Advanced Amblyopia Treatment for Primary Care Optometrists

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Disclosure of Conflict of Interest

- Carol Scott OD, FCOVD
- For COPE approval the presenter must identify the presence or absence of relevant financial relationships and or commercial interest that could affect the content of the educational material.
- I have no relevant financial relationships and or commercial interest.
- Title: Advanced Amblyopia Treatment for Primary Care Optometrists

Paradigms of Treatment

Traditional Amblyopia Definition

- Amblyopia is a decrease in visual acuity, usually in one eye.
- It persists after the correction of the refractive error or removal of pathological obstacle to vision and no organic cause can normally be found.
- The general estimate and prevalence of amblyopia is around 3.5%
- This developmental anomaly is mainly monocular and caused by either misalignment of the eyes (strabismus), a refractive error (anisometropia) or a form of deprivation.

Paradigms of Treatment

- National Institutes of Health (NIH)
National Institutes of Health - NIH

- **Treatment**
  - Patching, surgery, and glasses

- **Prognosis**
  - Treated before 5 usually will recover almost completely, although may have problems with depth perception
  - Delaying treatment can result in permanent vision problems.
  - “After age 10, only partial recovery of vision can be expected.”

> “After age 10, only partial recovery of vision can be expected.”


- “No compelling evidence that treatment is beneficial clinically for older (over age 10) children with amblyopia”


- Full ophthalmic correction (refractive amblyopia)
  - Wait for 2-3 months
  - RTO, if amblyopia persists begin occlusion

- Occlusion Therapy
  - Dosage protocols
    - Full time patching
    - Part time patching
    - Monitor periodically

The standard treatment paradigm

A Closer Look at Occlusion Therapy

- **Occlusion methodology**
  - Direct complete occlusion
    - Variety of eye-patch examples
  - Partial Occlusion
    - Optical defocus
    - Bangerter foils – graded occlusion (ATS-10)
    - Medicated Occlusion – Atropine (ATS-1, ATS-4, ATS-8, ATS-9)
Evolving paradigms expand "sensitive" period and decrease dosing

- PEDIG ATS-2A, 2B found duration of occlusion could be reduced to 2-6 hours per day with equal or better outcomes compared to constant occlusion
- PEDIG ATS-3 research found some improvements up to age 17
- PEDIG ATS-5 found occlusion therapy plus visual motor activities to be better
  - Patching and atropine

Emily

“...I just didn’t know what good vision was like…”

Amblyopia’s impact on quality of life: a systematic review

- In 2010 a systematic review of 1,876 papers on Amblyopia and filtered out duplicates to 632 acceptable articles
- The best 35 articles were selected based on strict scientific criteria with an emphasis on Quality of Life Assessment measures

Impact on Family Life

- Standard amblyopia treatment resulted in:
  - Increased stress and anxiety for the parent
  - Negatively impacted care giver-child relationships
  - Other relationships within family also affected
  - Siblings teased or bullied the child in treatment
  - The increase in parent attention associated with the treatment

Activities

- Frequently reported implications were the impact of amblyopia on career choice and educational attainment
  - Immediate impact on school activities during standard treatment (occlusion while at school)
  - Long term impact on adult hood
- Impact on daily living activities was well documented
Feelings and behavior

- Feelings of low self-esteem and negative self-image commonly reported due to amblyopia alone or due to its treatment
- Depression
- Frustration
- Embarrassment

Recognized limitations to occlusion therapy

- Acuity improves but will often regress when patching is discontinued — 54% (age 3-7), 80% (age 9-12) with residual amblyopia (≥20/32)*

*PEDIG ATS Background and summary

Recognized limitations to occlusion therapy

- Patient usually maintains binocular suppression
- Patient often remains “stereopsis deficient” or “stereo blind”

*PEDIG ATS Background and summary

Recognized Risk factors associated with Occlusion Therapy

- Psycho-social
  - Bullying, teasing
- Emotional
  - Frustration
  - Anger
  - General unhappiness
- Danger in playing sports, crossing streets, riding bicycle, operating motorized vehicles or machinery
- Difficulty functioning in classroom or other activities in daily living

Recognized pitfalls to occlusion therapy

- Poor compliance
- Patient drops out of treatment
- Poor results

Lazy eye

What other health care condition associates “lazy” with the disease? Good eye vs Bad eye
Penalize (“to punish”) the “good eye”, coined in by J.B. Weiss in 1968 referring to atropinization
Has this reference of judgment factored into the way doctors and the public have viewed this serious visual disorder?
Amblyopia Dogma

• If acuity is not improving patch longer
• A patient must try harder

Amblyopia Apathy

• You’ve got one good eye... protect it, sorry!
• Can’t help it if your child won’t comply with wearing a patch, sorry!
• After age 10 not much else we can do, sorry!
• It’s just the nature of lazy eye even after patching it can get lazy again, sorry!

Amblyopia fact or myth?

1. Is Amblyopia treatable only if caught before age 10?
2. Is Amblyopia a disorder that creates a monocular architecture in the brain preventing the capacity for binocular vision?
3. Is the only way to effectively treat Amblyopia by occlusion or atropine of the non-amblyopic eye?

Looking at the new research

• Amblyopia’s true impact on the visual brain – Visual processes
• Amblyopia’s true impact on the life of the person – Reading, real world visual motor tasks
• The emerging advanced treatment paradigm – The comparative speed of treatment – The absence of negative side effects – The sustainability of treatment

• Convincing evidence of abnormalities in structure and function within the “vision-for-perception” and “vision-for-action” cortex of people with amblyopia

Impaired visual decision-making in individuals with amblyopia

Faraz Farzin 1 and Anthony M. Norcia 2

Abstract
This book examines the effects of amblyopia on perceptual decision-making processes in accordance to the Necker cube paradigm. The Necker cube is a two-dimensional representation of a three-dimensional object that can be perceived in different ways depending on the observer's perspective. In this study, participants were asked to decide whether a virtual object was above or below a horizontal line. The results showed that participants with amblyopia had a slower reaction time and a higher error rate compared to participants without amblyopia. This is consistent with previous findings and supports the hypothesis that amblyopia impairs perceptual decision-making processes.

Where

What
Amblyopia and Real-world Visuomotor Tasks

S. Grant, MJ Moseley. Strabismus, 2011; 19(3) 119-129

Research review of eye-hand coordination, walking, driving, and reading skills of children and adults with amblyopia

- Amblyopes show a range of visuomotor impairments with the affected eye alone, but also in the binocular mode the amblyope is also slower and less accurate than normally sighted individuals.

Eye-hand Coordination

- Amblyopic individuals, children and adults have significant deficits in movement, speed and accuracy.
- Those who completed occlusion therapy in childhood with normalized “cured” VA in their amblyopic eye but have reduced stereo acuity (100-3000 arc secs) had significantly more spatial errors and eye-hand coordination vs controls.

Amblyopia and Reading

- Deficits in micro eye movements contribute to reduced reading speed associated with central or total suppression of the amblyopic eye compared to the normal control subjects.
- These deficiencies were apparent even when monocular testing with the non-amblyopic eye compared to the non-amblyopic controls.

Final Conclusion

- A highly consistent finding is that children and adults with no clinically measureable stereoacuity exhibit the least accomplished real-world visuomotor skills.

Amblyopia’s impact on vision...more than acuity

- Dysfunction contrast sensitivity
- Dysfunction binocular vision and stereopsis
- Dysfunction in accommodation
- Dysfunction in fixation
- Dysfunction in vergence
- Dysfunction visual information processing/reading
- Dysfunction visual motor integration

*ATS-18 Background and summary

PEDIG
Why?
Given that occlusion therapy has a track record of:
• poor outcomes
• poor compliance
• significant risk factors for “side–effects”

Why is there not an outcry for something better?

Is there a critical period for the treatment for Amblyopia?

Perceptual learning in Vision Research
D. Sagi, Vision Research 51 (2011) 1552–1566

• Long-term sensitivity – improvement with visual tasks as a result of perceptual learning found in adults.
• Neural plasticity is retained at an adult age, allowing flexibility in acquiring new visual skills when the need arises.

What is Perceptual Learning in vision research?
• Visually stimulating and challenging activities usually in a computer based game.
• Often consist of:
  – Vernier acuity activities
  – Contrast sensitivity activities
  – Letter identification
  – Spatial frequency
  – Grating acuity
  – Motion coherence

Looking for answers
Dennis Levi, OD, PhD
Robert F. Hess, PhD, DSc
Eileen E Birch, PhD.
Jonathan M. Holmes, M.D.
Vivian Manh, O.D., M.S.

Gaming the adult amblyopic brain?
Subjects: Amblyopes ages 18-58
• Play Medal of Honor: Pacific Assault with fellow eye patched
• Acuity measured every 10 hours for 40 hours
• All amblyopes improved
• VA improvements from 13-44%
• 2 mild amblyopes improved to 20/20

Dennis M. Levi, Optometry and Vision Science, Vol. 89, No. 6, June 2012
Perceptual Learning plus occlusion yields a faster result by a factor of 8 in children 6-8 yrs old. Perceptual learning improves response to treatment time - Levi

Robert Hess, PhD
- “Current evidence indicates that suppression plays a primary role in both the binocular and monocular deficits”
- “Thus, treatment for the binocular problem involving suppression should be in the beginning of treatment process”
- “It appears that the real enemy in amblyopia is suppression”

Robert F. Hess, PhD
- Director of Vision Research, Department of Ophthalmology
- McGill University, Canada
- “For many years these deficits were interpreted within a framework assuming that amblyopes are anatomically monocular and lacked any functional binocularity”
- “Recent findings have provided strong evidence that amblyopes actually have an intact binocular infrastructure including binocular processes, even in the adult amblyope, however what appears to have been lost is only a sign of suppression under binocular viewing conditions”

Robert F. Hess, PhD
- Director of Vision Research, Department of Ophthalmology
- McGill University, Canada
- “It has also recently been shown that binocular functions can be restored in adults with amblyopia dichoptic training aimed at getting the two eyes to work together, suggesting that the binocular visual system also retains a considerable degree of plasticity even in adulthood.”

Eileen E Birch, PhD
- Director, Crystal Charity Ball Pediatric Vision Evaluation Center
- “The usual treatment is to wear a patch over the “strong” eye, "to force the use of the amblyopic or weak eye
- "That does work, but there’s been some research lately (suggesting) that’s not really the right approach,
- “The condition often recurs after patching.
- “The treatment for amblyopia should also teach both eyes to work together....

Example of iPad Anaglyph Tetris
Results of binocular iPad Study on Preschool Children

- Best results with >8 hrs in 4 weeks with binocular iPad therapy
  - 1 line improvement
  - Patching 2 hrs per day plus iPad binocular game, same outcome. Thus patching did not help!
- No change with:
  - Occlusion Therapy only
  - <4hrs in 4 weeks with binocular iPad
  - Sham therapy
  - No therapy

Binocular Treatment with iPad study

- Repeated binocular iPad game play significantly improved visual acuity in amblyopic children
- Visual acuity improvement occurred rapidly, and is stable for at least 3 months following the cessation of treatment.
- In addition to the efficacy and durability of this binocular iPad treatment, it is fun and engaging and results in better compliance than patching, at the same time imposes little risk for adverse psychosocial effects.

Recent PEDIG Amblyopia Treatment Study (ATS-18)

Study Objectives -
- To compare the effectiveness of iPad binocular game play -1 hour/day
- versus Occlusion therapy - 2 hours/day
- in children ages 5-13 and 13-17
- Sample size 5 to <13 = 346, 13 to <17 = 166

- iPad Binocular Computer Game Treatment Group
  - iPad Hess Falling Blocks game (Anaglyph Tetris)
  - 1 hour per day x 7 days per week
- Patching Group
  - 2 hours per day x 7 days per week
  - Monitored over 16 weeks, q 4 weeks

- Coordinating Center – Jaeb Center for Health Research, Tampa Florida
- Protocol Chairs
  - Vivian Mann, O.D., M.S., UW Medicine Dept of Ophthalmology, Seattle Children’s Hospital
  - Jonathan M. Holmes, M.D., Department of Ophthalmology, Mayo Clinic
• Completed. Could not show any difference between patching 2 hrs and playing Tetris. Poor compliance from the patients affected the results since only 22% completed at least 75% of the treatment.

The problem with compliance seemed to be due to the fact that the patients got bored with the falling blocks game and stopped playing it. New study ATS-19 has started and is now using a game called Dig Rush that will be more fun and involves digging for gold and has 22 levels to keep kids engaged.

Since occlusion therapy typically
• Has limited results in acuity
• No improvement in binocular vision
• Psychosocial, emotional problems and negative factors
• How might we reduce or eliminate the need to rely on occlusion therapy and have a more effective treatment of amblyopia?
  – Including deficits in VIP and VMI?

Begin with Evaluation
• -Standard Snellen VA (Distance & Near)
  – Single Row
  – Single letter
• Contrast Sensitivity

Refraction
• - Retinoscopy
• -Subjective Refraction
**Binocular Vision**
- Binocular posture and alignment (9 cardinal positions)
  * Cover test
  * Maddox rod

- Sensory fusion
  * 1st degree: Simultaneous perception
    * Worth 4-Dot, etc.
  * 2nd degree: Flat Fusion
    * Worth 4-Dot, etc.
  * 3rd degree: Stereopsis
    * Distance and Near

**Accommodation**
- Mono Donders pushup
- Mono PRA (document VA target used)
- Mono NRA (document VA target used)
- +/-2.00 flipper (document VA target used)
- MEM - Dynamic Retinoscopy

**Expanded Assessment**
- Micro eye movements
  * KD (or DEM) Saccadic Eye Movement Test
    * Amblyopic eye vs Non-amblyopic eye

**Prescribe lenses**
- Least plus for maximum acuity with judicious balancing to minimize effect of aniseikonia and consider contacts and/or bifocals when appropriate
**Expanded Assessment**

- **VIP - Amblyopic eye only**
  - TVPS :VD, VC, VSR, VM, VSM, VFG
  - Jordan Left Right Reversal Test

**Visual Motor Integration**

- **Beery VMI - Amblyopic eye only**

**Diagnosis...Treatment Plan**

- Diagnosis influences duration
- Age is NOT a barrier!
- Prescribed Treatment
  - Office based
  - Home support

**Treatment: Phase 1**

*Anti-suppression, early binocular vision development*

- MFBF with VMI on SVI or WSF or with younger children use creative game applications of filters – plus detail recognition
- Anti-suppression eg. TBI lights, Eyetronix, etc
- Aggressive large peripheral stereopsis stimulation in video gaming mode at every session, eg. VTS-4, Vivid Vision, minimum 15-30 minutes/session

**The newest Office-based VT Tools**

- Tuan Tran, O.D.,
  Chief Optometric Consultant

**Treatment Phase 2**

*Routine general skill development*

- Accommodative stimulation (mono, bi-ocular, binocular) – plus detail
- Binocular ranges of fusion
- Oculo-motor development
- Beginning levels on VIP
Phase 3 -
Advanced VIP development in Amblyopic eye vs fellow eye...equate
• Advanced Visual information processing in all VIP areas monocular (using Bangerter foil, defuser on fellow eye) – plus detail recognition
• Visual Closure, Visual Spatial, Visual Figure Ground, Tachistoscopic, – plus detail recognition
• Visual motor integration – plus detail recognition

Monitoring weekly progress:
Weekly
• --Visual Acuity: Snellen (SR, SL) Distance
• --Suppression Zone: Distance and near – Worth 4 Dot Large, medium, small (VTS4)
• --Ranges of Fusion in VT activity
  – eg: Dog/Ring (VTS-4), Quoit Ring (vecto)
• -- Stereopsis: Distance and near Wirt, and near RDS

Monitor Monthly (q 8-10 visits)
• Visual Acuity – Snellen (SR, SL) Distance & Near
• CSF at near in amblyopic eye
• Dry Refraction with BVA
• Standard Binocular evaluation: von Graeffe phoria, Ranges of Fusion: distance and near, Suppression check, Stereopsis: distance and near
• Accommodation: PRA, NRA, +/- 2.00 with acuity suppression (Vecto #9)
• K.D. Amblyopic eye vs both eyes
• All relevant VIP testing (Amblyopic Eye vs non-amblyopic eye)

Home: Minimum 5 hours per week
(monitor dosing carefully)
• Home Amblyopia.iNet
• Home iPad Amblyopia Tetris Blocks
• Home 3D Minecraft or something similar
  if available
• Home 3D movies
• PTS-2 - (Phase 3)
• Monitor home dosing of MFBF and time on video games
• Use a Diffuser (Bangerter foil) only for occlusion (monocular activities)

Goal for each patient
• To attain maximum VA, Stereopsis, Visual information processing and visual motor integration woven into their own Transfer Package.
• VA goal 20/25 or better
• Stereopsis 60° or better at far and near
• VIP abilities including reading fluency (oral reading and TOSWRF) at or above age and grade level
• KD saccades at or above age level
• VMI at or above age level.

The standard occlusion treatment model
• Acuity improves but will often regress when patching is discontinued
• Treatment discouraged past age 10
• Patient often experiences emotional and psychosocial trauma with standard patching
• Patient at risk of accidents while patched
• Patient maintains binocular suppression after treatment
• Patient remains “stereo-blind”
The Advanced Treatment Paradigm

**Age is not a barrier to treatment**
- Occlusion dosage reduced to only a few minutes a day, if at all
- Patients are not at risk of being emotionally traumatized
- Patients at no greater risk of injury
- The patient will have a more enjoyable experience in treatment, thus improved compliance
- Binocular suppression is eliminated
- The potential for stereopsis is gained

**Amblyopia Hope**
- If Amblyopia is truly a serious disease of the visual system...
  - If the research is clear - two eyes are better than one in the treatment of amblyopia...
  - How might we facilitate change throughout optometry and ophthalmology acceptance of the advanced treatment paradigm?

**How might we?**
- Provide Doctors with facts
  - Amblyopia Research Portal
  - Binocular Models of Treatment for Amblyopia
- Provide Patients Hope
  - Facts
  - Stories and Videos
- Provide primary eye care doctors support
  - Active collaboration VT ODs showing how the primary care ophthalmic community can implement binocular treatment as first response
Phase 1 - Advanced Amblyopia Model for Primary Care Optometrists

- Begin with judicious prescription of lenses as needed
- 2-4 week adjustment to lenses instead of 2-3 month adjustment

Phase 1 - Advanced Amblyopia Model for Primary Care Optometrists

- Return to office -progress eval (92012) and Sensory motor exam(92060):
  - Establish baseline VA, distance and near
  - Measure suppression with Worth 4-Dot, distance and near
  - Measure stereo acuity

Phase 1 - Advanced Amblyopia Model for Primary Care Optometrists

- Begin Binocular treatment immediately after adaptation to Rx

Phase 1 - Advanced Amblyopia Model for Primary Care Optometrists

- Prescribe Binocular activity in computer based modality
  - Anaglyph (TV-Trainer) MFBF video gaming
    - 1 hour per day 6 days per week (and/or)

- Advanced amblyopia home computer programs treatment programs in MFBF mode (and/or)

- Anaglyph Binocular iPad-type games (and/or)
  - 1 hour per day 6 days per week
3D pictures and movies as much as possible

Amblyopia Games

Many “lazy eye” games, 3D videos, 3D games are available online. YouTube has several 3D videos.
Google “lazy eye” games, 3D games to find many choices.
There are games for all ages to enjoy using filters.

Phase 1 - Advanced Amblyopia Model for Primary Care Optometrists

Monitor q 4 weeks x 3 months
Past-patient exam and sensory motor exam
• Plus repeat refraction as needed
• Target >20/25, no suppression, RD Stereo acuity 20”

Phase 2 - For those with residual amblyopia

• Begin occlusion therapy (recommend graded occlusion)
OR
• Refer for Office-Based Optometric Vision Therapy
  — Intensive
  — Concentrated binocular vision development
  — Targeted
    • Visual information processing
    • Oculomotor
    • Visual-motor integration
    • Visual acuity development in a binocular field

‘HOW’ IS NOT JUST A QUESTION

VISIONHELP AMBLYOPIA PROJECT

How

IS THE ANSWER
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Thank you!

• And thanks to Dr. Dan Fortenbacher for his help and who is Emily’s doctor.
• Emily’s story on youtube at wow vision therapy amblyopia.