**Diagnosis and Management of Concussion in Primary Care Workshop**

AOA Optometry’s Meeting 2019

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**Timeline**

Background information/introduction to managing concussion patients - 30 minutes

Hands-on workshop experience - 35 minutes x 4 stations

- Eye movements
- Binocular vision
- Vestibular-ocular motor
- Visual Perceptual

Conclusion/Questions/Wrap up - 10 minutes

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**Workshop Objectives**

1. Learn what additional oculomotor testing should be added to the primary care optometric examination when a patient has suffered from a concussion
2. Practice performing oculomotor testing and how to modify the tests for patients with head injury
3. Understand what diagnoses are common in post-concussion oculomotor dysfunction
4. Develop techniques for home-based or in-office orthoptics that require minimal to no purchasing of additional equipment for the office to initiate treatment for patients.

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**Introductions**

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**What is a concussion?**

- Type of mild traumatic brain injury
- "External force or sudden movement that causes rapid acceleration/deceleration of the brain tissue within the skull that leads to an internal linear, translational, and rotational forces, that leads to a complex pathophysiological process, which results in a functional disturbance in brain function"
  - +/- loss of consciousness <30min
  - +/- direct blow to head
  - Could be whiplash or direct trauma to other parts of the body/spine
  - "Functional disturbance" = neuroimaging (MRI/CT scan) is normal
- Short-lived impairment of neurological function resolves spontaneously in MOST cases and follows a sequential course
  - May be prolonged and requires active treatment in some cases

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**What are common optometric complaints for an mTBI?**

- The obvious
  - Blurry vision
  - At distance after prolonged reading
  - Double vision at near
- The less obvious
  - Headaches/dizziness/nausea with reading, computer, phone etc
  - Visual anxiety in visually crowded areas (restaurants, grocery stores, school hallways)
  - Difficulties concentrating
  - Eyestrain/fatigue
  - Visual-derived nausea
  - Eye tracking difficulties

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Chief Complaint/Intake Questionnaire for TBI

- **Full Example Questionnaire In your Handouts**
- **Published Surveys: BIVSS, CISS-CON P, VLSQ-8 (Photosensitivity)**
- **Additional Questions we like to ask**
  - How do you feel in a visually crowded environment? (Walmart/costco/restaurants)
  - How do you feel when in a car? Are you currently driving?
  - How do you feel with fluorescent lights? Electronic devices?
- **Occupation they would like to return to/Patient quality of life GOALS and priority level**
  - Environment description
    - Number of computer screens
    - Lighting
    - Hours on the computer
    - Meetings
    - Telecommute

How does your evaluation differ for a patient with mTBI?

**Elements of a primary care eye exam**
- History
- Pupils
- Color vision (once)
- Screening visual field
- Refraction
- Sclera
- Retroillumination
- Slit lamp (Ocular ptosis)
- Examination of blind-detected visual acuity
- Refractive state
- Tonometer
- Fundus (eyeball, vessels, vitreous, optic disc, retina)
- External examination
- Biomicroscopy
- Internal examination
- Ophthalmic + Optic examination
- Diagnosis - history of TBI influences timing
- Initiation of diagnostic and treatment programs

**Elements of an eye exam**
- History
- Visual field (Threshold as separate visit)
- Examination of blind-detected visual acuity
- Refractive state
- Tonometer
- Astique, pampillonia, cataracts, glaucoma, AMD
- Accommodation (amplitude, facility, accuracy)
- Binocularity (fusional, stereopsis)
- Vergence (levels, angles, facility)
- Gaze posture (9 fields)
- Visual fields
- Visual perception & Processing
- Visual motivation evaluation
- Diagnosis - history of TBI influences timing
- Initiation of diagnostic and treatment programs

How to Set up your office for a TBI Patient

- These are not your normal patients walking into the office
- Prep your staff
- Tips for the patient before they even get to your exam - scripts
  - Ask that they arrive early so their symptoms from the drive can calm down
  - Sending out questionnaires ahead of time and having it filled in
- Waiting room
  - May need an added room if too visually or auditorily crowded
  - Eye plgs
    - Non-fluorescent lighting
    - Exam room
      - Lighting in the exam room
      - Keeping the noise level down
      - Only the necessary equipment/bedding
      - Minimal wall decorations/bling and designs

How to get mTBI patients into your office

Create a local multidisciplinary team

- Pediatricians/Primary Care Physicians/Physical Medicine and Rehabilitation
- Sports Medicine
- Neurology
- Neuro-psychology
- Psychology
- Physical Therapy
- Occupational Therapy
- Cognitive/Behavioral Therapy
- Social Workers/Care Managers
- Schools/Teachers/Counselors
- Hospitals
- CNS/Center for Neuro skills
Create a Multidisciplinary team

- Take providers out to lunch
- Put on a local CME
  - Discuss common signs/symptoms in concussion that may actually be vision in etiology
    - Physical symptoms
      - Vision-derived Dizziness/nausea/vomiting
      - Light sensitivity
      - Blurry vision
      - Double vision
    - Headache with near work/computer/reading
  - Cognitive Symptoms
    - Inability to concentrate/pay attention
  - Emotional Symptoms
    - Anxiety/horror in visually crowded areas
- Ask them how you can help identify issues that warrant other referrals
- Ask how often they would like reports and what information they would like

You’ve Finished your Assessment - Now What?

- How to communicate to the rest of the care team
  - Letter templates
    - School
    - Work
    - Providers
VISION REHABILITATION QUESTIONNAIRE

Please fill out this questionnaire carefully. Please return it to our office prior to your appointment.

Appointment: ___________________________ Time: ___________________________

GENERAL INFORMATION

Patient Name: ___________________________________________ Male ☐ Female ☐
Birth Date: ___________________________ Age: _______ Email: ___________________________
Home Address: ________________________________________ City: ___________________________
State: ___________________________ ZIP Code: ___________________________
Home Ph: ___________________________ Work Ph: ___________________________ Cell Ph: ___________________________
Marital Status: Single ☐ Married ☐ Divorced ☐ Widowed ☐ Other ☐

Were you referred to our office?
If yes, who may we thank for this referral? ___________________________________________
Phone Number: ___________________________ Address: ________________________________________
City: ___________________________ State: ___________________________ Zip Code: ___________________________

Do you have Major Medical Insurance? Yes ☐ No ☐
If yes, who is the carrier? ___________________________________________ Policy Number: ___________________________
Does the insurance cover eye examinations or glasses? Yes ☐ No ☐
Primary Insurance: ___________________________ Policy Number: ___________________________
Secondary Insurance: ___________________________ Policy Number: ___________________________
Social Security Number: ___________________________ Driver’s License Number: ___________________________
Occupation: ___________________________ Employer: ___________________________
Business Address: ___________________________ City: ___________________________ Zip Code: ___________________________
Spouse’s Name: ___________________________ Cell Ph: ___________________________

MEDICAL HISTORY

Date of injury/accident: ___________________________
Type of injury/accident:
☐ Motor Vehicle ☐ Hemorrhage ☐ Stroke ☐ Fall ☐ Medication Related
☐ Drug Abuse ☐ Carbon Dioxide ☐ Cord Around Neck ☐ Aneurysm
☐ Blow to Head ☐ Drowning ☐ Industrial Accident ☐ Tumor
☐ Poison or Toxic Substance ☐ Other: ___________________________
WHAT PART OF YOU HEAD WAS AFFECTED? (Check all that apply):

☐ Forehead ☐ Right side ☐ Left head ☐ Back head ☐ Top of head ☐ Face

Was your injury OPEN HEAD (bleeding) or CLOSED HEAD (non-bleeding)? ________________________________

Did you lose consciousness? Yes ☐ No ☐ If yes, for how long? ________________________________

SYMPTOMS IMMEDIATELY FOLLOWING ACCIDENT/INJURY: (Check all that apply)

☐ Double Vision ☐ Headache ☐ Blurred Vision ☐ Pain in or around eyes

☐ Loss of balance ☐ Dizziness ☐ Vomiting ☐ Flashes of light

☐ Loss of memory ☐ Neck pain/whiplash ☐ Restricted Field of View ☐ Restricted Motion

☐ Disorientation ☐ Other: ________________________________

INITIAL TREATMENT

When did you first see a doctor regarding your accident/injury? ________________________________

Name of Doctor: ________________________________ Specialty: ________________________________

Where were you seen? ________________________________

Were you hospitalized? ☐ No ☐ Yes how long? ________________________________

What were you and your family told? ________________________________

What did the initial treatments consist of? ________________________________

What prognosis/recommendations were you given? ________________________________

Were you given medications? ☐ No ☐ Yes Medication: ________________________________

For what kind of condition(s) ________________________________

List any medications, including vitamins and supplements used at the current time: ________________________________

SUBSEQUENT/OTHER PROFESSIONAL CARE

WHAT TYPES OF PROFESSIONAL CARE HAVE YOU RECEIVED OR ARE YOU CURRENTLY RECEIVING?

Physicians Name: ________________________________ Date: ________________________________

Address: ________________________________ City: ________________________________ Zip: ________________________________

Physiatrist Name: ________________________________ Date: ________________________________

Address: ________________________________ City: ________________________________ Zip: ________________________________
Neurologist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Neurophysiologist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Physical Therapist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Speech / Language Therapist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Psychologist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Osteopathic Physicians Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Occupational Therapist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Optometrist or Ophthalmologist Name: ___________________________ Date: ___________________________
Address: ___________________________ City: ___________________________ Zip: ___________________________

Do you have a history of allergies?  □ Yes  □ No
If yes, please explain: ___________________________

Has a neurological evaluation been performed?  □ Yes  □ No
If yes, by whom? ___________________________ Date: ___________________________
Results: ___________________________

Has a psychological evaluation been performed?  □ Yes  □ No
If yes, by whom? ___________________________
Results: ___________________________

Has a speech and language evaluation been performed?  □ Yes  □ No
If yes, by whom? ___________________________ Date: ___________________________
Results: ___________________________
MEDICAL HISTORY

Is there any history of the following? (Please check if there is a history)

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th>Family</th>
<th>Who</th>
<th>Patient</th>
<th>Family</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>High blood pressure</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
<td>—</td>
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<td>Diabetes</td>
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<td>☐</td>
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<tr>
<td>Thyroid condition</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Multiple Sclerosis</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
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<tr>
<td>Brain Tumor</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
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<tr>
<td>Stroke</td>
<td>☐</td>
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<td></td>
<td></td>
<td></td>
<td>Glaucoma</td>
<td>☐</td>
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<td>—</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Cataracts</td>
<td>☐</td>
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<td>—</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Blindness</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Strabismus</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Amblyopia</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Traumatic brain injury</td>
<td>☐</td>
<td>☐</td>
<td>—</td>
</tr>
</tbody>
</table>

VISUAL HISTORY

Have you had a previous vision evaluation? ☐ Yes ☐ No

If yes, doctor’s name: ___________________________ Date: __________

Address: _______________________________________

Reason for examination: __________________________

Were glasses, contact lenses or other optical devices recommended? ☐ Yes ☐ No

If yes, what? ___________________________________

Are they used? ☐ Yes ☐ No If yes, when? __________

If not, why not? ________________________________

Were any additional tests, treatments, or therapies recommended concerning your vision? ☐ Yes ☐ No

If yes, what? ___________________________________

Did you undergo these treatments? ☐ Yes ☐ No Explain ________________________________

Results and Recommendations: __________________

Why do you feel the need for a vision evaluation? ____________________________________________

______________________________________________
LIFESTYLE

Do you feel your vision interferes with activities of daily living? Yes  No

If yes, please explain (include effects involving home, work and hobbies, social and personal relationships):

What activities comprise the majority of your daily life since your accident/injury?

What activities can you no longer engage in due to your visual or other difficulties?

What other changes/limitations in your daily life do you attribute to your accident/injury?

What do you hope a Visual Rehabilitation Program can do for you?

EMPLOYMENT/EDUCATION INFORMATION (If applicable)

What is your current employment position?

If a student, what is the major course of study?

How many hours daily are spent working at near distance?

How many hours daily are spent reading/studying?

How many hours daily are spent on a computer?
<table>
<thead>
<tr>
<th>No.</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Double vision at distance</td>
</tr>
<tr>
<td>2.</td>
<td>Blurred vision at near</td>
</tr>
<tr>
<td>3.</td>
<td>Close or covers one eye</td>
</tr>
<tr>
<td>4.</td>
<td>Sensitivity to bright lights</td>
</tr>
<tr>
<td>5.</td>
<td>Has difficulty seeing in dim illumination</td>
</tr>
<tr>
<td>6.</td>
<td>Has difficulty focusing to near</td>
</tr>
<tr>
<td>7.</td>
<td>Difficulty changing focus to near</td>
</tr>
<tr>
<td>8.</td>
<td>Head tilted to one side</td>
</tr>
<tr>
<td>9.</td>
<td>Burning or shining eyes</td>
</tr>
<tr>
<td>10.</td>
<td>Itchy eyes</td>
</tr>
<tr>
<td>11.</td>
<td>Headaches associated with near work</td>
</tr>
<tr>
<td>12.</td>
<td>Skipping or repeating lines when reading</td>
</tr>
<tr>
<td>13.</td>
<td>Words running together when reading</td>
</tr>
<tr>
<td>14.</td>
<td>Omitting small words when reading</td>
</tr>
<tr>
<td>15.</td>
<td>Reading comprehension declining over time</td>
</tr>
<tr>
<td>16.</td>
<td>Availance of reading at near work</td>
</tr>
<tr>
<td>17.</td>
<td>Difficulty with whining; whining up hill or down hill</td>
</tr>
<tr>
<td>18.</td>
<td>Holds reading material too close</td>
</tr>
<tr>
<td>19.</td>
<td>Falling asleep when reading</td>
</tr>
<tr>
<td>20.</td>
<td>Confusion/deterioration</td>
</tr>
<tr>
<td>21.</td>
<td>Dizziness or nausea</td>
</tr>
<tr>
<td>22.</td>
<td>Car sickness/motion sickness</td>
</tr>
<tr>
<td>23.</td>
<td>Movement of objects in the environment is bothersome</td>
</tr>
</tbody>
</table>

Note: This document appears to be a visual chart or checklist for assessing vision-related issues, possibly used in a rehabilitation context.
<table>
<thead>
<tr>
<th>47.</th>
<th>Short attention span</th>
</tr>
</thead>
<tbody>
<tr>
<td>46.</td>
<td>Difficulty performing tasks formerly easy/routine</td>
</tr>
<tr>
<td>45.</td>
<td>Difficulty with money concepts, making change</td>
</tr>
<tr>
<td>44.</td>
<td>Difficulty with time management</td>
</tr>
<tr>
<td>43.</td>
<td>Poor or poor memory</td>
</tr>
<tr>
<td>42.</td>
<td>Difficulty following a series of directions</td>
</tr>
<tr>
<td>41.</td>
<td>Misplaces or loses papers, objects or belongings</td>
</tr>
<tr>
<td>40.</td>
<td>Inability to estimate distance accurately</td>
</tr>
<tr>
<td>39.</td>
<td>Poor hand-eye coordination</td>
</tr>
<tr>
<td>38.</td>
<td>Calculation, keys</td>
</tr>
<tr>
<td>37.</td>
<td>Difficulty with hand tools—scissors, screwdriver</td>
</tr>
<tr>
<td>36.</td>
<td>Difficulty with bathing/personal hygiene</td>
</tr>
<tr>
<td>35.</td>
<td>Tendency to knock things over on desk or table</td>
</tr>
<tr>
<td>34.</td>
<td>Difficulty using both sides of the body together</td>
</tr>
<tr>
<td>33.</td>
<td>Bumps into things</td>
</tr>
<tr>
<td>32.</td>
<td>Disabilities, helpless</td>
</tr>
<tr>
<td>31.</td>
<td>PLEASE OF RIGHT</td>
</tr>
<tr>
<td>30.</td>
<td>Distorted with head movements</td>
</tr>
<tr>
<td>29.</td>
<td>Uncontrollable in a market or mall</td>
</tr>
<tr>
<td>28.</td>
<td>Poor looks liked</td>
</tr>
<tr>
<td>27.</td>
<td>Poor balance</td>
</tr>
<tr>
<td>26.</td>
<td>Difficulty with peripheral vision</td>
</tr>
<tr>
<td>25.</td>
<td>Object jumps in and out of field of view</td>
</tr>
<tr>
<td>24.</td>
<td>Patterned wallpaper or carpets are bothersome</td>
</tr>
</tbody>
</table>
WORKSHOP GROUP 1: EYE MOVEMENTS
Eye Movements Testing:

*If we do not have eye movements, images would slip on the retina with any head movement*

**Classes of Human Eye Movements:**
- **Vestibular:** Holds images of the seen world steady on the retina during brief head rotations
- **Visual Fixation:** Holds images of a stationary object on the fovea by minimizing ocular drifts
- **Optokinetic:** Holds images of the seen world steady on the retina during sustained head rotation
- **Smooth Pursuit:** Holds the image of a small moving target on the fovea
- **Nystagmus quick phases:** Reset the eyes during prolonged rotation and direct gaze towards oncoming visual scene
- **Saccades:** Bring images of objects of interest onto the fovea

**Definition Fixations:**
The ability to view a stationary target with stability and control

**Fixation Testing:**
1. Patient looks at a small central target at 40 cm.
2. Present the target for 6 seconds and observe any fixation loss (count the number)
3. One loss is considered normal
4. Blinking more than one time is not normal
5. Perform monocular or binocular

**Record:**
1. Number of fixation losses in 6 seconds
2. Observations

**Definition Smooth Pursuit Eye Movement:**
Pursuit system generates smooth tracking of the eyes that closely match the pace of a slow moving target. Latency responses (delays) range between 80 ms to 120 ms. Predictive mechanisms can adjust eye movements when motion of the target can be anticipated.

**Importance of Pursuits:**
They are involved in processing visual motion. If the pursuits are abnormal, a patient will use their saccades to compensate. They may get dizzy or nauseous when traveling in a car, reading or watching things with visual motion.
**Pursuit Testing:**
- Target is a small letter or picture (approximately .5 cm)
- Test distance 40 cm or no less than Harmon’s distance
- Binocular

**A. Directional**
1. Pursuit performed rotationally both clockwise and counterclockwise
2. Movement is slow

**B. Extent**
Pursuit path should be estimated to be no more than 10 cm on each side of the patient’s midline

**C. Instructions**
1. Watch the ball as it goes around
2. Keep your eyes on the letter

**D. Observations**
Eye, head, posture and body movements

**E. Grading**
1. No attempt to follow the target to 10 re-fixations
2. Re-fixations 5 to 10 times
3. Re-fixations 3 to 4 times
4. Re-fixations 2 or less
5. No re-fixations

**Definition Saccadic eye Movement:**
Eye movements used to move the eyes quickly from one target to another. Maybe triggered by objects that are either seen or heard or as a natural strategy to scan a scene. The latency is usually 200 ms.

The final neural instruction for voluntary saccades arises from the brainstem neurons in the paramedian reticular formation. Normal saccades are fast, quick and accurate so they do not interfere with vision. Post-concussion, the saccades are often hypometric/inaccurate and slow to initiate. When associated with central vestibular dysfunction, symptoms of nausea and dizziness will occur with reading or watching television.
**Testing Voluntary Saccades:**

- Targets are two small letters or pictures (approximately .5 cm)
- Test distance 40 cm or no less than Harmon’s distance
- Binocular

**A. Directional**

Performed in the horizontal meridian and then repeated in the vertical meridian

**B. Extent**

Saccade should be estimated to be no more than 10 cm on each side of the patient’s midline

**C. Instructions**

2. Don’t look until you are instructed to look

**D. Observations**

Eye, head, posture and body movements

**E. Grading**

1. Gross overshooting and undershooting is noted
2. Large to moderate overshooting or undershooting is noted
3. Constant slight overshooting or undershooting is noted
4. Intermittent slight overshooting or undershooting is noted
5. No overshooting or undershooting is noted
NSUCO Oculomotor Test

Standard Instruction Set for the NSUCO Oculomotor Test

1. **Posture**: Standing, with feet should width apart, directly in front of the examiner.
2. **Head**: No instructions are given to the patient to move or not to move the head.
3. **Target characteristics**: Small (approximately 0.5 cm) reflective sphere (with young children, use picture targets).
4. **Movement of the target**:
   a. **Directional**:
      i. Saccades are performed in the horizontal meridian only.
      ii. Pursuits are performed rotationally, both clockwise and counterclockwise.
   b. **Extent**:
      i. Saccade extent should be estimated as no more than 10 cm on each side of the patient's midline (20 cm total).
      ii. Pursuit path should be estimated as no more than 20 cm in diameter, performed on the midline of the patient.
5. **Test distance** from the patient: No more than 40 cm and no less than the Harmon Distance. ([http://learningmanagement.ca/harmon-distance/](http://learningmanagement.ca/harmon-distance/))
6. **Ocular condition**: Binocular only.
7. **Age** of the patient: 2 years to adult.
8. **Instructions**:
   a. **Saccades**: "When I say red, look at the red ball. When I say green, look at the green ball. Remember, don’t look until I tell you to."
   b. **Pursuits**: "Watch the ball as it goes around. Try to see yourself in the ball. Don’t ever take your eyes off the ball."
9. **Observations**: Eye, head, and body movement.
10. **Scoring Methods**:
    a. See scoring guide below.
    b. Both saccades and pursuits are score along the following criteria:
       i. **Ability**
       ii. **Accuracy**
       iii. **Head Movement**
       iv. **Body Movement**
    c. Sample Scoring: S: 3 / 2 / 2 / 3; P: 3 / 3 / 4 / 4 (Note: Children who score poorly on saccades will not necessarily also do poorly on pursuits, and vice versa.)
NSUCO Oculomotor Test: Scoring Guide for Saccades and Pursuits

**Ability**
Can the patient keep his attention under control to complete

- 5 round trips for saccades
- 2 rotations each way (cw and ccw) for pursuits

**Saccades**

1. No attempt is made to perform the task to 1 round trip.
2. Completes 2 round trips.
3. Completes 3 round trips.
4. Completes 4 round trips.
5. Completes 5 round trips.

**Pursuits**

1. No attempt is made to perform the task to ½ rotation.
2. Completes ½ rotations but not one full rotation.
3. Completes 1 rotation but not 2 rotations.
4. Completes 2 rotations in one direction but not 2 in the other direction.
5. Completes 2 rotations in both directions.

**Accuracy**
Can the patient:

- Accurately and consistently fixate so that no noticeable correction is needed in the case of saccades, or
- Track the target so that no noticeable refixation is needed when doing pursuits.

**Saccades**

1. Gross overshooting or undershooting is noted.
2. Large to moderate overshooting or undershooting noted.
3. Constant slight overshooting or undershooting noted.
4. Intermittent slight overshooting or undershooting noted.
5. No overshooting or undershooting noted.

**Pursuits**

1. No attempt to follow the target to 10 refixations.
2. Refixations 4 - 10 times.
3. Refixations 2 - 4 times.
4. Refixations 2 or less times.
5. No refixations.

**Head and Body Movement**
Can the patient make the saccade or pursuit movement without moving the head or body? Both saccade and pursuit scoring use the same criteria for this aspect of the testing.

1. Gross movement of head/body.
2. Large to moderate movement of the head/body.
3. Consistent slight movement of the head/body.
4. Intermittent slight movement of the head/body.
5. No movement of the head/body.
Column Jumping (aka Door Jam Saccades)

**Purpose:** To develop accurate, efficient and rhythmic visual saccade eye movements and establish central/peripheral flexibility.

**Materials:**
- Door
- Letter Strips (HART Chart can be cut up in strips)
- Metronome
- Patch

**Procedure:**
1. Tape letter strips lengthwise on the door as shown below with strips approximately one foot apart. The length of each column will be four strips long.
2. Stand approximately five to six feet away and centered in front of the two sets of strips. Patch one eye.
3. Read letters moving back and forth between the strips beginning with tip left letter.
4. When above is easy, attempt to hold head still while reading letters. If this is difficult, try placing a sponge on head for additional feedback on stability.
5. When above is easy, separate the letter strips to width of door.
6. Discuss accuracy, speed and smoothness of fixation.
7. Remove patch and transfer it to the other side. Repeat all of the steps.

**Decrease the level of difficulty:**
1. Reduce the amount of letters
2. Draw lines straight across to the opposite letter
3. Move back a few steps

**Increase the level of difficulty:**
1. Add the metronome and set it at 60 bpm. Let them know if they are keeping to the beat. Vary the speed of the metronome to see, if the patient can recover and get on track.
2. Yoked prism glasses can be worn when this is done binocularly.
3. Airex pad can be added for balance and weight shifting.
4. Marsden Ball Games can be added to increase motor activity and control.
HART Chart Procedures

Purpose: Eye tracking and timing
Materials: HART Chart, metronome

Procedure:
Level I:
1. Post chart of letters or numbers on the wall
2. Left eye is patched, patient stands 4 to 6 feet away
3. Read letters going from left to right
4. Complete the chart
5. Read the letters vertically starting with the left column
6. Switch patch to the right eye and repeat sequence
7. When this is easy add the metronome setting it at 45 bpm

Goal is to stay on the beat and complete the chart

Level 2:
1. Repeat reading every other letter going horizontally: left eye patched
2. Repeat reading every other letter going horizontally: right eye patched
3. Repeat reading every other letter going vertically: left eye patched
4. Repeat reading every other letter going vertically: right eye patched
5. Add metronome and repeat each step above

Goal is to stay on task and keep the sequence

Level 3:
Increase the speed of metronome to 55 bpm and repeat Level I and Level 2

Level 4: Column Jumping
1. Read the first letter in Column 1, then move the eyes to the last column (10) and read that letter
2. Eyes then move back to Column 1 and read the first letter on the second row and then the eyes move the last column (10) and read the letter on the second row
3. Continue in this fashion moving down the columns vertically until all the letters in the first column and the last column are read
4. Now move into Column 2 and read the first letter on row 1 and then read the letter in column 9
5. Continue in this fashion going all the way down the chart to complete Column 2
6. Now move into Column 3 and complete that in the same fashion
7. Add a metronome (set at 50 bpm). Start at the beginning of the HART Chart and read the letter at the same time matching the beat of the metronome. Repeat all of the six steps above.

**Goal is to stay on task and keep the sequence**

Additional add on to the above:
   a. Add distractions (sound and movement)
   b. Add prisms and lenses
Letter or Number Tracking Sheet

Directions:
1. Locate the letters that are listed at the top of the page. This is done in alphabetical sequence by going left to right.
2. Use a pencil or a marker to underline, as you go across each line. When you come to the first letter that you are looking for, circle it and then continue to underline until you locate the next letter. Then circle it.
3. Continue until you complete the entire page.

Goal: is to go as fast as possible without making an error
LETTER FIND
Circle every q you find.

g q p d q j g q p g q g
j p q g j p g p q q d p
b j b q g q p g p q g j
q p g j b d q g q h p g
g p q p j q g p j q q b
p q p q g j p q q j p b
b p q j q p g h q p d b
i e b d q p g b q t k g
m q p q g b d g h q p q
q p d b q h q p p e b k
A cheerful old bear at the zoo,
Could always find something to do.
When it bored him to go,
On a walk to and fro,
He reversed it and walked fro and to.

An As A At tearful fearful cheerful cheery oil bold
told old fold beat fear hear bear bare bean am at art
ant the thee then zoom ooze ozone zoo would should
cold could allays always allies already fine fin find
mind kind sometime someway something somewhere to too
two ado dot doe do Went Whet When What is it in at
board border bared bored hem his him hit to so ton ago
go got ho Or Once On Ox a an wall wake woke walk two to
too art ant and sand from fro form She The He Hen
revered reveled rivaled reversed at it is in hand and
wand land walled wilted worked walked for frog fro and
band ant oat two too to

Name ___________________________ Date ___________________________
WORKSHOP GROUP 2: OCULAR POSTURE, ACCOMMODATION, VERGENCES
Ocular Posture, Accommodation, and Vergences

Diagnostic Techniques

- Ocular Posture
  - Important to detect phorias and aid in detection of muscle palsies secondary to concussion
  - Unilateral and alternating cover test, far and near, superior, inferior, and lateral fields of gaze for non-comitancies
  - Esophoria and convergence excess not uncommon after concussion
  - Undetected/asymptomatic/pre-existing phorias decompensate after concussion, cause > Sx

  - Cover Test
    - During alternating cover test, best chance to detect movement is fixing your eye on the cover paddle before switching it to the other eye. Thus you are best prepared to detect any movement (commonly practitioners will be moving their eyes at the same time as moving the cover paddle)

- Accommodation
  - Accommodative insufficiency, fatigue, infacility, and spasm all quite common after concussion and can occur simultaneously
  - Accommodative ability can collapse into a tight clear range

  - Accommodative Amplitude
    - Measured with an Accommodative ruler
    - Measure Monocularly, 3-5x; slowly
      - Ask if target is clear initially, then ask patient to indicate when target “gets a little blurry,” then ask if they can clear it, then push closer in until they report blur again, repeat until final blur point
    - Capture asymmetries, fatigue, ranges of blurs and clears

  - Accommodative Facility
    - Measured with +/- 1.50 or other appropriate flipper lenses, done monocularly; small near point target 20/40 or smaller. Time for at least 30 seconds
    - Capture overall rate in cycles per minute
    - Capture fatigue and if + or - lens is slower
    - Capture differences between right eye and left eye
Accommodative Accuracy
  ● Retinoscopy
    ○ Low hyperopia and accommodative problems go hand in hand
    ○ After concussion, accommodative spasm is common
  ● MEM
    ○ Lead or lag

Vergences
  ○ Fusional divergence often weakened after concussion
  ○ Can expect tighter fusion ranges for divergence and convergence at far and near
  ○ Impacted by accommodative problems
    • Near point of convergence
      ● CI very common, and most often in conjunction accommodative difficulties (pseudo-CI)
        ○ Choose detailed target, ask patient to report when image separates into two images (not when it blurs)
        ○ repeat at least 3-5x (there is often fatigue/slippage)
        ○ May also record recovery of single vision
        ○ Observe patient’s eyes carefully for break in fusion in case they suppress or fail to report diplopia. Often there is confusion about what “double” means

Vergence Ranges
  ● Best measured in free space with a prism bar to allow observation of eyes
  ● Far before near
  ● Divergence before convergence
  ● Record blur/break/recovery

Vergence Facility
  ● 6 prism BI, on and off
  ● Record time it takes to reach 10 cycles
  ● 6 prism BO, on and off
  ● Record time it takes to reach 10 cycles
  ● Optimal is 25 seconds or less for 10 cycles
Oculomotor Rehabilitation Techniques

***Note- all exercises must be modified/customized for the individual patient and how symptom-provoking each exercise is. We recommend telling the patient to start with a smaller dosage and make note of their symptoms for the next 24 hours. A mild elevation in symptoms is expected and actually helpful.

Accommodative Problems:

Accommodative Insufficiency

Monocular Push-ups (with patch)- Patch one eye, begin with a sticker or other small, detailed target; move the image in towards your eye as you try to keep the image clear. When the image first blurs a little try to clear and pull the target closer. This process may involve several blurs and clears. Finally, when the target cannot be cleared any more, push the target out very slowly and slightly until you can clear the image. Hold the image clear for 3 seconds, then pull away to relax the eyes and maintain the clear image. Repeat 3-5 times, per eye. Push-up dosage may be increased up to 10 per eye during the course of treatment.

Monocular Pull-aways (with patch)- Patch one eye. Begin with a sticker or other small, detailed target close to the eye; Pull the image very slowly away from the eye, actively trying to clear the image. As soon as the image becomes clear, hold it clear for 3 seconds. Then pull the image away further to relax the eyes but maintain clarity. Repeat 3-5 times, per eye. Push-up dosage may be increased up to 10 per eye during the course of treatment.

Accommodative Infacility/Spasm

Monocular HART Chart: Patch or otherwise cover one eye. Place the large far chart on the wall, at least 8 to 10 feet away at eye level. Hold the smaller, near chart at approximately 12 inches or the closest distance where the chart remains clear. Look at the first letter on the top left of the chart and say it out loud when it is completely clear. Then look at the next consecutive letter on the near chart, trying to clear it quickly, and continue alternating between the charts for 1 row. Attempt to move the near chart closer for the next row. Attempt at least 2-3 rows per session, per eye.
Monocular Flipper Reading:

***note: you may start with monocular flipper reading and progress to binocular flipper reading, or start with binocular flipper reading with milder cases. Binocular flipper reading is also used to rehabilitate vergence dysfunction.

Test for appropriate starting flipper level, between +/- 0.50 and +/- 1.50. Patient should be able to achieve 12+ cycles per minute (ideally 20 cpm) for the level to be appropriate as a home exercise.

Hold flippers straight in front of eyes and read a sentence of the reading material of your choice (may also use near HART chart). Flip the lenses after each sentence. Try to do the activity earlier in the day. Read for 5-10 minutes with the flippers per session.

Test the flipper rate at the next rehab session, and if appropriate, test and dispense the next highest flipper level.

Binocular Flipper Reading: This is a more challenging exercise than the monocular flipper reading. Test for appropriate starting flipper level, between +/- 0.50 and +/- 1.50. Patient should be able to achieve 12+ cycles per minute (ideally 20 cpm) for the level to be appropriate as a home exercise.

Hold flippers straight in front of eyes and read a sentence of the reading material of your choice (may also use near HART chart). Flip the lenses after each sentence. Try to do the activity earlier in the day. Read for 5-10 minutes with the flippers per session.

Test the flipper rate at the next rehab session, and if appropriate, test and dispense the next highest flipper level.

**Vergence Problems**

**Gross Convergence Insufficiency**
**Binocular Push-ups:** slowly pull a target/image closer to your nose. A detailed target is best. Attempt to keep the image single. When the image doubles (not blurs), move it away very slightly until you can make it single again (although it may be blurry). Hold the image single for 3 seconds and then pull away to relax the eyes (while keeping the image single). Do 1 or 2 sets of 5-10 push-ups.

**Binocular Pull-aways:** begin with target/image at nose. Pull the image away from the eyes slowly until the double image becomes single (but may be blurry). Hold the image single for 3 seconds and then pull away further to relax the eyes. Do 1 or 2 sets of 5-10 pull-aways.

**Brock String (3-5 minutes):** Keep both eyes open. Attach one end of string to a door handle, hold the other end to your nose. Focus on the far bead. Make sure to see the string form the X, and to see double of the other bead. If not, blink or flicker the string. Focus on the near bead. Try to gradually move the near bead closer and closer while maintaining a single bead.

**Vergence Dysfunction**

**Brock String (3-5 minutes) (modifications in addition to above instructions):**
- Add small accommodative target to bead
- Perform in nine fields of gaze
- Add RG glasses
- Add prism
- Add flippers

**Sliding Tranaglyph:**
The red/green glasses make it so that each eye is presented with a separate target and the brain has to fuse them together as one and perceive it in depth. The goal is to hold the fused image as long as possible while moving the targets. Put on red-green glasses. Position tranaglyph smooth side up. Slide it apart as long as you can see one big circle and a circle, x, and square aligned inside it. Hold the circle single for as long as you can. When the image becomes double, SLOWLY return the slider until the image is regained. Then continue to move the targets beyond the overlapping center point until the image breaks into two again. Repeat. Then, rotate the tranaglyph 180 degrees, still with smooth side towards you, repeat the exercise.

- The point of the exercise is to regain fusion/ 3-D image as quickly as possible and to hold it as long as possible while moving the targets.
- Modifications
  - Convergence - use plus lenses, BO prism, decrease working distance
  - Divergence - use minus lenses, BI prism, or decrease working distance
  - Add jump vergence - look away and back
  - Add speed component

**Stationary Tranaglyph (3-5 min):** Put on red-green glasses. Look at the pictures on the sheet,
work on keeping them single, making sure you still see the circle, x, and square. After you see one picture single, go to next picture. Then, turn the tranaglyph to the other side and repeat.

○ Modifications
  ■ Convergence - use plus lenses, BO prism, decrease working distance
  ■ Divergence - use minus lenses, BI prism, or decrease working distance
  ■ Add jump vergence - look away and back, use 2 cards at different distances, jump between cards
  ■ Add speed component

Lifesaver/sports fusion Card Opaque (2-3 min): Keep both eyes open. Focus in front of card, and bring the bottom two circles together. Make sure you see the word on the inside of circle. When successful, work on the second pair of circles.

Lifesaver Card Transparent (2-3 min): Keep both eyes open. Focus behind the card, and bring the bottom two circles together. Make sure you see the word on the inside of circle. When successful, work on the second pair of circles, and so forth.

Computerized random dot fusion/vergence training:

HTS (available for Mac or PC, also have download link)- $60 cost to OD
  Has games for BI/BO/Jump Duction/BU/BD/Pursuits/Saccades
Visionbuilder (available for PC only, download link only)- $60 cost to OD
  BI/BO/Jump Duction/BU/BD/Pursuits/Saccades
Other options: WebVT, others coming online soon- multiple price-points

Vergence Infacility

Binocular Flipper Reading: This is a more challenging exercise than the monocular flipper reading. Test for appropriate starting flipper level, between +/- 0.50 and +/- 1.50. Patient should be able to achieve 12+ cycles per minute (ideally 20 cpm) for the level to be appropriate as a home exercise.

Hold flippers straight in front of eyes and read a sentence of the reading material of your choice (may also use near HART chart). Flip the lenses after each sentence. Try to do the activity earlier in the day. Read for 5-10 minutes with the flippers per session.

Test the flipper rate at the next rehab session, and if appropriate, test and dispense the next highest flipper level.

Binocular near-far HART Chart: Place the large far chart on the wall, at least 8 to 10 feet away at eye level. Hold the smaller, near chart at approximately 12 inches or the closest distance where the chart remains clear. Look at the first letter on the top left of the chart and say it out loud when it is completely clear and single. Then look at the next consecutive letter on the near chart, trying to clear (and single) it quickly, and continue alternating between the charts for 1
row. Attempt to move the near chart closer for the next row. Attempt at least 2-3 rows per session.

**Prism Rock Reading and/or Near HART Chart (5 min.):** Performed with prism level ½ up to 6 or more. Try to progress to harder level on follow-ups when possible.

With the prism held vertically, alternate prism from one eye to next every sentence, emphasizing keeping words clear and single (at a normal reading distance). Do not spin the prism- keep it oriented the same way but slide across nose from one eye to the other. If using the near HART chart, begin by focusing on the first character in the first row of the small chart. Then slide the prism to the other eye and focus/fuse the next letter on the chart, emphasizing clear, single vision.

**Prism Rock TV and/or Far HART Chart (5-10 min):** Performed with prism level ½ up to 6 or more. Try to progress to harder level on follow-ups when possible.

With the prism held vertically, alternate prism from one eye to the next with each letter on the HART chart or TV at least 8 feet away (or every 5-10 seconds while TV viewing. Do not spin the prism- keep it oriented the same way but slide across nose from one eye to the other, emphasizing clear, single vision.

To add to the challenge, you could alternate from the near chart to the far chart each letter or row in addition to alternating the prism from one eye to the other.
WORKSHOP GROUP 3: VESTIBULAR-OCULOMOTOR PHOTOPHOBIA
Vestibular-Oculomotor Dysfunction

*Only perform if patient is not a fall risk, you feel comfortable, and their C-spine has been cleared by a professional. When in doubt - refer it out!*

**Diagnostic Techniques**

- **BESS (part of Scat 5)**
  - Can evaluate balance problems after a concussion, but lacks the ability to detect balance problems after 3rd day of recovery

- **Vestibular/Ocular Motor Screening (VOMS)**
  - Tests 5 Domains: - see Appendix 1 and 2 of Mucha et al VOMS
    - Smooth Pursuit
    - Saccades - Horizontal and Vertical
    - Near Point of Convergence (NPC)
    - Vestibular-Oculomotor Reflex (VOR) - horizontal
      - Holds image steady on the retina during brief head movements
      - Dynamic Visual Acuity Test
      - Head Thrust Impulse Test
    - Visual Motion Sensitivity (VMS)
  - Scoring
    - In Research
      - Clinical dichotomous scale (0= not present, 1 = present)
    - Clinical significance
      - 61% of patients report symptom provocation after at least 1 VOMD item
        - All VOMS items were positively correlated to the PCSS total symptom score
        - VOR and VMS most predictive of having a concussion
        - NPC>5 and symptom score>2 results in increase in probability of correctly identifying concussed patients
      - VOMS is reliable and has a low false-positive rate (2%)³
      - When used as part of a comprehensive exam, VOMS is consistent and sensitive to identifying concussion (Anzalone)
      - A positive VOMS in all domains except NPC and NPA is associated with a longer recovery time after sports-related concussion. VOMS may serve as a predictor of recovery time in patients⁴

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■ The VOMS does not provoke vestibular symptoms in healthy adolescents
■ VOMS measures unique aspects of vestibular function other than those measured by the BESS or K-D

● Opto-Kinetic System
  ● Holds image steady on the retina during sustained head movements

● Modified Romberg Test of Standing Balance
  ○ Screening test of vestibular-mediated balance function
  ○ Predicts clinically-important risk of falling during normal daily activities
  ○ Test examines participant’s ability to stand unassisted under four test conditions to test the sensory inputs that contribute to balance (Vestibular, vision, and proprioception)
  ■ Test conditions
    ● 1 - eyes open, firm surface (visual, proprioceptive, vestibular)
    ● 2 - eyes closed, firm surface (proprioceptive, vestibular)
    ● 3 - eyes open, compliant surface (visual, vestibular)
    ● 4 - Eyes closed, compliant surface (vestibular only)

■ Pass

■ Fail
  ● Needs to open their eyes
  ● Moves their arms or feet to achieve stability
  ● Beginning to fall or requiring operator intervention to maintain balance within 30 second interval

○ Normative Data
  ■ Time to failure decreased with increasing age
  ■ When an individual went below a time to failure of 20 seconds, there is a 3 fold increase in the odds of falling

Vestibular-Oculomotor Rehabilitation Techniques

Consider referral to a vestibular physical therapist, ESPECIALLY if patient has a history of whiplash or current neck pain/problem

● VOR
  ● Purpose- To train the Vestibular Ocular Reflex to be able to navigate more efficiently in the environment and tolerate activities that require your head and eyes moving at the same time.
  ● Sit in a firm chair with back support, 2 feet from the target with your chin tucked down slightly.
  ■ Exercise 1: Place two large “X” targets on wall that are at eye level about 2 feet apart. First move eyes to left target, maintain eyes on target and then move head to face the target. Then move eyes to the right target followed by the head. Repeat for 30-60 seconds or as tolerated

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- Progression: Increase speed when changing between targets. Can also do this with targets lined up vertically so you are looking up/down.

■ Exercise 2: VOR Exercises: Place one “X” target on wall at eye level. While keeping eyes on target and target in focus, rotate your head left and right at a consistent speed. Stop once you are unable to maintain eyes steady and target in focus. (this is often a very provoking exercise so use caution) or you are too provoked (7/10 symptoms).
- Progression: Can also move head up/down. Try to increase time the time you can perform exercise, increase speed (~2 Hz maximum)

■ Exercise 3: Hold thumb out in front of you at arm’s length. Keeping your eye’s focused on your thumb move your head to the left and the thumb to the right. Switch directions – head right and thumb left. Repeat x 10.
- With stationary target
- VORin space or with moving target

■ Exercise 4: Hold thumb out in front of you at arm’s length. Keeping your eye’s focused on your thumb stationary and move your head to the left and right at 60 beats per minute for 10 cycles (back and forth)
- Can Download metronome app. Then move your head up and down to 50 beats per minute for 10 cycles (back and forth).
  - Repeat throughout the day and build speed throughout the days and weeks.

- “Dishwasher”
  - Dishwasher - to stimulate vestibular system and improve tolerance to changes in head and neck movements in space. Begin by standing comfortably with your feet hip width apart. Position yourself facing Sticky note on the wall and have another sticky note positioned to the right or left of your body on the seat of a chair. Place a small letter or number in the center of each sticky note Find and touch the find and touch the sticky note while reaching across your body. Move your head and neck together quickly as you turn and bend down to touch the letter or number on the seat. Then return your head and neck to the starting position quickly and repeat 10x. Repeat this on both the right and left sides of your body. Do as many repetitions as you are able to tolerate and let your symptoms be your guide.
  - Modifications:
    - Easier – Make the movements smaller and slower.
    - Harder – Increase the distance between targets - Place the sticky note on the floor to increase the change in head and neck position. You can also increase speed of movements or try standing on one leg. Add a cognitive task by thinking of a word that starts with each letter or go backwards through the letters and numbers
  - 1. To Chair
  - 2. To stool or floor
  - 3. 360 turns, squats

- Driving Simulated eye movements/Blind Spot Check
  - Blind Spot Check - To increase ability to turn head and body easily and efficiently and to separate movements of eyes/head/neck. Be able to release from fixation and move head and eyes. Depending how difficulty this activity is the exercise can be done sitting supported or unsupported or standing. Start standing if possible. Keeping head still turn eyes to the left, then turn head to
look over shoulder keeping eyes looking left. Then return head and eyes forward in one smooth motion. (watch eyes to ensure they return forward without stopping along the way). Repeat same activity looking to the right.

- **Progression:** add a 90 or 180 degree turn of entire body after turning head. To maximize difficulty it can be progressed to sitting or standing on an unstable surface (eg, theraball, Airex mat, BOSU)
  - 1. Sitting or Standing
  - 2. With 180 degree turn

- **Visual Motion**
  - Smooth pursuits with crowded visual background

- **Loading accommodation/vergence activities**
  - Balance
  - Cognitive
  - Auditory
    - Metronome

### Photophobia

- **Diagnostics/Etiology**
  - **Case history**
    - Constant or intermittent?
    - Worse at beginning or end of day?
    - Certain types of lighting?
      - UV? Overhead fluorescent/LED? Computer Screens
    - Current adaptations?
      - No lights on in the house
      - Reduced brightness on all of their devices
      - Blue blockers/blue blocker setting
      - Tints
  - **Ocular Photophobia**
    - **Anterior Segment**
      - Dry eye syndrome
      - Uveitis
        - Flash light test
      - Conjunctivitis
      - Corneal Disease
      - Pupil Problems - Aniridia
      - Cataract surgery
    - **Posterior Segment**
      - Vitritis
      - Inherited - Achromatopsia, cone dystrophy, retinitis pigmentosa
      - Papilledema
      - Optic Neuritis
  - **Chiasm**

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- Pituitary tumor/apoplexy
  - Retro-chiasmal
  - Demyelination
  - Cortical visual impairment
  - Strabismus - exotropia
- Neurological Photophobia
  - TBI
    - mTBI
    - Moderate/Severe TBI
    - Light induced pain – intrinsically photosensitive retinal ganglion cells (melanopsin cells) – these RGC axons go to the suprachiasmatic nucleus (instead of LGN) for circadian rhythms and pain centers in the thalamus
    - Migraine
    - Blepharospasm
    - Progressive supranuclear palsy
    - Meningitis
    - Subarachnoid hemorrhage
    - Lesions of the the Thalamus
- Pharmacologic
  - Barbiturates
  - Benzodiazepines
  - Chloroquine
  - Haloperidol
  - Lithium
  - Methylphenidate
  - Zoledronate
- Other
  - Posterior fossa tumors
  - Pre-eclampsia
  - Neurasthenia (chronic fatigue syndrome)
  - Fibromyalgia
  - Measles
  - Rabies
  - Inflammatory bowel disease
  - Genetic disorders/syndrome (Trisomy 18)
  - Zinc deficiency with exocrine insufficiency
- Management
  - Neural adaptation to photosensitivity is a long-term process (>1 year)
  - Usage of tints may INHIBIT the adaptive process
  - Acute or chronic concussion
    - ATTEMPT light re-adaptation
      - Sunglasses outside OKAY
      - Sunglasses inside AVOID
○ Wearing dark glasses indoors → retinal dark adaptation of the retina → aggravation of light sensitivity

- Visor/Hat inside are great
- Phone strategy - reduce brightness to zero/comfort level and have patient gradually increase the level of brightness on their phone everyday
- Blue blockers/settings/lack of devices at night time only!

- If light re-adaptation fails or has migraine
  - Tints
    - Pink
      - Migraine
    - Blue/Purple
      - Dull headaches + light sensitivity
      - Magnocellular pathway?
  - 30% indoor wear, 80% outdoors
    - Reduce tint level or time of use to get patient to re-adapt to light
VOMS

Modified Romberg

Scat 5
To download a clean version of the SCAT tools please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097506SCAT5)

Photophobia
7 Katz BJ, Digre KB. Diagnosis, pathophysiology, and treatment of photophobia. Surv Ophth. 2016;61:466-477
WORKSHOP GROUP 4:
VISUAL PERCEPTION AND PROCESSING
Visual Perceptual & Processing

Diagnostic Techniques

- **Test of Visual Perceptual Skills - 4th Edition (TVPS-4)**
  - Age Norms: 5-21 years
  - Administration Time: 30 minutes
  - Description: TVPS-4 is an *untimed*, multiple-choice format test of visual perceptual skills. The multiple-choice format allows the administrator to adapt to patients with speech or language impairments. One advantage of the TVPS-4 is that each sub-test pertains to a specific visual perceptual skill. This allows the clinician to compare performance on specific skills.
  - Interpretation Tips:
    - Gather pre-TBI picture of the patient
    - Identify variable performance due to binocular vision dysfunction
    - Identify prolonged processing speed

  - Age Norms: 4-80+ years
  - Administration Time: 30 minutes
  - Description: MVPT-4 is an *untimed*, multiple-choice format test of visual perceptual skills. The multiple-choice format allows the administrator to adapt to patients with speech or language impairments.
  - Interpretation Tips:
    - Gather pre-TBI picture of the patient
    - Identify variable performance due to binocular vision dysfunction
    - Identify a deficit with a particular visual perceptual skill

- **Comprehensive Trail Making Test (CTMT)**
  - Age Norms: 8-74 years
  - Administration Time: 5-10 minutes
  - Description: CTMT is a *timed*, connect-the-dot format test that is useful for evaluating oculomotor and visual search abilities. The five sub-tests of the CTMT are progressively influenced by: sequencing, attention, concentration, resistance to distraction, and cognitive flexibility.
  - Interpretation Tips:
    - Gather pre-TBI picture of the patient
    - Identify oculomotor dysfunction
    - Identify difficulties with visual crowding
    - Identify deficits in cognitive flexibility/set-shifting

- **Test of Information Processing Skills (TIPS)**
  - Age Norms: 5-90 years
  - Administration Time: 20 minutes
  - Description: TIPS is a standardized measure of how well a person learns and retains new information, and the effects of interference on this learning process. Information is presented through either visual or auditory means during multiple sub-tests.
  - Interpretation Tips:
    - Gather pre-TBI picture of the patient
    - Identify processing deficits
Differentiate visual from auditory/language processing deficits

**Hemispatial Neglect**

- **Behavioral Inattention Test (BIT)**
  - **Age Norms:** 19-83 years
  - **Administration Time:** 10-15 minutes for conventional form
  - **Description:** The BIT is a standardized set of tests designed to identify unilateral spatial neglect. The conventional form (which has 6 sub-tests) is better suited to visual neglect in the optometric setting. The behavioral form (which has 9 sub-tests) is better suited for the occupational therapy setting.
  - **Sub-Tests**
    - Line Crossing
    - Letter Cancellation
    - Star Cancellation
    - Figure and Shape Copying
    - Line Bisection
    - Representational Drawing

- **Screening Tasks**
  - **Personal Neglect**
    - Self care questions (Comb hair, shave, apply make-up)
  - **Peripersonal Neglect**
    - Line Bisection
    - Cancellation Tasks
      - Albert’s Test
      - Bell’s Test
      - Star Cancellation
      - Mesulam Shape Cancellation
    - Figure & Shape Copying
      - Star, box, flower, clock

- **Spatial Neglect**
  - Object Reporting in Environment

- **Extinction**
  - May occur with or without neglect
  - Can occur in other senses or be cross-sensory

**Interpretation Tips From Oculomotor Tests**

- There are several instances where poor performance on oculomotor tests may instead be a representation of prolonged processing speed.
  - Does the patient have a slow but accurate performance? Also consider comparing sub-tests within a test (ex. King-Devick).
  - Do your clinical measures of pursuits & saccades correlate with the results of standardized oculomotor tests?
  - Does patient performance decline with cognitive load? Example: comparing King-Devick to Visagraph OR sub-test comparison on DEM OR sub-test comparison on CTMT

**Interpretation of exam procedures from a processing perspective**

- Color fields/visual fields

**Work/school recommendations**
VISUAL PERCEPTUAL TESTING

Test of Visual Perceptual Skills - 4th Edition (TVPS-4)
- Age Norms: 5-21 years
- Administration Time: 30 minutes
- Description: TVPS-4 is an untimed, multiple-choice format test of visual perceptual skills. The multiple-choice format allows the administrator to adapt to patients with speech or language impairments. One advantage of the TVPS-4 is that each sub-test pertains to a specific visual perceptual skill. This allows the clinician to compare performance on specific skills.

- Age Norms: 4-80+ years
- Administration Time: 30 minutes
- Description: MVPT-4 is an untimed, multiple-choice format test of visual perceptual skills. The multiple-choice format allows the administrator to adapt to patients with speech or language impairments.

Comprehensive Trail Making Test (CTMT)
- Age Norms: 8-74 years
- Administration Time: 5-10 minutes
- Description: CTMT is a timed, connect-the-dot format test that is useful for evaluating oculomotor and visual search abilities. The five sub-tests of the CTMT are progressively influenced by: sequencing, attention, concentration, resistance to distraction, and cognitive flexibility.

Test of Information Processing Skills (TIPS)
- Age Norms: 5-90 years
- Administration Time: 20 minutes
- Description: TIPS is a standardized measure of how well a person learns and retains new information, and the effects of interference on this learning process. Information is presented through either visual or auditory means during multiple sub-tests.

Behavioral Inattention Test (BIT) for Hemispatial Neglect
- Age Norms: 19-83 years
- Administration Time: 10-15 minutes for conventional form
- Description: The BIT is a standardized set of tests designed to identify unilateral spatial neglect. The conventional form (which has 6 sub-tests) is better suited to visual neglect in the optometric setting. The behavioral form (which has 9 sub-test) is better suited for the occupational therapy setting.
- Sub-Tests: Line Crossing, Letter Cancellation, Star Cancellation, Figure and Shape Copying, Line Bisection, Representational Drawing

Screening Tasks
- Personal Neglect: Self care questions (Comb hair, shave, apply make-up)
- Peripersonal Neglect: Line Bisection, Cancellation Tasks, Albert's Test, Bell's Test, Star Cancellation, Mesulam Shape Cancellation, Figure & Shape Copying, Star, box, flower, clock
- Spatial Neglect: Object Reporting in Environment
- Extinction
  - May occur with or without neglect
  - Can occur in other senses or be cross-sensory
VISUAL PERCEPTUAL & PROCESSING ACTIVITIES

Non-Digital Activities

Blink
Catchoo
Color By Numbers
Dot-To-Dot
Find It
I Spy
Legos
Mazes
Memory
Mighty Mind
Perfection
Qwirkle
Rush Hour
Set
Simon Says
Spot It
Tanagrams
Uno
Where's Waldo
Word Searches

Digital Apps

Attention Plz!
Count Battle
Highlights Hidden Pictures
Look Again
Matrix Game
My Mosaic
One Minute Mania
Photo Jumbler
POV For Spatial Reasoning
Rush Hour
Simon Says
Unblock Me
Video Puzzle
Visual Attention TherAppy
Word Search Party
Zentomino
Zotz
Dear Dr. Pediatrician,

I had the pleasure of examining our mutual patient XXX XXX on DATE for a post-concussion neuro-optometric assessment. XXX suffered from a concussion on DATE, and has been having symptoms of (headaches/nausea/dizziness provoked by reading/computers/visual motion) since his/her head injury.

While XXX’s ocular health and refractive error is stable, my examination revealed objective findings consistent with the following diagnoses, which are indicative of post-concussion vestibular-oculomotor dysfunction and causing the patient’s complaints:

- **F07.81** Post-Concussion Syndrome
- **H51.11** Convergence Insufficiency/Vergence Dysfunction
- **H52.533** Spasm of Accommodation, Bilateral
- **H52.7** Disorder of Accommodation (Accommodative Insufficiency/Instability)
- **H52.6** OTHER disorders of Refraction
- **H50.51** Esophoria
- **H50.52** Exophoria
- **H55.81** Eye Movement Disorder, Saccadic
- **H55.89** Eye Movement Disorder/Other Irregular Eye Movements - Pursuits, VOR
- **H53.14** Photophobia

Recent scientific literature indicates that post-concussion vestibular-oculomotor dysfunction responds well to active vestibular and oculomotor rehabilitation.** I have started the patient on an in-office/home-based rehab program as well as referred him/her to a XXX a vestibular physical therapist. It is possible that these oculomotor problems are also contributing to his/her cognitive complaints of (difficulties concentrating in visually crowded areas, difficulty focusing, difficulty multi-tasking, etc). If these cognitive complaints continue after the oculomotor dysfunction has resolved, XXX may need a referral to a neuropsychologist.

Since these oculomotor findings are indicative of post-concussion sequelae, I advise against return-to-play protocols until the vestibular-oculomotor dysfunction has resolved. I will inform you when XXX has improved to normal/baseline values.

I look forward to continuing to work with you in XXX’s multidisciplinary care. I have attached a handout of definitions of the aforementioned diagnoses and references for your convenience. Please do not hesitate to contact me with any questions, comments or concerns. My phone number and email are listed below.

Sincerely,

XXX, OD
Definitions of Diagnoses

**Vergences** are the neurological eye movements that coordinate the two eyes to cross/uncross when you look at something up close/far away. Convergence is how the two eyes cross when looking from far away to up close, and Divergence is how the two eyes uncross when looking from up close to far away. Vergences are coordinated in the brain stem.

**Convergence Insufficiency/Vergence Dysfunction**
Convergence Insufficiency is the inability for the eyes to cross towards/maintain alignment when looking at something up close for longer periods of time. Patients with convergence insufficiency may complain of double vision, blurry vision, headaches, and re-reading on all near tasks.

**Accommodation** is the ability for the ciliary muscle of the eye to focus on targets. If the eye is not appropriately focused on a target, it will look blurry. Unlike vergences, this is a monocular controlled pathway, if only one eye is not focusing properly the patient may not complain of blur, but rather headaches and fatigue with reading.

**Spasm of Accommodation, Bilateral**
In an accommodative spasm, the ciliary muscle overconstricts on near objects, causing the patient to have severe headaches with intermittent complaints of blur at distance.

**Disorder of Accommodation (Accommodative Insufficiency/Instability)**
In accommodative insufficiency, one or both eyes is unable to engage the ciliary muscle appropriately, causing near blur. With prolonged attempts to read the patient may develop fatigue, eyestrain, and headaches.

**Ocular posture:** Ocular alignment is unlikely to change post-concussion. However, often times an underlying eye misalignment/strabismus manifests post-concussion. Abnormal eye alignment may cause symptoms of double vision, eyestrain, and headaches.
- Esophoria/Esotropia is an inward eye turn while an exophoria/exotropia is an outward eye turn.

There are five main types of eye movements

**Fixation** is the ability to view a stationary target with stability and comfort. A patient may notice difficulty with fixation post-concussion if they have disruption in their saccades or vestibular-ocular reflex. If this occurs they may complain of oscillopsia (stationary objects appear to be moving), dizziness and/or nausea while concentrating on a target.

**Saccades** are the eye movements used to move the eyes quickly from one target to another voluntarily - both quickly and accurately. Post-concussion they are often hypometric/inaccurate, slow to initiate, and when associated with central vestibular dysfunction symptoms of nausea and dizziness when reading or watching television.

**Pursuits** are the eye movements used to track a slow moving object. They are also involved in helping process visual motion. If the pursuits are abnormal, a patient will use their saccades to compensate and may complain that they feel their vision is in “snap shots” or that they get dizzy/nauseous when traveling in a car, watching things with visual motion, or with reading.

The **Vestibular Ocular Reflex** is the reflexive eye movements that occur while the head is in motion. When the head moves in one direction, in order to maintain gaze, the eyes should make an eye movement at the exact same speed as the head and in the opposite direction as the head. If there is a mis-match in the direction or speed, the patient may be incredibly symptomatic for dizziness, nausea, and headaches when moving the body or heads.

**Photophobia** or light sensitivity is common in concussion. There are many types of photophobia (ocular vs neurological). Studies show that concussion-related photophobia is short wavelength dependent and recovery may be inhibited by use of indoor tints. It is recommended the patient wear a hat indoors, UV protection outdoors, and gradually re-adapt to light during the recovery process.
School/Work Letter
To Whom it may concern,
I had the pleasure of examining XXX XXX on DATE for a post-concussion neuro-optometric assessment. XXX suffered from a concussion on DATE, and has been having symptoms of (headaches/nausea/dizziness provoked by reading/computers/visual motion) since his/her head injury.

My examination revealed objective findings consistent with the following diagnoses, which are indicative of post-concussion vestibular-oculomotor dysfunction and causing the patient’s complaints/difficulties with returning to learning.

F07.81 Post-Concussion Syndrome - concussion symptoms lasting longer than 4 weeks
H51.11 Convergence Insufficiency/Vergence Dysfunction - Difficulty crossing eyes
H52.533 Spasm of Accommodation, Bilateral - Overfocusing on near work
H52.7 Accommodative Insufficiency/Instability - Inability to engage focus on near tasks
H50.51 Esophoria - eyes drift inwards
H50.52 Exophoria - eyes drift outwards
H55.81 Eye Movement Disorder, Saccadic - difficulty making fast eye movements
H55.89 Eye Movement Disorder, Pursuits- difficulty making slow eye movements
H53.14 Photophobia - light sensitivity, especially to fluorescent lights and electronic devices.

I have prescribed eye/vestibular exercises to rehabilitate XXX’s post-concussion sequelae, but it will take time to return to normal. In the meantime, please make the following accommodations to enable XXX to learn/work to the best of his/her ability:

Example: (See table below for specific recommendations correlated to each diagnosis)
- Double time on tests and assignments
- Note taker/provided with class notes

I have attached a handout of definitions of the aforementioned diagnoses and references for your convenience. Please do not hesitate to contact me with any questions, comments or concerns.

Sincerely,

XXX, OD
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodative Insufficiency</td>
<td>Delay on tests/quizzes</td>
</tr>
<tr>
<td>Convergence insufficiency</td>
<td>Increased time on tests and assignments</td>
</tr>
<tr>
<td>Vergence Dysfunction</td>
<td>Reduce amount/volume of homework</td>
</tr>
<tr>
<td>Saccadic Dysfunction</td>
<td>Permit oral exams/oral instructions</td>
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<tr>
<td></td>
<td>Planned breaks (1-2 min every 20 min of</td>
</tr>
<tr>
<td></td>
<td>prolonged near work)</td>
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<tr>
<td>Accommodative Spasm</td>
<td>Note taker</td>
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<td></td>
<td>Provided with class notes/powerpoint beforehand</td>
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<tr>
<td>Visual Crowding</td>
<td>Isolated working space</td>
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<tr>
<td></td>
<td>Use of a line guide</td>
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<tr>
<td></td>
<td>Large print/double spaced text</td>
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<tr>
<td></td>
<td>Reduced exposure to crowded environments</td>
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<tr>
<td></td>
<td>(band/choir/assemblies/lunch room/hallways)</td>
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<tr>
<td></td>
<td>Safe, isolated place to go if needs to rest</td>
</tr>
<tr>
<td></td>
<td>Preferential seating - front of class</td>
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<tr>
<td>Photophobia</td>
<td>Limited screen time - be provided print handouts</td>
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<tr>
<td></td>
<td>Be allowed to wear a hat in class</td>
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<tr>
<td></td>
<td>Limit direct fluorescent lights</td>
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<tr>
<td></td>
<td>Blue blocker/anti-glare on screens</td>
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