Clinical Pearls for Treating Vertical Deviations

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- Dr. Simonson is the Senior Research Optometrist for Gerull Labs which developed the Opto app & Stereoscope for iPad.
- She has three sons, ages 2, 4, and 8 who helped make videos for this presentation.
- Dr. Simonson volunteers weekly at the Erie Elementary School and is on the board of the Vision and Learning Forum.

Questions?
- Please e-mail questions: drjsimonson@yahoo.com
- I will post answers on my website www.bouldervt.com along with links to references, therapy exercise instruction sheets, and other helpful resources.

Course Description:
Dr. Simonson will share Clinical Pearls in treating vertical diplopia. This course will discuss eye alignment testing, prism prescribing and recommended techniques to decrease symptoms and improve fusion skills for patients with vertical strabismus.

1. Assessment of vertical ocular deviations including techniques to evaluate children.
2. Learn ways to determine the best prism prescription to enable fusion.
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3. Learn the best types of fusional targets to use in the therapy room.

4. Add head movement and target movement to vision therapy techniques.

Pearl: Use two barrel cards and offset one higher than the other.

5. Understand how to program a successful sequence of vision therapy activities for treating vertical deviations.


Pearl: Extend vertical AND horizontal fusion ranges.

Use prism to enable fusion

1. How much prism? Minimum to FUSE WELL.

2. What if it is a different amount depending on where they look? Create fusion in straight ahead gaze, extend to other areas with compensatory head positions and vision training.

3. What if it depends on how tired their eyes are? Prescribe more than 1 pair of lenses or add Fresnel as needed.

Goal: prevent double vision and closing one eye.

Use prism to enable fusion

1. Measure the angle of the eye turn in primary gaze at distance and near distances.
2. Determine gaze and distance of best fusion stability.
3. Determine the minimal prism to fuse images well in primary gaze.
4. Measure the fusional range.
5. Trial frame prescription for stability of fusion, comfort and clarity.

If the patient has suppression, I do not initially prescribe prism glasses.
Measure the angle of the eye turn in primary gaze (straight ahead, with no head turn or head tilt) at distance and near distances.

**Pearl:** Make sure the head is straight. Most patients will have a compensatory head tilt.

This test gets boring for kids – use animals and cartoons – just ask them to focus on the small details, like eyes and noses.

**Pearl:** Use a target stick to make it easy to get straight-ahead and down gaze. If needed, recommend separate distance glasses and reading glasses.

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**Targets:**

**Determine gaze and distance of best fusion stability.**

1. Which eye is higher?
2. Is it worse when looking to the right or left side?
3. Is it worse tilting to the right or left shoulder?
4. Is it worse looking up or down?

**2) Von Graefe Phoria Testing**

- The patient reports when the targets LOOK level.
Von Graefe measurement of a Vertical Phoria/Tropia

- **Typical Set Up:**
  - One eye: 12 BI prism (Use Horizontal Prism to dissociate)
  - Other eye: Vertical Prism to measure
    - Move prism until patient sees targets line up “like headlights on a car”
    - Patient instructed to watch the non-moving target

- **Interpretation**
  - Base Up Prism to neutralize: hypo
  - Base Down Prism to neutralize: hyper

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Maddox Rod

- This is my recommended test for getting an accurate subjective response from young children (as young as age 3).
- It combines the red lens test to look for comitancy in different gazes.

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4) Modified Thorington

- Use a scale to measure the amount of eye turn.
- It is used with a transilluminator and a Maddox Rod.
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5) Howell Phoria Cards
- These cards allow direct measurement of the distance and near phorias in real space.
- The patient simply has to tell which number the arrow points to.

6) Keystone

7) Bioptr
- Bernelloscope

8) Rotoscope/Amblyoscope/Synoptophore
- Physical movement of targets until they align.

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9) Computerized alignment testing

Determine gaze and distance of best fusion stability

VTS–3 Motor Fields
Less Lancaster
Red lens test
Maddox rod testing in various gazes
Cover testing in various gazes.

Pearl: Ask the patient when you do version testing when they see the target double and come back together. Measure with a vision disk.

Use the minimal amount of vertical prism for MAXIMUM ability

- (don’t under prescribe, but bias towards comfort).
- Usually this is about 90% of the turn.
- Example: A 4 pd Left Hypertropia (4 pd BD OS)
  - 90% x 4 pd = 3.6 pd BD OS

Measure the Fusional Range

1. Prism bar
2. Risley prism
3. Rotoscope
4. Vectograms

Measure the Fusional Range
Center the amount of prism in the middle of the fusional range.

- **Example 1:** The left eye can move from 1 BD to 6 BD without seeing double.
  - How large is the fusional range? = 5
  - Where is the center of the fusional range? ½ of 5 = 2.5, 1 BD + 2.5 BD = 3.5 BD (The 90% rule matches = 3.6 pd BD)

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**Trial Frame Testing**

- Split vertical prism between the two eyes to decrease prism distortion in the glasses.
- Trial frame testing allows the demonstration of the planned glasses prescription and the evaluation of small differences to finalize the prescription.

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**Use prism to enable fusion:**

- Often, vertical prism can be put into the patient’s glasses prism or applied to their glasses with Fresnel prism.
- Increase or decrease the amount as needed in the therapy room to make the patient functional.
- Angle the prism as needed if there is diagonal misalignment.

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**When is it challenging to use prism?**

1. Near and distances vertical deviations are not equal.
2. Contact lens wearers or Emmetropia.
3. Induced hyperphoria due to spectacle correction (anisometropia).
4. Torsional deviations (cyclophoria rotation).
5. Patient who does not wear glasses.
6. The need for very high amounts of prism.
7. Non-comitant eye turns (amount varies depending on the direction the patient looks).

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**Vision Therapy for Vertical Deviations**

Recommended Therapy Techniques and Concepts

*I will be demonstrating many techniques - participate if you are comfortable and rest your eyes as needed!*
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**Training Pearls:**
- Determine gaze and distance of best fusion stability.
- Place targets in the position of best fusion. This may be to the side.
- Place the person’s gaze in the position of best fusion. This may require a head tilt or turn.

**Therapeutic Goals:**
1. Develop adequate fusional vergences ranges (motor fusion)
   - In all positions of gaze
   - At near and far distances
2. Enhance accommodative/convergence ability
3. Enhance depth perception
4. Integrate binocular function with information processing
5. Enhance fusional vergence facility and flexibility
6. Integrate vision with accurate motor responses
7. Integrate sensory skills (vision, vestibular, kinesthetic, tactile, auditory)
8. Increase visual stamina
   - COVD Prescribed Treatment Regimen

**Eye movements**

OKN – Optokinetic nystagmus

1. Start with eye movements:
   - Do wide monocular eye stretches
     - to free adhesions and strengthen tissue from disuse
     - Attempt 10 times per day.
Eye movements
- (VOR – vestibular ocular reflex)
- Trampoline

VOR
- Use a shadow for visual feedback on head posture.

VOR
- Use a mirror for visual feedback on head posture.

- Draw a horizontal line on a board or use a horizontal edge in the room. Place your hand in front of your nose with your arm extended straight. Look at your hand.
  - Is the line straight, or is the left or right side higher?
  - What happens with a head tilt?
  - Tilt head to align the left and right lines and then work to gradually straighten head.

Swings
2. Use VERY STRONG stereo targets

- Vectograms are great!
  - A clown vectogram has more depth, use it first.
  - Work from stronger fusional targets (3rd degree stereo) to 2nd and 1st degree targets.

- Use projection to build fusional skills at distance.
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**Use Computer generated targets**
- VTS vertical fusion targets are better for initial training than HTS random dot targets.
- Home use of computer vergence programs are very supportive to therapy progress.

**When to Use Anaglyphs:**
- Typically you will use polarized targets before red/green targets
- EXCEPTION: when a cyclorotation or head tilt will prevent cancellation of the polarization.

**Use VERY STRONG stereo targets**

**Phantograms**

**Phantograms**

- Cover an eye
- Try to recover depth quickly

**3. Don't increase the demand too quickly.**

Make sure that when the patient is fused, that the patient is FUSED WELL.
1. Add head movement before increasing fusional demand.
2. Work the border of fusion. Do not alternate between single and double: adjust from blurry/uncomfortable back to single and comfortable.
3. Make it a goal to see tiny changes – “just noticeable differences.”
4. HEAD ROTATIONS

Procedure:
1. Stand with feet shoulder width apart and balanced. Rotate your head in a circle four times and switch directions 4 times until rotation is smooth and easy.
2. Look at a distant object and rotate your head.
3. Look at a near object held about two feet in front of you and rotate your head.
4. Alternate looking from far to near after each rotation.

5. Modify Target Positions:
   - Offset Targets Diagonally
   - Use Prism to move target positions optically.

CHIASTOPTIC THUMBS PROCEDURE

STEP 1 – convergence
1. Hold your thumbs at arms length, at eye level, 5 cm apart.
2. Slowly cross your eyes……you should notice that each thumb doubles.
3. Overlap the two inner thumbs so that you see a total of three thumbs.
   "May need to make thumbs diagonal.

STEP 2 – divergence/ base-in
1. Hold your thumbs at arms length about 2 cm apart.
2. Look beyond the thumbs through the separation. You will see four thumbs.
3. Relax your eyes to get three thumbs.
4. Slowly separate your thumbs while maintaining the center thumb clear and single.

ORTHOPTIC THUMBS PROCEDURE

STEP 3
1. Separate your thumbs 3 cm. Look through the separation and relax your eyes to fuse the four thumbs into three clear thumbs.
2. Next, cross your eyes and get 3 clear thumbs again. Continue this relax – crossing – relax – crossing pattern for several minutes.
3. For more of a challenge, increase the thumb separation and continue.

Use fingernail polish, stickers, or a marker as a suppression control.
Apply same principle to other free space fusion skill exercises:

6. Extend fusional ranges

Lines . . . Etc.

- Offset the lines vertically to aid fusion if necessary. You can also rotate the lines into a diagonal position if there is a pre-existing strabismus.
- A fun target for free-space fusion is “find the difference” puzzles. The patient will see “fusons” or “sliding” in the area that differs between the two images.

This can be done on-line at http://www.sightdifferece.com/practice.asp. The “Hard Level” has several targets to fuse. Movement is both horizontal and vertical, expanding fusion stability.

Offset targets and work to make them level.

BROCK STRING

Equipment: string with beads
http://www.youtube.com/watch?v=E9CVDsNgfw&feature=related

Procedure:
1. Attach one end of the string to a stationary object.
2. The patient holds the other end of the string between the thumb and forefinger just below the nose, exactly on the midline.
3. MAKE AN “X”
   The patient looks at the bead. If both eyes are performing as desired, he should see one bead and two strings.
If the patient only sees one bead and one string when both eyes are open, he is suppressing one eye. To break the suppression, try the following:

1. Check posture
2. Check peripheral awareness.
3. Blink rapidly several times.
4. Wiggle the string.
5. Move the bead closer to or further away.
6. Use red–green glasses for luster and suppression feedback.
7. Use at thicker string like a shoelace.

If the patient sees two beads and two strings, it means his eyes are not converged at the bead.

1. Move the bead closer or further.
2. Tilt or turn the head.
3. Use prism to make the beads level.

**BROCK STRING: increase difficulty**

1. Head turned to different positions: up & down (TIP) right and left (TURN). The string stays straight.
2. Head continuously moving, string stays straight.
3. Head stays still. The string is moved by the therapist to different positions.
4. Head stays still, string continuously moving in different positions or in a circular path.
5. Head moving, string moving.

You could also attach the string to a rotating peg board.

**PRISM JUMPS**

1. Add Base–Out and Base–In prism.
3. Repeat with the prism in front of the other eye.
7. Build fusional ranges (both horizontal and vertical ranges) and THEN wean off prism as SLOWLY as possible.

- Don’t be too quick to cut the prism. Typical: 1 prism diopter per month.
- Test prism decrease in the therapy room before remaking glasses.

8. Strong feedback to patient:

- Complete activities that give the patient strong feedback on relative eye positions: red light/red ring, voluntary vergences, after-image flash ball tracking.

Prism Rotations

This is one exercise that helps patients FEEL their eye position.

Sequencing Vision Therapy

1. Equalize monocular skills:
   - There can be contracture (tightening) of the muscle fibers causing decreased flexibility and mobility.
   - Eye stretches
   - Pursuit tracking (ball on back)
   - Saccade tracking (face of clock, 4 corners)
   - Rotations (pegboard, projected)
   - Acuvision/SVF/Saccadic Fixator
   - Space Fixator (look, ready, touch, back)

2. Build sensory fusion skills

- If the patient suppresses an eye, progress through:
  - Anti-suppression therapy
  - MPBF – monocular fixation in a binocular field
  - Superimposition
  - Secondary fusional targets
  - Stereoscopic fusional targets
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Anti-suppression

Make it EASY for the patient to MAINTAIN binocularity.
1. Vectograms (can move diagonally)
2. HTS or VTS computer vergences
3. Rotoscope/Amblyoscope/Synoptophore
4. Stereoscope with fusion cards
5. Wheatstone “Flying W” Cheiroscope

4. Support fusion with prism and target position.

- Use Prism as a Support to MAINTAIN fusion:
  1. Trial frame prism
  2. Fresnel prism on their glasses
  3. Prism Bar
  4. Lollipop prism
  5. Prism attached to a Stereoscope

- Use Target Position as a Support to MAINTAIN fusion:
  1. Offset targets in the scope

Maintain Binocularity

- Use the vestibular ocular reflex to help with eye movements and to extend the fusional ranges:
  - Have the patient STOP with the target looks “less clear” “less 3-D” “different” etc.
  - DO NOT go: single–double–single–double
    1. Head turns left and right
    2. Head tips up and down
    3. Head tilts to right shoulder and left shoulder
    4. Head Rotations

5. Add Head turns, tips, tilts, and rotation.

- Allow the patient to put their head in the BEST POSITION to FUSE, then work towards straight
6. Use Free Space Fusion Techniques.
Offset targets as needed to enable fusion.
- If there is a cyclorotation, you may also need to tilt the targets to fuse.
- Use CIRCULAR TARGETS, and you won’t have to rotate the targets to fuse the images.
  1. String and Dowel
  2. Brock String
  3. Chiasopic Thumbs
  4. Eccentric Circles
  5. Life saver cards (cut apart)

7. Increase the Difficulty
1. Move the head position
   • Move to level to a more difficult position (opposite tilt/turn)
   • Move the body closer and further from the target
2. Change the target positions:
   • Go from diagonal to level for all targets
   • Move targets closer and further
   • Increase BI and BO ranges first
   • Work on vertical fusional ranges
3. Decrease the supportive prism
   • Use a prism bar to back down step by step.
   • Use a prism flipper with slightly less prism.
   • Decrease Fresnel prism.
   • Decrease prism on Bresnelloscope.
   • Decrease prism in the patient’s glasses prescription.
4. Use more challenging fusional targets:
   1. Tranaglyphs
   2. Morgenstern Color Fusion Cards
   3. Sports Disk
   4. BC Fusion Cards (~70 series is vertical fusion)
   5. Keystone or Alphabet fusion Cards
   6. Aperture Ruler
   7. Magic Eye
5. Pull eyes into vertical alignment WITHOUT 3D FUSION:
   1. Squinchel
   2. After-image flash tracking
   3. Voluntary Vergences
   4. Red light/red ring
   5. Simultaneous perception targets
6. Increase the ease and speed of alignment
- Start with small transitions:
  1. Prism flipper (example: 3 BD/2 BD and increase increments to 3 BD/1 BD etc)
  2. Prism Bar
  3. Double vectograms
  4. Jump ductions on the computer

- Near-far targets
  1. Start with small transitions (“walk away” techniques)
  2. Build up to a projected vectogram, projected computerized target, or window target to a hand-held target

- Look away or Close eyes – work on speed to regain fusion.

Moving Targets

Recommended Therapy Exercises:
- Rotate free space fusional targets at arms length: eccentric circles, Brock string, string and dowel, vectograms, and tranaglyphs for home therapy.

Vertical Vergences
- Compensating vertical vergence ranges can be improved in patients with a vertical misalignment.
  - Maintain fusion in activities of daily living = functionally less double vision and eye strain.
  - Maintain fusion with good posture (no compensations with head or body)
  - Maintain fusion in all gazes
  - Maintain fusion with rotating and moving targets

Specific Vertical Fusion Exercises:
1. Vertical Vectogram
2. Vertical Visicare Cards for the Bernelloscope
3. Variable prism Bernelloscope
4. Vertical VTS-3 and HTS
5. Prism (bar and lollipop)
6. BC Cards – 70 series
Signs & Symptoms

- What are the Signs and Symptoms of Vertical Strabismus?
  1. An eye turn
  2. A sensation of monocular viewing
  3. A head turn or tilt
  4. Poor depth judgment
  5. Fatigue
  6. Double vision
  7. Eye Strain (asthenopia)
  8. Poor eye-hand coordination
  
  - You are GREAT at training these skills! That is the GOOD NEWS.

How long will therapy take?

- This is the bad news!
- It is much more difficult to build vertical fusional skills compared to horizontal fusional skills.
- According to COVD, successful therapy may require 60 – 80 hours of office therapy.

References:

6. The College of Optometrists in Vision Development Fact sheets
8. Courses by Drs. Cathy Stern, Curt Baxstrom, Bob Sanet