></td>
</tr>
</tbody>
</table>

Orthoptist__________________________ Date__________________