BINOCULAR VISION PART III: MANAGING BINOCULAR VISION DISORDERS

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LECTURE OBJECTIVES

• Learn how to manage common near binocular vision disorders

• Learn how to perform common vision therapy techniques

• Learn how to manage convergence insufficiency with vision therapy
POLL QUESTION 1

What is your comfort level in the management of binocular vision disorders (not vision therapy)?

A) Very comfortable/routinely do
B) Occasionally manage some, but not all, binocular vision disorders
C) I have learned about but never implemented management
D) I am not comfortable with binocular vision management at all
POLL QUESTION 2

What is your comfort level in implementing vision therapy?

A) Very comfortable/routinely do
B) Occasionally manage some, but not all, binocular vision disorders
C) I have learned about but never implemented management
D) I am not comfortable with binocular vision management at all
BINOCULAR VISION MANAGEMENT RESOURCES

• *Clinical Management of Binocular Vision: Heterophoric, Accommodative and eye movement disorders.* Mitchell Scheiman, Bruce Wick


• *Essentials of Clinical Binocular Vision.* Edited by Erik M. Weissberg

• [www.bernell.com](http://www.bernell.com) Vision Therapy Equipment

• [www.good-lite.com](http://www.good-lite.com) Vision Therapy Equipment
COMMON NEAR BINOCULAR VISION DISORDERS

Accommodative insufficiency

Ocular motor dysfunction

Convergence excess

Convergence insufficiency
ACCOMMODATIVE INSUFFICIENCY MANAGEMENT

• Signs:
  – Reduced findings with minus lenses
  – Reduced amplitude of accommodation

• Symptoms:
  – Blur, headache, eyestrain, double vision, reading problems, difficulty shifting focus, words moving on the page and sensitivity to light
ACCOMMODATIVE INSUFFICIENCY MANAGEMENT

• First correct refractive error even if seems small

• Add lenses good starting point
  – Can range from +0.75 to +2.00
  – Must trial frame and gauge patient comfort

• Vision therapy can make the treatment with lenses even more effective

• Focus on accommodative but also vergences
OCULAR MOTOR DYSFUNCTION

- **Signs:**
  - Difficulty with pursuits, saccades and fixation
  - Poor fixation during cover test
  - Using a finger to direct fixation

- **Symptoms:**
  - Loss of place when reading
  - Excessive head movements when reading
  - Difficulty copying from board to paper

- **Associated with other binocular and accommodative anomalies**
OCULAR MOTOR DYSFUNCTION MANAGEMENT

• Addition lenses are typically not helpful
  – unless associated accommodative problems

• Vision therapy is the treatment of choice
  – Include both accommodative and binocular techniques

• Communication to those involved in the child’s education

• Compensating strategies
  – Using a finger or ruler to underline sentences
OCULAR MOTOR VISION THERAPY

Letter circling

Visual Tracing

Marsden Ball

Red/Green Glasses & flashlight (suppression)
LETTER CIRCLING

• Purpose:
  – To improve smooth pursuits, saccades and tracking

• Procedure:
  – Have the patient circle or fill in a letter
  – E’s and O’s work best due to their frequency
  – Start monocularly and then proceed binocularly

• Endpoint:
  – Keep track of time for paragraphs of similar length
  – Record number of mistakes
  – When mistakes are minimized and a timing plateau is reached can increase difficulty
VISUAL TRACING

• **Purpose:**
  – To improve smooth pursuits and tracking

• **Procedure:**
  – Various workbooks, mazes, Where’s Waldo books
  – Have patient start monocularly and then progress binocularly
  – Can have patient start with a pencil to help tracking and then progress to using eyes only

• **Endpoint:**
  • Work through the books binocularly without mistakes
MARSDEN BALL
MARSDEN BALL

• Purpose:
  – Help the patient develop appropriate ocular motor coordination

• Procedure (s):
  – Highly variable
  – Circle:
    • Ball is swung around the head with a clearance of at least 18 inches
    • Patient tracks the ball as far as possible while keeping the head still
  – Batting:
    • Increase the difficulty by having the patient bunt the ball
    • Can increase the difficulty again by calling out colors, numbers, letters etc. and having the patient find and hit those on the ball
MARSDEN BALL

• Endpoint:
  – Patient can bunt the ball and contact the appropriate numbers/letters/colors when called
  – Minimal time and effort
RED/GREEN GLASSES & PENLIGHT

- **Purpose:**
  - Decrease the intensity and frequency of suppression

- **Procedure:**
  - Start with conditions least likely to suppress then move to normal conditions
  - Patient wears red/green glasses
  - Holds 6 pd base-down before the dominant eye
  - Views a penlight at distance
  - Ask how many colors and lights are seen
  - When diplopia is maintained increase the room illumination
  - Remove red/green glasses when diplopia is maintained with normal lighting (suppression typical)
  - Decrease lighting until diplopia is noted and then slowly increase lighting
RED/GREEN GLASSES & FLASHLIGHT

- **Endpoint:**
  - Typically requires 2-4 weeks of in-office and home therapy
  - When the patient can maintain diplopia without the red/green glasses in normal room illumination
CONVERGENCE EXCESS MANAGEMENT

• Symptoms:
  – Difficulty reading, focusing, fluctuating vision
  – Holds reading material close
  – May close an eye
  – Possible head tilt after visual fatigue

• Signs:
  – Esophoria near>distance
  – High AC/A ratio
  – Low divergence ranges
  – Elevated convergence ranges
  – Normal NPC
  – Difficulty with minus lenses on binocular accommodative facility (BAF)

• Associated accommodative excess
CONVERGENCE EXCESS MANAGEMENT

• Correct refractive error even if minimal

• Plus lenses may or may not be helpful
  – Focus on eliminating any esophorises
  – Must trial frame the near prescription to ensure comfort
  – Initial follow-up 1 to 2 months to evaluate the glasses

• Vision therapy program recommended
  – Improve relaxation of accommodation
  – Work on divergence techniques

• Stress proper working distance at near and frequent breaks
CONVERGENCE INSUFFICIENCY

- The most common binocular vision dysfunction

- Symptoms:
  - Double vision at near
  - Words swimming on the page
  - Eye strain/difficulty focusing
  - Headaches above the eyes particularly later in the day
  - Avoidance of near point tasks

- Signs:
  - Receded near point of convergence
  - Exophoria near>distance
  - Low positive fusional vergences based on Sheard’s criterion
  - Low AC/A ratio
  - Difficulty or inability to clear plus lenses on binocular accommodative facility

- Often find an associated accommodative dysfunction
CONVERGENCE INSUFFICIENCY MANAGEMENT

• Home/office based vision therapy is the treatment of choice for CI
  – Convergence insufficiency treatment trials (CITT) studies
  - Recommend program of 12 weeks with good compliance
  - One hour office visits every 1 to 2 weeks is required to monitor progress and implement changes
  - 15 mins. of “homework” five days a week
GLASSES AND CI

• Not the treatment of choice

• Lenses can improve visual efficiency and improve symptoms in certain cases
  – Plus lenses may work with associated accommodative insufficiency
  – Powers range from +0.75 to +1.25, determined by trial framing and repetition of binocular vision testing
GLASSES & CI

• Glasses with base-in prism (can include plus) may work in certain cases
  – Must complete a prism adaptation test first
  – Start with least amount of prism that satisfies Sheard’s criterion
  – Split the prism between the two eyes
  – Trial frame for comfort
  – Typically not successful if prism is > 10 to 12 prism diopters
CI & VISION THERAPY

• According to the CITT studies and other literature vision therapy is treatment of choice for CI

• Evidenced-based vision therapy program outlined in the CITT manual of procedures

• Multiple stages needed and each technique has a specifically stated endpoint

• Home therapy should have around 3 tasks for a total of 15 mins. 5 days a week with follow-up every 1-2 weeks
CI & VISION THERAPY

• Need a program to develop
  – Vergence: Brock string, loose prisms, Lifesaver cards, Eccentric circles
  – Accommodation: Monocular & binocular chart rock, monocular & binocular lens rock,
  – Ocular motility: Circling/filling in E’s, visual tracing, Marsden Ball
  – Suppression: Red/green glasses & flashlight
SEQUENCE OF TRAINING

• **Vergence**
  1. Brock string
  2. Lifesaver cards
  3. Eccentric circles
  4. Loose prisms

• **Ocular motor**
  1. Circling/filling in E’s (monocular than binocular)
  2. Visual Tracing (monocular than binocular)
  3. Marsden Ball
  4. Red/green glasses and penlight (suppression)

• **Accommodation**
  1. Monocular chart rock
  2. Monocular lens rock
  3. Binocular chart rock
  4. Binocular lens rock
POLL QUESTION 3

- True or false? The lack of luster can indicate that the patient may be suppressing.

A) True
B) False
VERGENCE TECHNIQUES

Brock String

Lifesaver Cards

Eccentric Circles

Loose Prisms
BROCK STRING

https://www.google.com/search?q=brock+string&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiuiJvtxrcAhWJv1MKHYtEBjYQ_AUICygC&biw=1045&bih=679#imgrc=pIXycoxL3ocE-M:
BROCK STRING PROCEDURE

• Purpose: To help develop the patient’s ability to voluntarily converge and diverge and to develop a normal NPC

• Procedure:
  – 1 m of string strung with two beads (red and green beads)
  – Red bead is set at the end of the string & green at 40 cm
  – Ask the patient to look and describe the near bead
  – Patient should report one green bead and two red beads (physiological dioplopia) and the strings crossing at the green bead
  – Instruct the patient to switch fixation to the red bead (now the green bead will be double and the red single)
  – Instruct the patient to always try to make the strings cross at the bead they are directed to look at
BROCK STRING PROCEDURE

• Once the patient is able to fuse the near and far beads
  – Have the patient touch the bead for kinesthetic feedback
  – Use binocular minus lenses to stimulate convergence

• Maintain fixation on the near bead for 5 seconds and then switch to the far bead and maintain for 5 seconds (this is a cycle)

• Have the patient perform 10 cycles then move the bead 5 cm closer and repeat

• Endpoint:
  – Move the near bead to
  – converge to a distance of 5 cm for 10 cycles comfortably
LIFESAVER CARDS

Transparent

White Card
LIFESAVER CARDS

• **Purpose:**
  – Increase the amplitude of NFV & PFV
  – Decrease the latency of the fusional vergence response
  – Increase the velocity of the fusional vergence response

• **Procedure:**
  – Target separations are printed on the cards
  – Have both white backgrounds and clear (helps divergence)
  – Patient starts with the bottom, fuses for 10 seconds, then jump to the next target and fuse
LIFESAVER CARDS

• **Endpoint:**
  – Achieve clear chiastopic (convergence) and orthopic (divergence) fusion with all the targets on the cards
  – Switch between chiastopic and orthopic fusion with all of the targets on the lifesaver cards
  – Maintain chiastopic and orthopic fusion with all targets on the Lifesaver cards and move them laterally or in a circular fashion
ECCENTRIC CIRCLES

https://www.google.com/search?q=eccentric+circles+jump+fusion&tbm=isch&source=iu&ictx=1&fir=DQopfdYdy4s44M%253A%252C2vGsg7tNRRyJIM%252C_&usg=AFrqEzc6XPJMjvqzjilEdzALQhKEP6-okw&sa=X&ved=2ahUKEwjSz6ivqeHcAhVirlkKHd7DBL4Q9QEwAnoECAUQCA#imgrc=y-Slg7-yfYNoVM:
ECCENTRIC CIRCLES PROCEDURE

• Purpose:
  – Increase the amplitude of NFV & PFV
  – Decrease the latency of the fusional vergence response
  – Increase the velocity of the fusional vergence response

• Procedure:
  – Converge in front of the plane of accommodation (chiastopic)
  – Diverge beyond the plane of accommodation (orthopic)
  – Typically also include anti-suppression and accommodative cues
  – A’s are held together and fusing Base-out they will perceive the outer circle floating closer
  – A’s together the patient will perceive the inner circle floating closer
ECCENTRIC CIRCLES PROCEDURE

• Procedure:
  – This will be the exact opposite when the B’s are held together
  – It is incorrect to think A’s are used for convergence and B’s for divergence
  – Will need to calculate the prismatic demand given the separation of the cards
  – @ 40 cm 4 mm = 1 prism diopter ie. 12 cm = 30 pd
ECCENTRIC CIRCLES

• Endpoint:
  – Clear chiastopic (convergence) with a card separation of 12 cm and clear orthopic (divergence) with a card separation 6 cm
  – Switch between chiastopic and orthopic fusion with cards held 6 cm (20 cpm)
  – Maintain chiastopic & orthopic fusion with a card separation of 6 cm while moving the cards laterally or in a circular movement
LOOSE PRISMS
LOOSE PRISM PROCEDURE

• Purpose:
  – Increase the patient’s ability to converge and diverge

• Procedure:
  – Set 20/40 size targets at 3 m, intermediate and 40 cm
  – Have the patient hold the 4 BO prism before the right eye and look at the distance target
  – Have the patient try to make the double image into one
  – When the image is single then the patient remove the prism and repeat the procedure 10 times
  – Repeat the procedure 10 times while looking at the intermediate and near targets
  – When the patient is successful then repeat the sequence but increase the prism by multiples of 4 (can reduce by 2 if the patient is unable)
  – Repeat and switch the orientation of the prism

• Endpoint:
  - Patient can successfully fuse
  - 20 BO at all distances
  - 12 BI (intermediate & near)
  - 8 BI at distance
ACCOMMODATIVE TECHNIQUES

Monocular letter chart rock

Monocular lens rock

Binocular letter chart rock

Binocular lens rock
MONOCULAR LETTER CHART ROCK

• **Purpose:**
  – Restore normal monocular accommodative amplitude and facility

• **Procedure:**
  – Left eye is occluded
  – Place chart with 20/40 distance letters (10 lines with 5 letters per line) 40 cm from the patient
  – Patient backs away until either the letters become blurry or the patient has reached a distance of 3 m
  – Patient also holds a small chart of 20/40 near letters (10 lines with 5 letters per line) at 40 cm and calls off the letters on the top line while slowly moving the chart closer
MONOCULAR LETTER CHART ROCK

- Procedure:
  - When the patient can no longer keep it clear then move the chart 2.5 cm further away and shift focus to the first line on the distance chart and alternate between reading one letter off the distance chart and one off the near chart until all the lines are complete.
  - Repeat the procedure with the right eye occluded.
MONOCULAR CHART ROCK

- **Endpoint:**
  - Patient can successfully clear the near chart held at a distance equal to an age appropriate amplitude
  - Clears the distance chart at 3 m
  - Maintain focus while switching between the two charts
MONOCULAR LENS ROCK

- **Purpose:**
  - Normalize accommodative amplitude and facility

- **Procedure:**
  - Occlude the patient’s left eye
  - Hold age appropriate reading material at 40 cm
  - Can use flippers or lenses to switch between different combinations lenses
  - Ask the patient to clear the print while alternating between the two lenses
  - Have the patient occlude the right eye and repeat the procedure
  - Can move through a series of lens designs to increase the difficulty
  - Goal is to complete 20 cycles in 1 min.
BINOCULAR LETTER CHART ROCK

• Purpose:
  – Restore normal binocular accommodative amplitude and facility

• Procedure:
  – Place chart with 20/40 distance letters (10 lines with 5 letters per line) 40 cm from the patient
  – Patient backs away until either the letters become blurry or the patient has reached a distance of 3 m
  – Patient also holds a small chart of 20/40 near letters (10 lines with 5 letters per line) at 40 cm and calls off the letters on the top line while slowly moving the chart closer
  – When the patient can no longer keep it clear then move the chart 2.5 cm further away and shift focus to the first line on the distance chart and alternates between reading one letter off the distance chart and one off the near chart until all the lines are complete
BINOCULAR LETTER CHART ROCK

• Endpoint:
  – Patient can successfully clear the near chart held at a distance equal to an age appropriate amplitude, clears the distance chart at 3 m and can maintain focus while switching between the two charts
BINOCULAR LENS ROCK

- **Purpose:** to normalize accommodative amplitude and facility under binocular conditions

- **Procedure:**
  - Hold age appropriate reading material at 40 cm
  - Can use flippers or lenses to switch between different combinations of power of lenses
  - Ask the patient to clear the print while alternating between the two lenses
  - Have the patient occlude the right eye and repeat the procedure
  - Can move through a series of lens designs to increase the difficulty
  - Goal is to complete 20 cycles in 1 min.
  - Can use the same lens designs as in monocular lens rock
LENS ROCK DESIGNS

- +/- 0.50
- +/- 0.75
- +/- 1.00
- +/- 1.25
- +/- 1.50
- +/- 1.75
- +/- 2.00
- +/- 2.25
- +/- 2.50
- Max plus at +2.50 and can increase up to -6.00 (go in 0.50 D steps)
VISION THERAPY FEEDBACK MECHANISMS

• Diplopia (double vision):
  – Probably the easiest cue to explain to patients
  – Can stress concept using physiological diplopia during Brock String

• Blur:
  – Cue to the patient that they are either under or over focusing

• Suppression:
  – Can vary between training implements
  – Will need to remind the patient which cues to pay attention to
VISION THERAPY FEEDBACK MECHANISMS

- **Luster:**
  - Combination of colors when the patient is asked to fuse different colors ie. Red & green
  - A lack of luster could also indicate that the patient may be suppressing

- **Kinesthetic awareness:**
  - Understanding the feelings of converging and diverging and stimulating and relaxing convergence

- **SILO (Small in, Large out):**
  - Perceptual changes while fusing and divergence & convergence demand is varied
  - The target may appear to become smaller and move closer to the patient with convergence and larger and further away with divergence
VISION THERAPY FEEDBACK MECHANISMS

• **Float:**
  – Associated with SILO
  – Convergence the target should appear to float closer
  – Divergence the target should appear to further away

• **Localization:**
  – Point to where the target appears to be when fusion occurs in space
  – Based on the concept of physiologic diplopia
  – If pointer is in the area of where the visual axis cross they will see one target and one pointer
Pencil push-up therapy has been promoted as efficient and effective home based CI therapy but studies have reported mixed results.

Results from the CITT studies indicate that pencil push-up therapy is not an effective treatment for CI.

Multiple studies have indicated that outpatient/office based vision therapy is more effective than home based convergence exercises (pencil push ups).
OTHER CONSIDERATIONS FROM CITT

• Good communication is key to success

• Continue to stress the goals of vision therapy, what the patient’s problem is and how vision therapy will help the patient reach their goals

• Stress the changes occurring in the patients visual system/internally vs. just the equipment used in training

• Use positive reinforcement
  – Always reward the patient for attempting the task even if not successful

• Be careful and aware of frustration level
  – Fidgeting, avoidance of work and other nervous behavior
  – Start at the level which is easy and then slowly increase rather than starting at too hard a difficulty level

• Determine starting or baseline level
  – Working at this level helps train the patient in important feedback cues and helps build confidence and motivation
DECREASING DIFFICULTY

• Decreasing difficulty for divergence:
  – Increase working distance
  – Plus lenses
  – Base-out prism

• Decreasing difficulty for convergence:
  – Minus lenses
  – Base-in prism
  – Increase working distance
INCREASING DIFFICULTY

• Increasing difficulty divergence:
  – Minus lenses
  – Base-in prism
  – Decrease working distance

• Increasing difficulty convergence:
  – Plus lenses
  – Base-out prism
  – Decrease the working distance
How would you increase the difficulty level of the Brock String procedure when treating a patient for CI?

A) Add plus lenses
B) Decrease the working distance
C) Add base-out prism
D) All of the above
SIMPLIFIED EVIDENCED BASED THREE PHASE VISION THERAPY FOR CI
PHASE ONE

• Phase 1: Gross convergence, positive fusional vergence, monocular accommodative procedures

• Techniques:
  - Gross convergence: Brock string
  - Positive fusional vergence: Lifesaver cards
  - Monocular accommodative: Loose lens accommodative rock, letter chart accommodative rock

• Home vision therapy: Brock string, loose lens accommodative rock, letter chart accommodative rock, lifesaver cards

• Endpoint:
  – Brock String: Converge to bead 2.5 cm from nose
  – Lifesaver Cards: Able to clear all four levels of difficulty and hold for at least 5 seconds
  – Loose Lens Accommodative Rock: Clear +1.50/-3.00, 10 cycles per min.
  – Letter Chart Accommodative Rock: Clear near chart at age-appropriate distance and be able to clear distance chart
PHASE TWO

• Phase 2: ramp fusional vergence and monocular accommodative facility

• Techniques:
  – Eccentric circles, flipper accommodative rock, letter chart accommodative rock

• Home VT:
  - Eccentric circles, flipper accommodative rock, letter chart accommodative rock

• Goals:
  – Eccentric circles: 30 prism diopters base-out/15 base-in
  – Loose lens accommodative rock: clear +2.00/-6.00, 10 cpm
  – Letter chart accommodative rock: clear near chart at age-appropriate distance, change fixation and clear far letter chart at 3 m for 10 cycles
PHASE THREE

- Phase three: jump fusional vergence and binocular accommodative facility
- Techniques: eccentric circles, loose prism facility, binocular accommodative facility
- Home VT: eccentric circles, binocular accommodative facility, loose prism jumps
- Goals:
  - Eccentric circles: chiastopic fusion with a card separation of 12 cm (30 prism diopters base out) and clear orthopic fusion with a card separation of 6 cm (15 prism diopters base in)
  - Switch between the two with the cards held 6 cm apart for 20 repetitions
  - Binocular accommodative facility: Single clear vision while viewing 20/30 point at 40 cm through +2.00 and alternately -2.00 for at least 13 cpm without suppression
  - Loose prism facility:
    - Clear, single, binocular vision when viewing a 20/30 target at 40 cm through 25 prism diopters base-out and then without prism for at least 10 cpm
    - Clear, single, binocular vision when viewing 20/30 target at 40 cm through 12 base in prism and then without prism for at least 10 cpm
QUESTIONS?