Advanced Strabismus and Amblyopia Diagnosis and Treatment
Drs. Christine Allison, Kelly Frantz, Mitchell Scheiman, David Cook

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Disclosure Statement:
Nothing to disclose
Amblyopia

• Amblyopia, also referred to by the public as "lazy eye", is a unilateral or infrequently bilateral condition in which the best corrected visual acuity is poorer than 20/20 in the absence of any obvious structural anomalies or ocular disease.

• Amblyopia is the most common cause of monocular visual impairment in children.

• Prevalence 1-4% in children world-wide

Types of Amblyopia

- **Refractive Types:**
  - Anisometropic
  - Isoametropic
- **Strabismic**
  - Exotropic
  - Esotropic
- **Form deprivation**
  - Congenital cataracts
Refractive Amblyopia

- **Anisometropic**
  - Difference between the two eyes of at least 1.00 D
  - More anisometropia, the greater the amblyopia
  - Myopia > 3.00
  - Hyperopia > 1.00
  - Astigmatism > 1.50

- **Isoametropic**
  - High, uncorrected bilateral refractive error
  - Myopia > 8.00
  - Hyperopia > 5.00
  - Astigmatism > 2.50
Diagnosis of Amblyopia

• Thorough Case History
• Visual Acuity- distance and near
• Refractive Error
• Eye Posture
• Stereopsis Testing
• Eccentric Fixation
• Dilated Fundus Exam
Visual Acuity

• Different types of charts
  – Single letter vs single line
  – S-chart

• Crowding Bars

• Distance and Near VA should match!
Refractive Error

- Retinoscopy – Not Autorefraction
- Cycloplegia
- Keratometry/Topography
Optimum refractive correction

• Full (cycloplegic) correction may be appropriate
  – Full-time wear important
  – Sports goggles

• If plus must be cut, do so equally OU
  – Generally cut by no more than 1.50 D.

• Consider CLs for >2-3 D anisometropia

• Follow up regularly
Eye Posture

• Cover Test
  – Be sure to control fixation

• Hirshberg/Kappa
• Krimsky
Stereo testing

• Do it First if you suspect any strabismus!
• Random Dot better than lateral disparity
• Distance Stereo Testing
• Near Stereo Testing
• Worth 4 Dot
Eccentric Fixation

• a unilateral condition in which some part of the retina other than the fovea is used for fixation, but the fovea retains it’s normal straight ahead projection.
Ways to Test EF

• Haidinger’s Brush

![Haidinger’s Brush Diagram]

Figure 8.24  Pointing task with Haidinger brush. Patient is instructed to align the pointe (P) with the Haidinger brush (HB) superimposed on the fixation point (F). (A) Central fixator with brush, pointer, and fixation point all aligned. (B) Eccentric fixator with the primary visual direction at the eccentric point. HB, which represents the lovesa, is not superimposed with the fixation point, which represents the eccentric fixation point. (C) Scenario that may occur midtherapy during the process of disrupting the eccentric fixation. P and HB are aligned and appear to be straight ahead to the patient; however, fixation is still eccentric.
Visuoscopy technique

- Insure patient understands task
- Occlude eye not being tested!
- Dim the direct ophthalmoscope light – insure patient can see target
- Hold grid with straight lines at 90° and 1
- Evaluate steadiness as well as magnitude and direction
- Confirm by moving target slightly; ask patient to refixate
- Estimate VA: MAR = EF (in ∆) + 1

2.5∆ superior and 2.5∆ nasal EF OS
Microstrabismus characteristics

- Strabismus of up to $10^\Delta$ (constant)
- ET most common
- Primary or post-surgical
- Amblyopia in strabismic eye
- Reduced stereopsis
- Central suppression
- Anomalous correspondence (AC), typically harmonious type
- Eccentric fixation common

Amblyopia Treatment

- Correct Refractive Error
- Occlusion Therapy
- Atropine Therapy
- Treatment of EF
- Vision Therapy- encourage binocularity
Results with refractive correction alone

- **Bilateral refractive amblyopia**
  - 74% of children (ages 3-<10) reached ≥20/25 within 1 year
    (PEDIG, Am J Ophthalmol, 2007; 144:487-96)

- **Anisometropic amblyopia**
  - 27% of cases (ages 3-<7) resolved (w/in 1 line)
  - Much better success when initial VA >20/100
  - Mean improvement ~3 logMAR lines (took up to 30 weeks)
    (PEDIG, Ophthalmology 2006;113:895-903)

- **Strabismic amblyopia**
  - 32% of cases (ages 3-<7) resolved (w/in 1 line)
  - Mean improvement ~3 logMAR lines
    (PEDIG, Ophthalmology 2012; 119:150-158)

Most (>90%) achieved best VA by 18 weeks
(Ophthalmology 2012;119:150-158)
Types of Corrective Lenses

• Single Vision- full-time wear
• Bifocals
  – Esotropic Amblyopes
  – Set seg higher
• Contact Lenses
  – When cosmesis is an issue
  – Good for slowly increasing refractive error
  – Anisometropia
• Prism
  – May use to help decrease size of strabismus
  – Correcting hypertropia is important
Types of Occlusion

- Patching
  - Direct patching
  - Indirect patching?
- Bangerter Filters
- Contact Lenses- Occlusion CL’s
Results with direct occlusion

- 2 hours/day – initial VA 20/40-20/80
  - 62% of children (ages 3-7) improved to >20/32 or >3 lines within 4 months
  - Mean improvement 2.4 lines in 4 months
    (PEDIG, Arch Ophthalmol 2003; 121:603-11)

- 6 hours/day – initial VA 20/100-20/400
  - Mean improvement 4.8 lines in 4 months
    (PEDIG, Ophthalmology 2003; 110:2075-87)

- Taper the patching
Does Age Matter?

- Amblyopic eye vision improves with optical correction alone in about ¼ of 7 to <18 year olds.

- In 7 to < 13 year olds, additional improvement is seen with patching/atropine regardless of whether amblyopia was previously treated.

- In 13 to <18 year olds, additional improvement may occur with patching if amblyopia was not previously treated, but may not occur if previously treated.
Bangerter filters

Subjects: children ages 3-9 with 20/40 to 20/80 amblyopic VA
  – Bangerter group (full-time): 38% gained >3 lines in 24 weeks
  – Patching group (2-6 hr./day): 35% gained >3 lines in 24 weeks
    (PEDIG, *Ophthalmology* 2010; 117:998-1004)

Filters reduce suppression and promote binocular vision in amblyopic patients with aligned eyes
  (Chen et al., *IOVS* 2015; 56:139-149)
Atropine Treatment

- Patient/parent selection
  - Minimal stinging
  - Cheaper than stick on patches
  - Preferable to have moderate to high hyperopia versus myopia, with adequate VA in amblyopic eye

- Daily vs Weekend
  - 1% atropine in non-amblyopic eye
  - Compliance may be better with daily
What about Ipad Games?

• Thus far, patching groups have done better in studies, but POOR COMPLIANCE has been an issue.

• More interesting games may lead to better compliance

• Study with Adults showed improved VA, stereo, CSF, and reading speed in video game group \(\text{(Vedamurthy et al., Vis Res 2015)}\)
Reverse Patching?

• Some studies in China suggest,
• Patching strengthens the patched eye, thus
• Longer lasting effect
• Leading to better binocularity?
  – Inverse Occlusion, A Binocularly Motivated Treatment for Amblyopia Zhou, et al

• Helpful for patients with EF
Treatment of EF

- Haidinger’s Brush
- Fast-Pointing Techniques
- After-image transfer for foveal tagging
- Anti-suppression therapy
Haidinger’s brushes (MITT) for EF treatment
Fast pointing for EF treatment

- Quickly move hand to target without watching hand
- Encourages foveal fixation
  - Can perform with MITT
  - Quickly insert pegs into pegboard
  - Insert stick or pipe cleaner into straw
  - Can spear food (then eat!)
  - Dot center of circles on paper with marker
    - Make them progressively smaller
    - Make it a game to engage interest
After-Image Transfer
Vision Therapy

• Encourage Binocularity of both eyes

• Anti-suppression Techniques
  – Monocular in a Binocular Field
  – TV Trainer, Red lens coloring, MFBF Game, Cheiroscopic tracing, red/green anti-suppression charts
Summary

• Determine type of amblyopia

• Treatment- refractive error correction, occlusion therapy, vision therapy

• Improvement is possible at any age!

• New Therapy options are still to come!
Thank you!!

• callison@ico.edu
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Disclosure Statement:
Nothing to disclose
Objectives

- Review anomalous correspondence types
- Explain sensory status tests and interpretation
  - Worth 4-dot
  - Bagolini striated lens test
  - Red lens test of correspondence
  - Hering-Bielschowsky afterimage test
  - Major amblyoscope (Synoptophore)
Status of correspondence

- Normal correspondence (NC) – both foveas linked to same visual direction
- Anomalous correspondence (AC) – fovea of one eye linked cortically with non-foveal point of fellow eye
  - Typically occurs in constant unilateral strabismus
  - Onset in preschool years
Angles in AC

∠D: Objective angle (actual deviation)
∠S: Subjective angle
∠A: Angle of anomaly
∠D – ∠S = ∠A
∠D_m + EF = ∠D_t \quad (m: \text{measured}, t: \text{true})
∠A_m + EF = ∠A_t

- Sign convention:
  - Eso, BO prism, nasal EF, crossed foveal tags are (+)
  - Exo, BI prism, temporal EF, uncrossed foveal tags are (-)
Types of correspondence

- Remember: $\angle D - \angle S = \angle A$
  - Normal (NC): $\angle D = \angle S$, $\angle A = 0$
  - Harmonious AC (HAC): $\angle S = 0$, thus $\angle D = \angle A$
  - Unharmonious AC (UAC): $\angle D > \angle S$, both same direction
  - Paradoxical AC type I (PAC I): $\angle D$ and $\angle S$ have opposite directions
  - Paradoxical AC type II (PAC II): $\angle S > \angle D$, both same direction

- Covariation from AC to NC (in some intermittent strabismus)
Worth 4-dot

- Testing for suppression
  - Test at 40 cm, intermediate, and far
  - Suppression is foveal if present only at distance
  - Suppression is deep if present in bright and dim room

<table>
<thead>
<tr>
<th>Test distance</th>
<th>Subtends (degrees)</th>
<th>(Δ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 inches</td>
<td>4.5</td>
<td>7.8</td>
</tr>
<tr>
<td>3 feet</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>6 feet</td>
<td>1</td>
<td>1.75</td>
</tr>
<tr>
<td>10 feet</td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td>20 feet</td>
<td>0.3</td>
<td>0.5</td>
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</tbody>
</table>
Worth 4-dot

- Diplopic responses
  - Attempt to neutralize with prism (measures $\angle S$)
  - For example, uncrossed diplopia requires BO prism
  - If $\angle D = \angle S$, likely NC

Patient’s view of uncrossed diplopia, wearing red lens OD, green OS
Worth 4-dot – testing for AC

- Check unilateral cover test (UCT) for movement when patient sees 4 dots
  - Through prism, if needed to obtain 4 dots
  - Hold white dot at bottom
  - Ask patient to watch bottom dot
  - Cover/uncover each eye in turn
  - If NO strabismus on UCT, then NC
  - Presence of strabismus confirms AC
    - If no added prism (\(\angle S = 0\)), suggests HAC
    - If added prism (\(\angle S < \angle D\)), suggests UAC
Bagolini striated lens test

- Testing for AC

- If perfect cross seen and no movement on UCT, suggests NC
- If perfect cross seen and positive movement on UCT, suggests HAC ($\angle S = 0$)
Bagolini striated lens test

- Testing for suppression:
  - 1 line or part of line missing

- Diplopic responses:
  - Attempt to neutralize $\angle S$ with prism
  - Check UCT through prism: movement suggests AC
Red lens test of correspondence

- Test of AC
- First step: measure $\angle D$
  - Alternating cover test
  - Distance transilluminator target
  - Preferred eye fixating (prism over fellow eye)
Red lens test of correspondence

- Second step: measure $\angle S$
  - Vertical prism ($\sim 10 \Delta$) and red lens over non-preferred eye
  - Confirm that patient sees a red light while fixating white light
  - If two lights not aligned vertically, add horizontal prism over same eye until patient sees them aligned vertically
  - If $\angle D \neq \angle S$, suggests AC (must correct $\angle D$ for any EF)
Hering-Bielschowsky afterimage test

- Test of AC: measures $\angle A$
  - Patient at 1 m from centimeter grid or stick
  - Flash preferred eye monocularly with horizontal streak
  - Flash strabismic eye monocularly with vertical streak
  - Confirm patient sees both streaks while fixating center dot of grid with both eyes open
  - Determine any separation in cm between centers of streaks
Hering-Bielschowsky afterimage test

- Testing for AC
  - Direct measure of $\angle A$ but must correct for EF: $\angle A_m + EF = \angle A_t$
  - If $\angle A_t \neq 0$, suggests AC
  - Refer to sign convention
Hering-Bielschowsky afterimage test

- Useful in diagnosing/monitoring **covariation** in intermittent strabismus
  - AC when eyes are strabismic
  - NC when eyes are aligned
- Use afterimages during vision therapy to monitor AC versus NC
Major amblyoscope diagram – examiner’s side

1. On-off switch
2. Head rest adjustment
3. Chin rest adjustment
4. Interpupillary distance adjustment (use patient’s distance IPD)
5. Slide carriers
6. Locks for viewing tubes
7. Scales for prism diopters and degrees of horizontal deviation
8. Handles for introducing BI or BO prismatic effect (BI toward patient, BO away)
9. Knobs for introducing BU or BD prismatic effect
Major amblyoscope diagram – patient’s side

10. Slide removal button
11. Lens wells
## Major amblyoscope slide types

<table>
<thead>
<tr>
<th>Slide Type</th>
<th>Image</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| YELLOW BINDING   | ![Image](wicket.png) | - Stereoscopic  
- Labelled with D |
| RED BINDING      | ![Image](lion.png)   | - Simultaneous Perception  
- Labelled with G or H |
| GREEN BINDING    | ![Image](rabbit.png) | - Fusion Series  
- (Sensory & motor fusion)  
- Labelled with F |
Major amblyoscope (Synoptophore)

- Testing for AC
  - Adjust instrument for patient’s distance IPD and height
  - Distance Rx (can use instrument lens wells)
  - Dim room
  - Primary targets
  - Remind patient to fixate center of target being viewed
Major amblyoscope

- Measure $\angle D$ by alternately turning off targets and neutralizing all movement
  - Read red scale (prism diopters)
- Measure $\angle S$ by asking patient to superimpose one target within the other
  - If suppression, use brighter illumination for strabismic eye’s target, or flash targets
  - If vertical separation, adjust dial until patient reports targets superimposed
- If superimposition possible at $\angle S$, direct attention to center of fixating eye’s target, then instruct patient to fixate fellow eye’s target as you turn off (“douse”) light for fixating eye.
- Any movement to refixate suggests AC (repeat for other eye if needed).
Equipment sources

Amblyoscope:

Other equipment mentioned:
www.bernell.com
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Optometric Management of Constant Esotropia with Anomalous Correspondence

Mitchell Scheiman, OD, PhD
No Financial Disclosures
Overview

• Criteria for Cure
• Key Prognostic Factors
• Motor vs Sensory Treatment
• Treatment to achieve Functional Cure
• Treatment to achieve Functionally Adequate Cosmetic Cure
ANOMALOUS CORRESPONDENCE INTERPRETED AS A MOTOR PHENOMENON*

Meredith W. Morgan†
School of Optometry, University of California
Berkeley, California

ANOMALOUS RETINAL CORRESPONDENCE*
Its essence and its significance in diagnosis and treatment

Hermann M. Burian, M.D.
Boston, Massachusetts
sympoium paper

Management of Anomalous Correspondence: Efficacy of Therapy

BRUCE WICK*
DAVID COOK†
College of Optometry, University of Houston, Houston, Texas
Home Visual Therapy for Constant Esotropia with Anomalous Correspondence

BRUCE WICK*
Rapid City, South Dakota

Abstract
A home therapy method for eliminating anomalous correspondence is described. This method is applicable to patients over 12 yr old with esotropia greater than 15–20Δ. A case report is included.
"FORCED ELIMINATION" OF ANOMALOUS RETINAL CORRESPONDENCE IN CONSTANT EXOTROPIA — A CASE REPORT*

ABSTRACT
"Forced elimination" of anomalous correspondence in a patient with constant exotropia is discussed. Therapy was similar to classic visual therapy for esotropia; presenting targets at the angle of strabismus (Angle H) using a troposcope. Home therapy methods using anaglyphic techniques and after-images are described.

Bruce Wick†
Rapid City, South Dakota
Key References

2. Caloroso E, Rouse M. Clinical Management of Strabismus. OEP
Constant Esotropia: Decision Making Process

• 3 Step Approach
  1. Accurate diagnosis
  2. Understand of factors that affect prognosis
  3. Choose the treatment objective
     • Functional cure
     • Functionally adequate cosmetic cure
Step 1: Diagnosis

- Acuity
- Refractive Error
- Strabismus/Amblyopia Evaluation
  - Motor Evaluation
  - Sensory Evaluation
Step 2: Factors that Affect Prognosis

1. Frequency
   • Intermittent vs constant
2. Direction
   • Esotropia vs exotropia
3. Correspondence
   • Anomalous vs normal
Step 3: Choose Treatment Objective

• “The best course of treatment for those patients with small strabismic angles, deep suppressions, good cosmesis, and no subjective symptoms may be simply - no treatment”

  Caloroso and Rouse: Clinical Management of Strabismus

• AC in esotropia makes the prognosis very guarded

Potential Treatment Objectives

• **Flom’s Functional Cure:**
  – Clear, single, comfortable BV present at all distances up to NPC (which is normal)
  – Must be stereo and normal ranges of motor fusion
  – Loss of bifixation no more than 1% time (5-10 minutes/day) and diplopia occurs when this happens
  – Small amounts of prism may be worn (≤5Δ)

## Functional Cure Rates (AC vs NC)

<table>
<thead>
<tr>
<th>Study</th>
<th>Success rate if NC</th>
<th>Success Rate if AC</th>
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<tbody>
<tr>
<td>Flom (1963)</td>
<td>40% (23/58)</td>
<td>3% (1/33)</td>
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<tr>
<td>Ludlam (1961)</td>
<td>86% (37/45)</td>
<td>23% (6/26)</td>
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<tr>
<td>Etting (1973)</td>
<td>75% (9/12)</td>
<td>10% (1/10)</td>
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<tr>
<td>Etting (1978)</td>
<td>100% (25/25)</td>
<td>28% (5/18)</td>
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<tr>
<td>Wick and Cook (1987)</td>
<td>------------------</td>
<td>53% (28/53)</td>
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# Model for Estimating the Probability of Functional Correction of Esotropia

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<th>Factors</th>
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<td><strong>+ Factors (add 0.1)</strong></td>
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<tr>
<td>Marked suppression</td>
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**Estimated Probability**

*From Flom 1990 Clinical Mx of Binocular Anomalies in Principles and Practice of Pediatric Optometry, Rosenbloom and Morgan. 1990. Lippincott*
Example: 10 year old with constant, comitant 15Δ ET with AC and mild marked suppression

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*From Flom, 1990 Clinical Mx of Binocular Anomalies in Principles and Practice of Pediatric Optometry, Rosenbloom and Morgan, 1990. Lippincott*
Potential Treatment Objectives

• **Wick/Cook Functionally Adequate Cosmetic Cure**
  – Cosmetic alignment (Small angle up to 5Δ)
  – Peripheral fusion (up to 100 sec of stereo)
  – Central suppression
  – No blur, diplopia, visual discomfort
  – Small amounts of prism may be worn (≤5Δ)
  – Slight amblyopia (20/40)

Rationale Behind this Approach

- Small angle constant ET
- Unilateral CT vs Alternate CT
- Angle of deviation much larger with occlusion
  - “Phoria superimposed on the tropia”
  - Peripheral fusional vergence
  - Anomalous fusional vergence
- Goal of therapy to replicate this naturally occurring phenomenon
Management Decision

**PROCESS**

- Analyze findings relative to possible outcomes
  - Functional vs Functionally Adequate Cosmetic Cure
- Consider success rates of various options
Treatment of Constant ET

Functional Cure
Overview

• Passive treatment
  – Constant occlusion
  – Over-correcting prism

• Active treatment
  – Office-based vision therapy
    • Fusional vergence procedures @ objective angle
  – Goal: eliminate AC and suppression (constant double vision)
  – Prescribe correcting prism
  – Free space VT
Passive Therapy

- Occlusion
  - Constant alternate occlusion
  - Why?
Passive Therapy

- Disruptive devices
  - Overcorrecting or disruptive prism
- Procedure
- Overview of process
Over Correcting Prism

• How much prism?
  – Enough to create sustained diplopia (more than 15 minutes)
• How long does the patient wear the prism?
• How do you know if the prism is working?
• When do you stop using over correcting prism?
How Long does the Patient Wear the Prism?

- Based on response in office
  - Wear ~ 1 hour a day or less based on office-response
  - Concept of Anomalous Fusional Movements (AFM)
- Similar to normal fusional vergence except:
  - Performed slower
  - Less accurate
- The faster the AFM the more deeply embedded the AC
When to stop using over correcting prism?

• Progress
  – Diplopia is present for longer periods of time with prism on
• Adaptation takes longer
• Patient experiences diplopia without prism
• Diplopia is NC diplopia
Active AC Therapy

• Stereoscopes at objective angle
  – Sensory stimulation
    • Amblyoscope
    • Mirror Stereoscope
  – Determine the conditions that minimize/eliminate AC
    • Lighting
    • Flashing
    • Movement
    • 1\textsuperscript{st} degree targets
Use Different Target Types

1st Degree Targets

2nd Degree Targets

3rd Degree Targets
Centration Point Therapy

- Point in space where visual axes cross
- Best approach:
  Diopters = objective angle/pd (cm)
  Example: 30 pd ET, pd = 6 cm
  Diopters = 30/6 = 5 D
  To find centration point find reciprocal of 5D
  100/5 = 20 cm
  So work at 20 cm using + 5.00 d lenses
Centration Point Therapy

Patient’s View

fovea

Z-point

fovea
Major Amblyoscope

Use a variety of stereoscopes

“instrument training” vs. “free space training”
Double Mirror Stereoscope

Use a variety of stereoscopes

“instrument training” vs. “free space training”
Suppression Therapy

• Stereoscopes
Single Oblique Mirror Stereoscope
Mirror Superimposition
TV Trainers
Free Space Therapy

• As progress occurs
  – NC diplopia more often
  – $2^{nd}$ and $3^{rd}$ fusion at objective angle
• Prescribe correcting base-out prism and any vertical required to achieve normal fusion
• Then Free space VT
  – Vectograms
  – Aperture Rule
  – Eccentric Circles
  – VTS4
Treatment of Constant ET

Functional Adequate
Cosmetic Cure
Objective is Totally Different

- Try to duplicate naturally occurring small angle ET
- More deeply embed AC
  - Improve anomalous fusional vergence movements
- VT at SUBJECTIVE ANGLE
  - Major amblyoscope
  - More emphasis on Free-space therapy
    - Peripheral targets
    - Projected Vectograms
    - VTS4
Signs of Progress

• Smaller angle deviation with Unilateral CT
  – No change with Alternate CT
  – Satisfactory cosmesis

• Peripheral stereopsis

• Can measure Vergences ranges at subjective angle
Time Frame

• Functional Cure
  – 9-12 months
  – VT 2x per week
  – But significant time with constant occlusion
  – Significant issues with diplopia

• Functionally Adequate Cosmetic Cure
  – 6-9 months
  – VT 2x per week
Challenges

- Complicated therapy (Functional Cure)
  - VT must be done by highly trained therapist of OD
    - Typical vision therapist may not be able to monitor AC
- Expensive
- Requires VERY high level of commitment
Summary

• 3 Step Approach
  1. Accurate diagnosis
  2. Understand of factors that affect prognosis
  3. Choose the treatment objective
     • Functional cure
     • Functionally adequate cosmetic cure

• Carefully select patients:
  • Full disclosure of complexity of Treatment
  • Age
  • Motivation
Testing and Training Stereopsis in Strabismus

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Stereo Basics

Seeing Space—Egocentric Stereo

“[I saw] palpable volume[s] of empty space… I could see, not just infer, the volume of space between limbs…the sink faucet reached out toward me…the grape was rounder and more solid than any grape I had ever seen…Objects seemed more solid, vibrant, and real.”

Testing

The collision of the doctor’s and patients best guesses.

(Diagnosis—sorting through the wreckage)
Relative Stereo

Which is closer:
The shoe’s toe or laces?
Contour Stereopsis at 16”
Centration Range—Penlight

- Centration Range
- Centration Point
- Avoidance of Bifixation
Quoits with Dot at C-Range

- At Centration Range
- Moving C to 3
- Shaking
- Peripheral awareness
- Loop with pointer
- Compare to finger
  - Touch finger even with quoit
Quoit with Dot at C-point
Randot Stereopsis at Centration Point
Absolute or Egocentric Stereo

How far are the pilings away from your nose?

Two-Finger Demo
Stereo Basics

…[S]tereopsis is a qualitative visual experience related to the perception of egocentric spatial scale. Specifically, the primary phenomenal characteristics of stereopsis (the impression of “real” separation in depth) is proposed to the linked to the precision with which egocentrically scaled depth (absolute depth) is derived.

VTS4--Stereo

- Shaking Target—Dog and Ring
  - Sword inside or next to ring
  - Hands to side of ring
  - Awareness of Frame
  - Back away as far as ring follows.
  - Reduce Size of Ring
  - No shaking
Anomalous Binocular Vision (ABC)

The visual behavior is such as if each eye were directly related to body-posture only. . . . If body posture is experimentally eliminated as a cue to the visual direction, all relationship between the right and left visual impressions seems to be lacking . . . .

Luster
Split Field = ABC
How do you blend the two eye’s perceptions?

- Peripheral Awareness—Increase the Sphere of Attention

Reduces bifoveal avoidance of alignment

Aligns eyes

Circumvents ambiocular response to combine perceptions of two eyes
Training Stereopsis
Sphere of Attention
Area Selected for Simultaneous Viewing
Sphere of Attention
Eyelash Vision versus Face Vision
Sphere of Attention
Eyelash Vision versus Face Vision
The Sphere of Attention
Sphere of Attention
Sphere of Attention
Sphere of Attention
Sphere of Attention
Peripheral Awareness—Expanding the Sphere of Attention.

1. Divided Attention—See both sides of room, or see floor and ceiling at the same time.

2. Gestalt Seeing—See object (or floor) as a “Business card.”

Vectogram Local

Quoit Separation = Distance between Pupils
Quoit Separation = 2 X Interpupillary Distance
Quoit Separation = \( \frac{1}{2} \) Distance between Pupils
Vectogram Local
 Vectogram Local

Zone of Confusion

- Area of space where patient is adapted.
- Patient’s perception is normal in periphery but adapted centrally.
- The further away the vectogram, the more central.
  - Quoit gets closer to plastic holder instead of following patient.
  - Patient’s local of quoit no longer certain.
Vectogram Local

Goal—

- To get the vectogram out to its predicted location.
- To integrate this with movement.
- If shaking the vectogram makes it come further out, then the patient has not a) fully aligned his eye and/or b) fully expanded his space.
Peripheral Awareness—Expanding the Sphere of Attention.

1. Divided Attention—See both sides of room, or see floor and ceiling at the same time.

2. Gestalt Seeing—See object (or floor) as a “Business card.”

Peripheral Awareness
See Gestalt
Quoits with Dot Back-away

- Move as Far Away as Local is Good
- Continue 3 to C
- With Near-Far Jumps
- With Cover-Uncover-Recover
Quoits with Dot on Wall

To Get Float

- Shaken and Blurred
- Language
- Gradually Decrease Blur
- Work Responsibility and Control
Quoits with Dot on Wall

Dowel Sticks
- One on dot
- One touching other, even with Quoit
- Circling Quoit
- Two Stick Touch
  - Feel them
  - Hear them
Quoits with Dot on Wall

Responsibility and Control

◼ “Look Hard at the fuzz on the dot.”
◼ “Make the rope go flat.”
◼ “Be aware of the whole room, of all the space between your nose and the wall.”
◼ Make the Quoit pop out.
Spirangle

Gross Local

- On wall or handheld
- Shaken and Blurred
- Compare Outside to Inside
- Responsibility and Control
- Gradually Decrease Blur
- With Stick or Dowels
Vectograms

**Movement**

- Move forward and back with proper localization.
- Stop moving back when the vectogram stops following patient and recedes toward wall.
- At greatest distance with correct local work
  - Near are Jumps
  - Cover/uncover/recover
Vectograms

Movement

- Add balance:
  - Head rotations
  - Leg Swings
  - Balance Board
  - Walking Rail
VTS4--Stereo

- Shaking Ring
  - Sword inside or next to ring
  - Hands to side of ring
  - Awareness of Frame
- Shaking Ring—Dog or Robot
- Plane Slide with SILO
- Fish Slide with SILO
- Ring and Cat Large Rotated
- Small Cat Rotated
- Alligator or Frog—Rotated
- Greatest Distance at which Target follows you.
- Near-Far Jumps and Cover-Uncover
VTS4--Stereo

- Shaking Ring
  - Sword or arm inside or next to ring
  - Hands to sides of ring
  - Awareness of Frame
  - Gestalt
  - Back up until ring no longer follows
VTS4--Stereo

- Shaking Target—Dog and Ring
  - Sword inside or next to ring
  - Hands to side of ring
  - Awareness of Frame
  - Back away as far as ring follows.
  - Reduce Size of Ring
  - No shaking
VTS4--Stereo

- Shaking Target—Ring
  - Sword inside or next to target
  - Hands to sides of target
  - Awareness of Frame Gestalt compared to blue.
  - Compare distances of letters
  - Back away so long as blue follows.
VTS4--Stereo

- Shaking Target—Ring
  - Sword inside or next to target
  - Hands to side of target
  - Awareness of Frame Gestalt
  - Dolphin Closest
  - Sea Horse closer than clam, etc.
  - Back away so long as green background follows.
VTS4--Stereo

- Frog
  - Sword next to Frog
  - Awareness of Screen Frame Gestalt
  - Large to small
  - Rotated
VTS4--Stereo

- Combining Movement
  - Therapist moves on Z axis; patient moves to keep realign target with therapist.
  - Cover Uncover
  - Near Far Jumps
  - Walking Rail
  - Infinity Walk
  - Long Distances for exotropes
  - Tiny Targets 4 inches at 40 feet
Convergence Insufficiency
A/V Flexibility and SILO
Randot NV—Ranges
Convergence Insufficiency
A/V Flexibility and SILO
Randot NV—Ranges
3D Without Vectos
Free Space Stereo
Yoked Prisms

1) View Room

2) Walk with high power yoked prisms
   a) Perceived as up-hill with base down
   b) Perceived as down-hill with base in
   c) Encourage seeing big, see entire length of room.

3) Remove prisms, View Room
Free Space 3D

Hand Mirror

Examine features of face.

Be aware of frame and see face recede behind glass.

Adjust distance of mirror
Free Space 3D

Wall Mirror

- Aware of nose
- Aware of frame
- Aware of masking tape
- Aware of Hands

Responsibility and control
- Look at nose
- See distance to frame
Free Space 3D Stereo Hand

- Shift attention between each fingertip being aware of that finger’s length.
- Closing one eye at a time, compare the view of each eye with the view of both.
- Vary the separation of the fingers, opening and closing hand with fingers slightly curved.
- Be simultaneously aware of all five finger tips and palm.
- Shake the hand.

- Rotate hand in a circle
- Vary the distance of hand from face.
Free Space 3D

Look at my eyeglass bridge.

See the space between your nose and my face.
Gestalt Attention

See all the doorframe simultaneously—while noticing the increase in depth perception of the next room.
Shape of the Sky
Shape of the Sky
Shape of the Sky