CURRENT STRATEGIES FOR AMBLYOPIA MANAGEMENT: GLASSES, PATCHES, DROPS, AND BEYOND

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Disclosure Statement: Nothing to disclose

FUNCTIONAL AMBLYOPIA

- All structures are anatomically normal however visual acuity fails to develop normally due to an interruption in visual stimulation.
- Leading cause of vision loss in children.
- Visual acuity may be restored if identified early and treatment initiated.

RISK FACTORS FOR FUNCTIONAL AMBLYOPIA

- Exam must identify amblyogenic risk factors.
- Occlusion
  - Cataracts
  - Posis
  - Corneal opacity
  - Risk of severe amblyopia
  - Must be treated early.

- Uncorrected significant refractive error
  - Typically unilateral but may be bilateral.
PLAYING THE DETECTIVE

- Clues that this child might have functional amblyopia...
  - Look for amblyogenic factors
    - Strabismus
    - Occlusion
    - Anisometropia or bilateral high refractive error
  - Visual acuity
    - Optotype recognition VA may be obtainable as early as 2.5 years old
    - Not always easy or reliable in preschoolers

Clues from our exam...

- 2 year old male
- Full term delivery without complications
- Mother has no vision concerns
- Failed preschool vision screening

Clues from our exam...

<table>
<thead>
<tr>
<th>VA</th>
<th>20/180 OU Teller ??</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT @ distance</td>
<td>Ortho</td>
</tr>
<tr>
<td>CT @ near</td>
<td>Ortho</td>
</tr>
<tr>
<td>MEM</td>
<td>&gt;1.50 OU (high lag)</td>
</tr>
<tr>
<td>Pupils, EOM's, VF</td>
<td>Grossly normal</td>
</tr>
<tr>
<td>Anterior Seg</td>
<td>Normal, clear media</td>
</tr>
<tr>
<td>Posterior Seg</td>
<td>Normal</td>
</tr>
</tbody>
</table>

- Visual acuity—first clue about amblyopia
  - 20/180 OU by Teller (reliability?)
  - What tests are appropriate for measuring amblyopic VA?

Designing VA test for amblyopia

- Optotype Recognition
  - Preschool optotypes needed for young amblyopes
  - Optotypes would have similar shapes (look the same at threshold levels)
  - Optotypes would have uniform spacing and crowding
    - Amblyopes affected by crowding. Isolated optotypes will inflate the visual acuity. More accurate VA measures with crowded optotypes.
    - Spacing of the symbols should be within one optotype width of one another or have "crowding bars" within one optotype width to give truest measure of VA.

Visual acuity testing

- Teller Cards
  - Pediatric symbols
  - Optotype recognition
  - Uniform spacing/crowding (within one optotype)
  - Similar optotypes?
    - Detection test
    - Poor choice for amblyopic VA

  Our patient had 20/180 VA OU with Teller...
### Visual Acuity Testing

- **Lea Flip Book**
  - Pediatric symbols
  - Optotype recognition
  - Uniform spacing? (within one optotype)
  - Similar optotypes
    - Lea symbols all look the same at threshold

- **Lea Chart**
  - Pediatric symbols
  - Optotype recognition
  - Uniform spacing/crowding (within one optotype)
  - Similar optotypes
    - Lea symbols all look the same at threshold

- **Flip books with bars**
  - Pediatric symbols (use matching card)
  - Optotype recognition
  - Uniform spacing—crowding maintained by bars
  - Similar optotypes
    - Lea symbols and HOTV all look the same at threshold

- **Testing Guidelines**
  - Optotype recognition (not detection)
  - Uniform spacing with crowding
    - Nearest contours approx 1 optotype width
  - No isolated optotypes
  - Optotypes look the same at threshold
    - HOTV and Lea excellent choices for preschoolers
  - Lap card for matching increases testability of preschoolers

### Clues from Our Exam...

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<tr>
<td>Posterior Seg</td>
<td>Normal</td>
</tr>
<tr>
<td>Wet Ret</td>
<td>+7.25-1.50X90 OD</td>
</tr>
<tr>
<td></td>
<td>+8.00-0.75X90 DS</td>
</tr>
</tbody>
</table>

### Guidelines for Amblyogenic Refractive Error*

- **Anisometropic Refractive Error**
  - Hyperopia ≥ +1.50D
  - Astigmatism ≥ 2.00D
  - Myopia ≥ -2.00D

- **Symmetric Refractive Error**
  - Hyperopia ≥ +4.50D
  - Myopia ≥ -3.00D

*For children 3 and older, based on guidelines from Amblyopia Treatment Studies (PEDIG/NIH)
MEASURING REFRACTIVE ERROR

- Dry Ret
  - Static (distance) – control accomm?
  - Dynamic (near) - give info on near accomm accuracy
- Wet ret – standard of care for children

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage</th>
<th>Onset of action</th>
<th>Duration of action</th>
<th>Indication</th>
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<tbody>
<tr>
<td>Tropicamide</td>
<td>0.5% infants</td>
<td>15-30 mins</td>
<td>4-6 hours</td>
<td>Effective cyclo for myopes</td>
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<tr>
<td></td>
<td>1.0% &gt;12 mos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclopentolate</td>
<td>0.5% infants</td>
<td>15-30 mins</td>
<td>8-24 hours</td>
<td>Effective cyclo for most Rx</td>
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<tr>
<td></td>
<td>1.0% &gt;12 mos</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atropine</td>
<td>1%</td>
<td>3-6 hours</td>
<td>7-14 days</td>
<td>Suspect resistant hyperopia</td>
</tr>
</tbody>
</table>

MADISON

- 7 year old female
- Headaches after school and home work. Doesn't get headaches on weekends or vacation. Mom notices she holds reading material very close.
- She’s had glasses for a year and at most recent exam, OD suggested bifocals but parents not sure about this recommendation (felt like doc was hurried). – wants second opinion

Habitual Rx: +1.50 -3.25X178
+1.00 -2.50X169

VA (with hab rx) 20/25 OD, 20/40 OS

CT @ dist Ortho
CT @ near 4-6 XP
NPC (accom tgt) 2/4 cm
NPC (red lens) 4/12 cm
PFV @ near X/16/14
NPV @ near X/35/20
MEM <0.50 (stable)
Accom Amps 14D, 12D
NRA/PRA <2.25/-6.5077

Reduced uncorrected VA

Normal ocular health

To Whom It May Concern,

This letter will provide a summary of [patient’s name]'s recent findings for your review. [Explain the purpose of the letter, including the patient's recent examination or testing results, and any recommendations or conclusions drawn from the information provided.]

[Include any relevant medical terms or abbreviations used in the summary.]

[Reiterate the key points and findings from the recent examination or testing, focusing on the patient's current status and any changes from previous evaluations.]

[Conclude the letter by reiterating the importance of the patient's ongoing care and emphasizing the need for continued monitoring or follow-up.]

Sincerely,

[Signature]

[Professional title or credentials]

[Name]

[Contact information]

[Address]

[City, State, ZIP Code]
**Refraction Error**

<table>
<thead>
<tr>
<th></th>
<th>OD</th>
<th>OS</th>
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</thead>
<tbody>
<tr>
<td>Habitual Rx</td>
<td>+1.50-3.25X178</td>
<td>+1.00-2.50X169</td>
</tr>
<tr>
<td>Dry Subjective</td>
<td>+2.00-3.25X178</td>
<td>+1.25-2.50X169</td>
</tr>
<tr>
<td>Wet Auto</td>
<td>+3.25-5.00X180</td>
<td>+2.75-4.25X171</td>
</tr>
<tr>
<td>Wet Ret</td>
<td>+3.50-4.75X005</td>
<td>+3.75-4.50X171</td>
</tr>
<tr>
<td>Final Rx</td>
<td>+2.25-4.75X180</td>
<td>+2.00-4.50X171</td>
</tr>
</tbody>
</table>

RTC 5 weeks: No headaches since getting glasses!
VA 20/20 OD, OS

**Measuring Refractive Error**

- Cycloplegic retinoscopy is gold standard
- 1% cyclopentolate with 1% tropicamide for children greater than 12 months old
- 0.5% cyclopentolate with 0.5% tropicamide for infants up to 12 months of age
- Tropicamide 1% for myopes

**FOLLOW-UP**

- 2.5 years
  - VA 20/40 OD, OS, OU with HOTV
  - Good alignment, 250 sec stereo
- 4 years
  - VA 20/30 OD, OS, OU with HOTV

High bilateral refractive error with bilateral amblyopia requires good spec compliance and monitoring ref error!

**Refraction Error**

- Which of the following 3 year olds are at greatest risk of amblyopia?
  1. +3.00 OD, +3.25 OS
  2. +2.00 OD, plano OS
  3. -2.00 OD, -2.00 OS
  4. -1.50 OD, +1.00 OS
  5. +2.00-1.00X180 OU
  6. +1.00-3.50X180 OU
  7. -5.00 OD, -5.50 OS

**Henry**

- 3 year old male (Sept 2007)
- VA (HOTV) 20/80 OD and OS
- CT @ dist ortho
- CT @ near 2-3XP
- Wet Ret +3.75-3.50X013 OD
- +3.75-3.50X003 OS
- Rx (20 cut) +1.75-3.50X013
- +1.75-3.25X003

Now what?
**Henry**

<table>
<thead>
<tr>
<th>Date</th>
<th>HOTV VA</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/07 (baseline) 3y 5m</td>
<td>20/80 20/80</td>
<td>Aligned given full cyl rx with 205 cut</td>
</tr>
<tr>
<td>2/08</td>
<td>20/32 20/50</td>
<td>Poor compliance—stressed importance</td>
</tr>
<tr>
<td>4/08</td>
<td>20/50 20/40</td>
<td>Likes glasses now?</td>
</tr>
<tr>
<td>7/08</td>
<td>20/50 20/50</td>
<td>Rechecked wet ret and re-Rx (similar)</td>
</tr>
<tr>
<td>10/08</td>
<td>20/40 20/40</td>
<td>Good compliance</td>
</tr>
<tr>
<td>6/09</td>
<td>20/25 20/25</td>
<td>Full exam with wet ret</td>
</tr>
</tbody>
</table>

**Bridget**

- 5 year old. Failed school screening. No previous eye examinations (April 2013)
- VA 20/80 OD, 20/32 OS
- CT distance and near Ortho
- MEM +3.50 OD, +2.00 OS
- Stereo 500 sec (RDS)
- Dry Ret/Auto +3.75-3.25X019 +1.25-0.75X033
- Wet Ret +4.75-3.50X025 +2.75-1.00X167
- Rx (2D cut) +2.75-3.00X025 +0.75-0.75X167

- 2 month follow-up (4 months from baseline)
- VA (HOTV) 20/25 OD, 20/25 OS, 20/20 OU
- CT distance and near Ortho
- Hab Rx +2.75-3.00X025 +0.75-0.75X167
- Stereo 250 sec
- Routine follow-up—no amblyopia treatment

- Up to 25% of amblyopes will resolve with spectacles alone (bilateral AND unilateral amblyopia)
- Monitor VA every 4-6 weeks for resolution of amblyopia before initiating treatment (may go as long as 12-16 weeks)

**Malachi**

- 3 yo male—mother says he sits close to TV. No previous eye examinations, no eye turns. Born at 36 weeks, 5 lbs, 5 oz.
- VA (HOTV) 20/25 OD, 20/250 OS
- CT @ distance Ortho
- CT @ near 8° XP
- Stereo Nil
- MEM +1.25 OD, >4.00 OS
- Wet Ret and final Rx +0.50 -4.75-1.50X020
- Dx: Refractive amblyopia
- Tx: Full time Rx wear; RTC 2 months

**Malachi—Follow Up**

- 2 month follow-up
  - VA 20/25 OD, 20/160 OS
  - CT ortho at distance and near
  - MEM: plano OD, +0.50 OS
  - Hab Rx: +0.50 OD, -4.75-1.50X020 OS
  - What next?
    - Continue to follow q 4-6 weeks
    - Initiate amblyopia tx
### Amblyopia Treatment Options

#### Patching
- Patch non-amblyopic eye
- Provides stimulation to amblyopic eye

#### 1% Atropine
- Drop placed in non-amblyopic eye
- Parasympatholytic
  - Blocks accommodation
  - Mydriasis
- All near work must be done with amblyopic eye

### Patching vs Atropine

#### Patching
- **Advantages**
  - No systemic side effects
  - Limited duration each day
- **Disadvantages**
  - Compliance?
  - Obtrusive
  - Impaired binocular vision during tx

#### 1% Atropine
- **Advantages**
  - Good compliance if drop is instilled
  - Effect lasts for a week
  - Unobtrusive
  - Allows for some binocular vision
- **Disadvantages**
  - Potential systemic side effects
  - Light sensitivity

### 1% Atropine

- Parasympathetic blocking agent
- Potential systemic side effects—RARE (more common in trisomy 21)
  - Dryness (mouth, skin, throat)
  - Restlessness
  - Irritability
  - Delirium
  - Tachycardia
  - Flushed skin
  - Ataxia
  - Convulsions
  - Fever
  - Coma

*For sensitive patients, consider 1% homatropine*

### Questions...

- Which is better, atropine or patching?
- How much atropine?
- How much patching?
- Upper age limit to treat successfully?
- Additional near work beneficial?

### Amblyopia Treatment Studies (ATS)
- Organized by the Pediatric Eye Disease Investigator Group (1997)
- Supported by National Institutes of Health
- Network of MD’s and OD’s
- Large scale pediatric studies

### Which is better, atropine or patching?
- **ATS 1**
  - 419 kids
  - Age 3 to <7 years
  - Unilateral amblyopia (VA 20/40 to 20/100)
  - 215 given 6 hours of patching/day
  - 204 given 1 drop atropine daily
  - Outcome measure VA at 6 months
  - Successful with VA 20/30 or better or improvement of 3 lines or more from baseline
WHICH IS BETTER, ATROPINE OR PATCHING?

- Results
  - Patching group improved 3.16 lines from baseline (79% success)
  - Atropine group improved 2.84 lines from baseline (74% success)

- VA improvement was slightly faster in the patching group

HOW MUCH PATCHING?

- Severe Amblyopes: 20/100 to 20/400
  - 6 hours/day patching (n=85)
  - Full time patching (n=90)

- Moderate Amblyopes: 20/40 to 20/80
  - 2 hours/day patching (n=95)
  - 6 hours/day patching (n=94)

- Outcome measure: VA after 4 months of treatment

2 HOURS VS 6 HOURS PATCHING FOR MODERATE

- Baseline
- 5 Weeks
- 4 Months

- Severe Amblyopes: 20/32
- Moderate Amblyopes: 20/40

- 20/32
- 10/32
- 20/63
- 10/63

- 20/32
- 10/32
- 20/63
- 10/63

- 20/32
- 10/32
- 20/63
- 10/63

- Parent questionnaire showed both tx well tolerated but parents liked atropine slightly more

Answer: Both patching and atropine are effective treatments for amblyopia


- ATS 2A & B
- 175 kids with severe amblyopia
  - 3 to <7 years
  - VA 20/100-20/400
- 189 kids with moderate amblyopia
  - 3 to <7 years
  - VA 20/40 to 20/80

- 20/400
- 20/200
- 20/100
- 20/50
- 20/25

- Electronic Visual Acuity Tester
- Severe Amblyopes: 20/100 to 20/400
- Moderate Amblyopes: 20/40 to 20/80

- 20/63
- 20/63
- 20/63
- 20/63

- 20/40
- 20/40
- 20/40
- 20/40
**Patching Compliance**

- **2-Hour Patching Group**
  - Excellent: 58%
  - Good: 25%
  - Fair: 14%
  - Poor: 1%

- **6-Hour Patching Group**
  - Excellent: 37%
  - Good: 37%
  - Fair: 18%
  - Poor: 6%

**Full Time vs 6 Hours Patching for Severe**

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Six-Hour N=85</th>
<th>Full-Time N=90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>20/160</td>
<td>20/160</td>
</tr>
<tr>
<td>Five-Week</td>
<td>20/63-2</td>
<td>20/63-2</td>
</tr>
<tr>
<td>Four-Month</td>
<td>20/050</td>
<td>20/050</td>
</tr>
</tbody>
</table>

**Patching Compliance**

- **6-Hour Patching Group**
  - Excellent: 53%
  - Good: 35%
  - Fair: 6%
  - Poor: 6%

- **Full-Time Patching Group**
  - Excellent: 43%
  - Good: 43%
  - Fair: 15%
  - Poor: 15%

**How Much Patching?**

- **Severe Amblyopes**
  - 6 hours/day showed 4.8 lines of VA improvement
  - Full-time patching showed 4.7 lines of improvement
  - Compliance was better with 6 hr group
  - Improvement was better with younger group (<5)

- **Moderate Amblyopes**
  - Both the 2 hr/day and the 6 hr/day groups showed 2.4 lines of improvement in VA
  - Compliance was good with both groups
  - 62% of patients in both groups reached 20/32 or improved 3 lines from baseline

6 hrs/day = full time occlusion for severe amblyopia

6 hrs patching/day = 2 hrs/day for moderate amblyopia

**Patching Treatment**

- Begin all amblyopes with 2 hours of daily patching
  - Monitor vision every 6 weeks
  - If VA improving, continue patching
  - If VA stops improving
    - Consider ramping up to 6 hours/day patching
    - Consider switching to or adding atropine

- **Considerations for patching**
  - No depth perception while patched (stay off wheels)
  - Adhesive or soft (“patchworks”) patches
    - Adhesive excellent for preventing peeking
      - Available OTC at drug store
    - Soft patch good for adhesive sensitive patients
**Patching Treatment**

- ATS 4
  - 168 kids
    - 168 moderate amblyopes
  - 83 Daily Atropine
  - 85 weekend atropine

**How Much Atropine?**

- 168 kids
  - 3 to < 7 years old
  - VA 20/40 to 20/80

- 83—prescribed daily atropine 1% drops
- 85—prescribed weekend atropine 1% drops
- Outcome measure VA at 4 months

**How Much Atropine?**

- Both daily and weekend atropine showed 2.3 line improvement in VA
- Parents reported slight preference for daily atropine
- 2 patients had reverse amblyopia

**Atropine Compliance**

- Daily Atropine Group
  - Excellent: 68%
  - Good: 26%
  - Fair: 2%
  - Poor: 4%

- Weekend Atropine Group
  - Excellent: 68%
  - Good: 26%
  - Fair: 2%
  - Poor: 4%

**Adverse Effects**

- Light sensitivity (no treatment changes)
  - Daily group – 13 (16%)
  - Weekend group – 25 (29%)

- Facial flushing / fever
  - 2 patients in daily group – 1 stayed on treatment and 1 switched to homatropine

**1% Atropine Treatment**

- Weekend atropine just as effective as daily atropine for moderate amblyopia
- Prescribe atropine twice per week initially for all levels of amblyopia
- Monitor VA every 6 weeks
  - If VA improving, continue with atropine
  - If VA not improving, consider increasing to daily atropine and/or switching or adding patching

1% ATROPINE TREATMENT

- Considerations for atropine
  - Light sensitivity expected—recommend sun glasses and/or hat outside
  - May instill drop while child sleeping (he, he)
  - Give parent list of potential systemic side effects and have parent monitor child after first dose
  - May switch to homatropine for sensitive patients

Amblyopia Treatment Sequence

- Provide refractive correction
- Recheck VA every 6 weeks for improvement
- VA not improving: begin treatment
- VA improving: monitor q 6 weeks
- Amblyopia resolved: routine follow-up (25%)
- 1% atropine: 2x/week—monitor q 6 weeks
- Patching: 2 hours/day—monitor q 6 weeks
- VA not improving:
  *Ramp patching up to 6 hours/day
  *Ramp atropine to daily
  *Consider switching tx or combining
- VA improving: continue tx

MALACHI—FOLLOW UP

- 2 months later (April)
  - VA 20/20 OD, 20/25 OS
  - MEM +2.25 (atropine) OD, +0.50 DS
  - Hab Rx: +0.50 OD, -4.75 -1.50X020 OS
  - D/C Atropine, RTC 6-8 weeks

- 2 months later (June)
  - VA 20/15 OD, 20/25 DS
  - MEM +1.00 OD, plano OS
  - Wet Ret/Final Rx:
    - +0.50 OD
    - -3.75 -3.50X034
  - RTC 6-8 weeks

- 3 months later (Sept)
  - VA 20/15 OD, 20/20 OS
  - MEM +0.50 OD, +0.50 DS
  - RTC 3 months

MALACHI—FOLLOW UP

- 2 month follow-up (February)
  - VA 20/25 OD, 20/160 OS
  - CT ortho at distance and near
  - MEM: plano OD, +0.50 DS
  - Hab Rx: +0.50 OD, -4.75 +1.50X020 OS
  - What next?
    - Initiate amblyopia tx
    - Began 1% Atropine twice/week in OD
    - RTC 6-8 weeks for VA check

MALACHI—FOLLOW UP

- 6 yo wearing glasses for 6 months. Attempted patching but it “didn’t work”
  - VA w/hab (Lea symbols) 20/100 OD, 20/40 OS
  - CT @ dist and near 10%/CRET
  - MEM: +2.50 OD, +4.25 OS
  - Hab Rx: +5.75 -1.25X167, +2.50 -0.75X179
  - Wet Ret/Final Rx: +6.50 -0.75X180, +5.00 -0.50X176
  - OD cut by 0.75D, OS cut by 2.50D

Gave full plus
Brody

- 8 week follow-up
  - VA with new Rx: 20/50 OD, 20/32 OS (HOTV)
  - CT 8-10Δ CRET at distance and near
  - Dx: Refractive and strabismic amblyopia
  - Tx: mother opted for Atropine 2x/week
    - 2 weeks later mom called concerned about Brody playing baseball with one eye dilated, switched to patching 2 hours/day

Brody Summary

- 6 year old with strabismic and refractive amblyopia
  - Began with atropine 2x/week for 2 weeks
  - Switched to patching 2 hours/day for 4+ months
    - Showed some improvement but still 20/64
  - Switched to daily atropine for 12 weeks
    - VA stabilized at 20/40
  - Approximately 7-8 months of treatment
    - Still had residual amblyopia...why?

Why didn’t Brody’s amblyopia resolve?

- Maybe the atropine isn’t as effective in strabismics?
  - Studies have shown that atropine just as effective in strabs as aniso amblyopes
  - Patient does not have to alternate fixation to achieve results with atropine

- Was he too old? (he was 6 after all)
  - Studies of children 3-7 years of age showed no age effect with treatment

Amblyopia Treatment Sequence

- Provide refractive correction
  - Recheck VA every 6 weeks for improvement

- VA not improving
  - begin treatment
    - 1% atropine 2x/week
      - monitor q 6 weeks
- VA improving
  - monitor q 6 weeks
  - Patching 2 hours/day
  - monitor q 6 weeks

- Amblyopia resolved
  - routine follow-up (25%)
    - VA not improving
      - *Ramp patching up to 6 hours/day
      - *Ramp atropine to daily
      - *Consider switching tx or combining
    - VA improving — continue tx

How long to treat?

Up to 50% of all treated amblyopes will have residual amblyopia (VA 20/30 or worse)

Much research needed—more to come…
**How long to treat?**

- ATS 4 (weekend vs daily atropine in 3-7 yo)
  - Patients allowed to continue until VA stabilized
  - Average 20-26 weeks (approximately 6 months)
  - 4-6 months with good compliance

- ATS 5 (patching vs control in 3-7 yo)
  - Patients followed for up to 17 weeks still showing improvement in VA (nearly 4 months)

**How old is to old to treat amblyopia?**

- Younger group (7-12)
  - 53% Tx group had ↑ in VA
  - 25% of optical group had ↑ in VA

- Older group (13-17)
  - Overall, 25% of tx group and 23% of optical group had ↑ in VA (no difference)
  - No previous amblyopia tx
    - 47% tx group had ↑ in VA
    - 20% optical group had ↑ in VA
  - Previous amblyopia tx
    - 25% tx group had ↑ in VA
    - 23% optical group had ↑ in VA

**How frequently does the amblyopia recur?**

- ATS 2C
  - 156 kids (3 to 7 years) whose amblyopia had been successfully treated (3 logMar lines of improvement)
    - 77% had received patching
    - 23% had received atropine
    - Followed for 52 weeks to watch for recurrence

**Recurrence overall during 1-year follow-up**

- Recurrence (↓ 2 logMAR -Confirmed by repeat testing)
  - 21% (95% CI 14% to 28%)

- Alternative Definition - Non replicated 2 logMAR ↓ VA
  - All recurrences - 24% (95% CI 17% to 32%)
**Timing of the 35 recurrences**

- Nearly 70% occur in the first 15 weeks.

**Recurrence of amblyopia**

- 24% of cases had recurrent amblyopia
  - Equal chance with patching and atropine
  - Recurrence more common (42%) for those stopping intense level of patching (6-8 hours)
  - Recurrence less common (14%) for those who stopped tx at 2 hours of patching

  Taper patching to 2 hours/day before discontinuing treatment

**Does additional near work during patching help?**

- There was no statistical difference in the VA outcomes for either group.

Additional “unstructured” near activities while patching does not appear to provide any additional benefit

- More active or structured near activities have shown some promise...

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Patching vs Atropine

- **Patching Stopped (111 pts)**
  - 25% Recurrence (95% CI 17% to 34%)
- **Atropine Stopped (33 pts)**
  - 21% Recurrence (95% CI 7% to 35%)

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**Pediatric Eye Disease Investigator Group. Randomized trial of Near Versus Distance Activities While Patching for Amblyopia in Children Aged 3 to Less Than 7 years. Ophthalmol. 2008 Nov;115(11):2071-2078.**
10 subjects played MOH with sound eye patched for 40 hours (2 hour sessions)  
VA increased 1.6 logMAR (31.2% improvement)  

3 subjects played Sim City Societies for 40 hours and showed 1.5 lines of improvement  
These subjects then switched to MOH for 40 hours and showed a gain of another letter  


Control Group  
7 controls wore patch for 20 hours while doing “visually demanding” activities and found NO change in VA  
Then, 5 of the controls switched to video games for 40 hours and showed 1.7 lines of improvement  

Amblyopia Treatment Sequence  
Provide refractive correction  
Recheck VA every 6 weeks for improvement  

VA not improving  
begin treatment  
1% atropine 2x/week- monitor q 6 weeks  
Patching 2 hours/day- monitor q 6 weeks  
30 mins of video game play while patched?  
VA improving — continue tx  
*Expect treatment effect within 4-6 months  
*No need for additional near work  
*Upper age limit for success unknown  
*Taper treatment before d/c  

Amblyopia resolved  
routine follow-up (25%)  

Recovery in VA was 5 times faster with video games than would be expected by conventional occlusion  
It would take greater than 200 hours to obtain comparable results in children  
Authors speculate visual attention increases the ability to extract visual information  

Video Game Study Summary...  

Will a Bangerter Occlusion Foil perform as well as patching for the treatment of moderate amblyopia?  

Bangerter Occlusion Foils  

186 kids: 3 to <10 with VA 20/40 — 20/80  

89 kids: Bangerter full time on good eye  

97 kids: 2 hour of daily patching
Bangerter Foils were not shown to be as effective as patching, however the difference was very small. Bangerter foils are a reasonable option instead of patching.

WHERE HAS CURRENT TREATMENT FAILED?

- 15-50% of amblyopes fail to achieve normal visual acuity with best treatment
- At 10 year follow up after treatment, approximately 50% still have 2 or more lines of difference in VA and only 13.7% had 60 sec of arc or better stereo.

CURRENT TREATMENT STRATEGIES PENALIZE THE BETTER SEEING EYE TO ENCOURAGE RECOVERY OF VA IN AMBLYOPIE EYE:

- Assumes monocular condition
- Hess (and others) have shown evidence that the non-amblyopic eye cortically inhibits signals from amblyopic eye
- The primary condition is cortical and binocular
- Reduction in VA is secondary

TREATING AMBLYOPIA AS A BINOCULAR CONDITION: DICHOPTIC TRAINING

- Dichoptic gaming—both eyes open, each eye seeing different parts of target
  - Lower contrast stimulation to non-amblyopic
  - High contrast stimulation to amblyopic
  - Counteracts suppression providing equal inputs from each eye cortically
**Dichoptic Training**

- Contrast between each eye is adjusted with each game trial to keep ambyopic eye at threshold
- Five 1 hour sessions
- Study on 14 aniso and strabismic amblyopes (8.5 ± years) show sig (p=0.0001) improvement in VA (0.1 logMAR) and stereo vision

Knox, Simmons, Gray. IOVS. Dec 2011

**Dichoptic Training in Adults**

- 18 amblyopic adults
  - Tetris with goggles 1hr/day X 14 days (14 hours)
  - 9 played dichoptically
  - 9 played monocularly for 2 weeks and then crossed over to dichoptic training for 2 weeks

2 lines of improvement in VA
4X greater stereo w/Di

**IPOD Tetris**

- Hess et al devised iPod and iPad adaptations
  - Original version used lenticular prisms
  - More recent adaptations use R/G targets
    - Amblyopic eye contrast increased
    - Fellow eye contrast decreased

**IPOD Tetris and More...**

- Children assigned Red/Green dichoptic iPad games 4 hours/week for 4 weeks at a time
  - After 1st 4 weeks (16 hrs of iPad), mean VA improvement approximately 1.2 lines
  - Younger children (<7yo) had greatest improvement in VA (1.5 lines)
  - Only 3 of the 12 that completed a 2nd 4 weeks had additional improvement in VA

**Dichoptic Gaming for Amblyopia Treatment**

- Action, first person shooter (like) video games under development...
  - http://www.youtube.com/watch?v=71RML96XxC
  - Denis Levi and company

**Treatment Summary**

- Begin with refractive Rx first
  - Up to 25% will resolve with the Rx alone regardless of the type of amblyopia
  - Treatment with 2 hours of daily patching or 1 drop of 1% atropine 2x/week initially (may consider Bangerter)
  - May ramp up tx if VA not responding
  - Treatment may take 4-6 months
  - Up to 50% will have residual amblyopia (VA=20/30)
  - Taper patching and/or drops to minimum dosage before d/c treatment
  - Unstructured "near work" not helpful but video games might be!
Amblyopia Treatment Sequence

Provide refractive correction
Recheck VA every 6 weeks for improvement

- VA not improving, begin treatment
  - 1% atropine 2x/week, monitor q 6 weeks
  - Patching 2 hours/day, monitor q 6 weeks
  - VA improving — continue tx
    - Expect treatment effect within 4-6 months
    - No need for additional near work
    - Upper age limit for success unknown
    - Taper treatment before d/c
  - VA not improving — ramp patching up to 6 hours/day
    - Ramp atropine to daily
    - Consider switching tx or combining

- VA improving, monitor q 6 weeks
- Amblyopia resolved, routine follow-up (25%)
- VA not improving — begin treatment
  - 1% atropine 2x/week, monitor q 6 weeks
  - Patching 2 hours/day, monitor q 6 weeks
  - VA improving — continue tx
  - VA not improving — ramp patching up to 6 hours/day
    - Ramp atropine to daily
    - Consider switching tx or combining

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