Diagnosis & Management of Accommodative & Binocular Vision Disorders

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The kids are coming!

- It’s a 3D World
- Technology

Important Statistics

- It is estimated that 1 out of 4 children have an undiagnosed vision problem that interferes with their ability to read and learn (COVD)
- As much as 80% of learning is accomplished through the eyes (AOA)

What Causes These Problems?

1) May be developmental in nature
2) May be due to regression of a previously acquired skill

Case History – What Do You Need To Know?

- Enough information to:
  - make a tentative diagnosis
  - Determine if additional tests are needed
- Probe for the most common:
  - Physical symptoms
  - Performance symptoms
Over 15 visual skills are critical to reading and learning

- Success In School
- Visual Information Processing
- Healthy Eyes and Brain

Conditions most likely to cause physical and/or performance symptoms:
- Uncorrected Refractive Error
- Oculomotor Dysfunction
- Accommodative Dysfunction
- Binocular Vision Dysfunction

Associated Symptoms: Oculomotor Dysfunction
- Loss of place and/or omission of words when reading (most common)
- Poor attention, easily distractible
- Asthenopia (almost any discomfort around the head and eyes)

Associated Symptoms: Accommodative Disorder
- Transient blurred vision
- Asthenopia (eye strain)
- Pain in or around the eye
- Headaches
- Difficulty sustaining near visual function
- Abnormal postural adaptation/abnormal working distance

Associated Symptoms: Binocular Vision Dysfunction
- Asthenopia (eye strain)
- Headache
- Pain in or around the eyes
- Diplopia
- Difficulty sustaining attention during visual tasks
- Inaccurate depth perception
- Muscular incoordination/clumsiness

Associated Symptoms: Binocular Vision Dysfunction
- Abnormal posture adaptation
- Abnormal working distance
- Motion sickness
- Dizziness after sustained task
Most Critical Visual Skills to Assess in the Pediatric Patient

- Ocular Motility
- Accommodation
- Binocularity

Assessing Ocular Motility

- Fixation
- Pursuits
- Saccades

Assessing Ocular Motility: Fixation, Pursuits, & Saccades

- Pursuits and saccades both depend on foveal fixation of the object of regard
- With pursuits, foveal fixation is maintained on a moving object
- With saccades, the individual shifts fixation from one object of regard to another

Assessing Ocular Motility

- Typical targets include Wolff wand, sticker affixed to a tongue depressor, or a small penlight
- Having a variety of targets is helpful when evaluating a young child who has difficulty sustaining attention

Gross Measurement of Pursuits

- Patient follows a target that is slowly moved through the horizontal, vertical, and diagonal meridians.

Gross Measurement of Pursuits

- Do not move the target too rapidly, or fixation will be lost and pursuit movement will appear jerky
Expected Findings: Pursuits
- Pursuits in preschoolers are frequently accompanied by head/body movement
- Smooth pursuits with minimum head movement and good ability to sustain are normally present by 6 or 7 years old

Gross Measurement of Saccades
- Hold two targets approximately 16 inches apart and rhythmically direct the patient to shift fixation from one to the other on command
- Most important to perform horizontally when there are reports of difficulty losing place when reading

Gross Measurement of Saccades
- Is there an over/undershoot?
- Can they sustain overtime?
- Is there head movement?
- Is there gross motor overflow?

Expected Findings: Saccades
- Young school-age children exhibit less accuracy, more difficulty with attention, and more head movement/gross motor overflow
- Accurate, well-sustained saccades with minimum head movement/gross motor overflow expected by 8 or 9 years old

NSUCO Oculomotor Test
- A normalized free space test shown to have good reliability and validity
- 8 observations are made - 4 pursuits and 4 saccades
- A score is given for each category: accuracy, ability, head movement, and body movement

<table>
<thead>
<tr>
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<th>ABILITY</th>
<th>ACCURACY</th>
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Assessing Accommodation

- **Accommodative Amplitude:**
  - Push-up Method
  - Negative Relative Accommodation (NRA)
  - Positive Relative Accommodation (PRA)

Assessing Accommodative Amplitude

- **Push-up:** subjectively measures the amplitude monocularly
- Measure the distance at which the patient reports a blur
- Minimum Expected: 15 – (1/4) Age

Assessing Accommodative Amplitude

- With young children, can modify procedure by starting with the chart very close, pull it away from the child until they can first read the letters.
- No significant difference in measurement with push-up and pull-away method

NRA/PRA - An Indirect Assessment of Vergence

- “As I add lenses in front of your eyes, keep these letters clear for as long as you can. Tell me when the letters are blurry.”

NRA - An Indirect Assessment of Vergence

- NRA: measurement of ability to relax accommodation as well as positive fusional vergence (convergence)
- Add plus lenses until the patient first reports blur of the target
**PRA – An Indirect Assessment of Vergence**
- **PRA**: measurement of ability to stimulate accommodation as well as negative fusional vergence (divergence)
- Add minus lenses until the patient first reports blur of the target

**NRA/PRA**
- Expected findings:
  - NRA +2.00 +/- 0.50
  - PRA -2.37 +/- 1.00
- The two findings should be approximately balanced (+2.50/-2.50)

**Assessing Binocularity**
- **Alignment/Motor Fusion**
- **Sensory Fusion**

**Assessing Binocularity:**
- **Cover test**
- **Stereopsis – Global/Local**
- **Worth 4 Dot**
- **Near Point of Convergence**
- **Phoria – Von Graefe technique**
- **BI/BO Vergences**

**Cover Test: Distance**
- Isolate a 20/30 letter on the distance visual acuity chart (or 2 lines above threshold if acuity is not 20/30)
- Instruct patient to fixate the letter and “keep it clear” throughout testing.
- Perform both unilateral and alternating
Cover Test: Near
- Hold a fixation stick 40 cm from the patient's face and have the patient fixate an isolated 20/30 letter
- Instruct the patient to fixate the letter and "keep it clear" throughout testing
- Perform both unilateral and alternating

Clinical Pearl: Performing Cover Test
- Using a translucent occluder will allow you to observe the non-fixating eye
- An acrylic fixation ball for near testing helps keep the attention of a young child
  - "Who do you see in there?"
  - "Am I right side up or upside down?"
  - "Show me where my nose is in there."

Randot Stereopsis
- Make sure the patient is wearing polarized glasses over his/her appropriate prescription
- Hold the target upright at 40 cm to avoid any glare
- Do not allow the patient to turn or tilt the head
- Retest with new prescription anytime stereopsis is reduced

Assessing Sensory Fusion: Worth 4 Dot
- This is the best test to determine which eye a patient is suppressing
- Test should be performed at 16 inches and 3 feet (peripheral target vs. central)

Worth 4 Dot: What does it mean?
- Expected response is 4 Dots: 2 green, 1 red, and one either red/green/orange
- Suppression OD = Sees only 3 green dots
- Suppression OS = Sees only 2 red dots
- Diplopia = Sees 5 dots total (usually 3 green and 2 red)
How Deeply Embedded is the Suppression?

- Patient gives suppression response at 16 inches or 3 feet, repeat the test in dim illumination
- Suppression is shallow when patient reports normal findings with the lights off
- The suppression is deeply embedded if it is still present with the lights off

Near Point of Convergence

- Starting at 40 cm, have the patient fixate an isolated letter on the fixation stick
- Slowly move the stick towards the patient at eye level, asking him/her to report when there are two targets
- Once diplopia occurs, slowly move the target away from the patient and have him/her report them they see one again

Near Point of Convergence: Expected Finding

- When using an accommodative target:
  Break 5 cm and Recovery 7 cm
- When using a non-accommodative target:
  Break 7 cm and Recovery 10 cm

Clinical Pearls: Performing NPC

- Repeat the test 3-5 times to look for recession
- Can perform the test with a non-accommodative target such as a penlight to determine if better/worse
- When receded, repeat while the patient wears low plus lenses and look for improvement
- Most important test to perform when patient complains of diplopia after near work

Near Phoria: Von Graefe Technique

- Use isolated 20/30 letter or vertical line position at 40 cm
- Place 10-12 BI prism before OS and 6 BD prism before OD
- Instruct the patient to tell you when the targets are lined up in a straight line - like buttons on a shirt

Near Phoria: With +0.75 Sphere

- Repeat procedure with +0.75 sphere in addition to distance prescription
- This is helpful in determining the effect of addition lenses on near posture
- Keep in mind the norms for near phoria:
  - Ortho to 6 exophoria
Smooth Vergence Testing
- Have the patient fixate a vertical line of 20/30 letters on the near card
- Slowly introduce prism asking the patient to tell you when it becomes blurry or double.
- Continue 2-4 prism diopters past break point, and slowly reduce prism asking the patient to report when the targets become one again

Tips For Performing Vergence Testing
- Always perform BI before BO!
- Young children often “forget” to mention diplopia
- If the patient isn’t reporting diplopia, ask which way the target is moving. This will tell you which eye the patient is suppressing

Smooth Vergences: Expected Findings
- Base-in (near): Blur 13, Break 21, Recovery 13
- Base-out (near): Blur 17, Break 21, Recovery 11

Smooth Vergences: A Suppression Response
Example:
- While performing BI vergences, the patient reports the target is moving to his left. What does this mean?

Diagnosing Oculomotor Dysfunction
- If a patient is of school age and cannot demonstrate maximum ability with either pursuits or saccades, then OMD is diagnosed
- Consider OMD to be present if symptoms exist and any failure criterion is met (ability, accuracy, head movement, body movement)

Diagnosing Accommodative Dysfunction
- Accommodative Insufficiency – difficulty stimulating accommodation
- Accommodative Excess/Spasm/Pseudomyopia – difficulty relaxing accommodation
- Accommodative Infacility – difficulty changing accommodative response
Accommodative Insufficiency: Symptoms
Generally related to reading or other near tasks:
- Blurred vision
- Headaches
- Eyestrain
- Fatigue/sleepiness
- Reading problems

Accommodative Insufficiency - Signs
- Reduced amplitude of accommodation
- Reduced PRA
- Low BO to blur finding at near
- Can possibly be associated with a phoria that falls outside expected values

Accommodative Excess: Symptoms
Generally related to reading or other near tasks:
- Blurred vision - worse after reading
- Headaches
- Eyestrain
- Difficulty focusing from far to near - intermittent distance blur
- Sensitivity to light

Accommodative Excess: Signs
- Reduced NRA
- Low BI to blur finding at near
- Can possibly be associated with a phoria that falls outside expected values
- Myopic refraction with little to no improvement in BCVA - Pseudomyopia caused by Accommodative Spasm

Accommodative Infacility: Symptoms
Generally related to reading or other near tasks:
- Blurred vision - particularly when looking near to far or far to near
- Headaches
- Eyestrain
- Fatigue/Sleepiness
- Reading problems

Accommodative Infacility: Signs
- Reduced NRA and PRA
- Low BI to blur finding at near
- Can possibly be associated with a phoria that falls outside expected values
Diagnosing Binocular Vision Disorders

- Convergence Insufficiency
- Convergence Excess
- Fusional Vergence Dysfunction

Convergence Insufficiency: Symptoms
Generally related to reading or other near tasks:
- Blurred vision
- Headaches
- Double vision
- Eyestrain - pulling sensation around eyes
- Words moving on the page when reading

Convergence Insufficiency - Signs
- Receded NPC
- Greater exophoria at near than distance
- Reduced positive fusional vergence
- Low NRA

What about Pseudo-CI?
- Will present with typical signs of CI: Reduced NPC/PPV/NRA & exophoria at near
- May also demonstrate: reduced amplitude of accommodation/PRA with improved NPC/near phoria with low plus

Convergence Excess: Symptoms
Generally related to reading or other near tasks:
- Eyestrain
- Headaches
- Blurred vision
- Occasional double vision
- Inability to concentrate when reading

Convergence Excess: Signs
- Esophoria greater at near than distance
- Reduced negative fusional vergence
- Low positive relative accommodation
Fusional Vergence Dysfunction

- Ortho, or low eso/exo at distance & near
- Normal NPC
- Low (constricted) ranges BI and BO at distance and near
- NRA & PRA both low (constricted)

After The Diagnosis

When to treat?
When to Monitor?
What about the asymptomatic patient?

As a General Rule of Thumb...

- If there is any deviation from the expected, consider treatment or consultation.
- Always consider treatment when the patient has longstanding symptoms.

The Asymptomatic Patient

- Educate the patient about the symptoms most commonly associated with the clinical findings
- Consider monitoring sooner than 1 year to determine if condition is worsening

The Asymptomatic Patient

Example of when to monitor:

A patient is being given his/her 1st myopic prescription. Near phoria through manifest is 2 eso. This is a common occurrence with 1st time myopic correction – monitor this patient over time

Sequential Management Approach

1) Optical correction of ametropia
2) Added lens power
3) Prism
4) Occlusion
5) Vision therapy
When to Monitor for Improvement
- Have patient wear prescription for 4-6 weeks
- Perform re-evaluation to assess status of accommodative and binocular function
- If accommodative, ocular motor, or binocular disorders still persist then additional treatment must be considered

Prescribing Addition Lenses
- Addition lenses alter the demand on either the accommodative or binocular systems
- The most common example of the effectiveness of the use of addition lenses is Convergence Excess

Findings to Consider When Determining Plus at Near:

<table>
<thead>
<tr>
<th>Test</th>
<th>Findings</th>
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<tbody>
<tr>
<td>AC/A ratio</td>
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<td>Refractive error</td>
<td>Hyperopia</td>
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<tr>
<td>Near phoria</td>
<td>Esophoria</td>
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<tr>
<td>Positive relative accommodation</td>
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<td>BI vergences (near)</td>
<td>Normal to High</td>
</tr>
<tr>
<td>Amplitude of accommodation</td>
<td>Low</td>
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</tbody>
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Conditions That Respond Best to Addition Lenses:

- Convergence Excess
- Accommodative Insufficiency
- Ill-sustained accommodation

What About Near Posture?
- Performing Von Graefe phoria at near can help determine the prescription and the effect of lenses on the patient
- The goal is to prescribe addition lenses that help the patient maintain an expected posture at near (Ortho to 6 exo)

When Prism May Be Helpful
- Horizontal relieving prism
- Vertical relieving prism
- Use when vision therapy is inappropriate or impractical
Relieving Prism: Horizontal & Vertical
- Should be used primarily with high esophoria at distance (Divergence Insufficiency) OR when VT isn't likely to be achieved
- Vertical prism should be prescribed first when a vertical and horizontal deviation are both present

Prism: A Secondary Treatment Option
Convergence Insufficiency: for cases where the patient cannot comply with vision therapy

Vision Therapy: When is it recommended?
- Accommodative disorders
- Binocular disorders
- Oculomotor disorders

VT as the Treatment of Choice:
- Convergence Insufficiency
- Oculomotor Dysfunction
- Accommodative Excess
- Accommodative Infacility
- Fusional Vergence Dysfunction

Convergence Insufficiency Treatment Trial (CITT)
- Most effective treatment for CI was office based therapy combined with home reinforcement activities (75% achieved improvement)

When Vision Therapy is Indicated:
- Educating the patient/parent
- Explaining the diagnosis
- Explaining need for additional testing
Locating a Doctor That Offers Vision Therapy

College of Optometrists in Vision Development website:

www.covd.org

Click “Locate a Doctor” in upper right corner and enter zip code or city/state

THANK YOU!!