

# NEUROLOGICAL VISION SCREENING AFTER TBI CLINICAL PRACTICE GUIDELINE

## Recommendations for Screening Neurological Vision Impairment

- **Client-Centered Treatment Plan:** Develop in collaboration with an OD or MD.
- **Visual Screener:** Can be conducted by a trained non-vision specialist clinician, but does not replace a full evaluation by a vision specialist.
- **Identify Candidates and Referrals:** Helps identify appropriate candidates and make necessary referrals.
- **Communication:** Facilitates communication between therapist and doctor.
- **Scope of Practice:** It is not within an OT's scope to diagnose.
- **Treatment by Licensed Therapist:** Many conditions can be treated by a trained therapist in vision therapy techniques, in collaboration with a vision specialist.
- **Collaboration Benefits:** Integrates assessments of visual function (eye/lower-order cerebral mechanisms) and functional vision (person-level dysfunction/higher-order cerebral mechanisms) to improve quality of life.

### Vision Specialists

<b>Optometrist (OD)</b>	<ul style="list-style-type: none"> <li>• Diagnose and treat vision problems, eye diseases, and related conditions.</li> <li>• Prescribe eyeglasses and contact lenses.</li> <li>• Provide medication to treat eye disorders.</li> <li>• Cannot perform surgery but often provide pre and post-surgical care.</li> </ul>
<b>Ophthalmologist (MD)</b>	<ul style="list-style-type: none"> <li>• Specializes in the medical and surgical care of the eyes and visual system.</li> <li>• Prevents eye disease and illness.</li> </ul>
<b>Neuro Ophthalmologist</b>	<ul style="list-style-type: none"> <li>• Subspecialist in neurology and ophthalmology.</li> <li>• Addresses visual problems related to the nervous system.</li> </ul>
<b>Useful Associations and Resources</b>	<ul style="list-style-type: none"> <li>• American Optometric Association: <a href="http://www.aoa.org">www.aoa.org</a></li> <li>• Neuro-Optometric Rehabilitation Association:</li> </ul>

[www.nora.cc](http://www.nora.cc)

- College of Optometrists in Vision Development:  
[www.covd.org](http://www.covd.org)



Refer neuro/concussion patients to an optometrist for a neuro-optometric/sensorimotor evaluation, as not all optometrists perform this type of assessment. (See specialists on page 10).

### Terminology

<b>Subsystems for Oculomotor Control</b>	Version, vergence, and accommodation must be synchronized for efficient control during activities like reading.
<b>Accommodation</b>	Ability of the eye to change focus from distance to near objects, controlled by the ciliary muscle adjusting the intraocular lens shape.
<b>Dysfunctions</b>	<ul style="list-style-type: none"><li>• Accommodative Insufficiency</li><li>• Spasm (overstimulation)</li><li>• Infacility (slowed response)</li></ul>
<b>Vergence Eye Movements</b>	<b>Simultaneous movement of both eyes in opposite directions:</b> <ul style="list-style-type: none"><li>• Single vision</li><li>• Binocular vision</li><li>• Stereopsis (binocular depth perception).</li><li>• Includes convergence and divergence.</li></ul>

### Binocular Vision Disorders

#### Strabismic

- Esotropia: eyes turn in

<b>(misaligned eyes)</b>	<ul style="list-style-type: none"> <li>• Exotropia: eyes turn out</li> <li>• Hypertropia: one eye turns up</li> </ul>
<b>Non-strabismic</b>	<ul style="list-style-type: none"> <li>• Esophoria: eyes tend to turn in</li> <li>• Exophoria: eyes tend to turn out</li> <li>• Hyperphoria: one eye tends to turn up</li> </ul>
<b>Diplopia (Double Vision)</b>	<ul style="list-style-type: none"> <li>• Occurs when misaligned eyes cause an object to stimulate the fovea of one eye and a non-foveal part of the retina of the other eye.</li> </ul>
<b>Suppression</b>	<ul style="list-style-type: none"> <li>• Visual system ignores input from one eye, often linked with strabismus or amblyopia.</li> </ul>
<b>Versional Eye Movements</b>	<ol style="list-style-type: none"> <li>1. <b>Saccades:</b> Fast, simultaneous eye movements in the same direction to change the fixation point, essential for visual scanning (e.g., reading). Dysfunction includes impaired velocity, accuracy, and initiation.</li> <li>2. <b>Pursuits:</b> Smooth, continuous eye movements to track a moving object, crucial for activities like driving and sports. Dysfunction includes ataxia (jerky movements) and decreased velocity.</li> </ol>
<b>Peripheral/Ambient Vision</b>	<p><b>Provides spatial awareness</b></p> <ul style="list-style-type: none"> <li>• General information for</li> <li>• Balance</li> <li>• Movement</li> <li>• Coordination</li> <li>• Posture</li> </ul> <p><b>Unstable ambient vision after brain injury may cause</b></p> <ul style="list-style-type: none"> <li>• Vertigo</li> <li>• Light</li> </ul>

	<ul style="list-style-type: none"> <li>• Motion sensitivity</li> <li>• Nausea.</li> </ul>
<b>Vestibulo-Ocular Reflex (VOR)</b>	<ul style="list-style-type: none"> <li>• One of the fastest human reflexes</li> <li>• Essential for gaze stabilization during head movements</li> <li>• Compensatory eye movements stabilize retinal images</li> </ul> <p><b>VOR impairment may cause</b></p> <ul style="list-style-type: none"> <li>• Vision issues (e.g., "shaky" images)</li> <li>• Dizziness</li> <li>• Imbalance.</li> </ul>

## Background

### Brain Function Changes After Mild TBI/Concussion

- Subtle changes can occur even after mild TBI/concussion.
- Approximately 80% of perception, learning, cognition, and activities are vision-mediated.
- Over half of brain circuits involved in vision, many of which are vulnerable to head impacts.
- Visual system tests help detect functional changes.

### Common Visual Issues Post-TBI

- Abnormal oculomotor and binocular vision skills (e.g., convergence, accommodation, muscle balance, saccades, pursuits).
- Vestibular-ocular reflex issues and subjective visual complaints are common post-TBI.

### Prevalence and Detection

- Oculomotor dysfunction in TBI patients is estimated to be as high as 90%.

- Common issues include accommodative and convergence deficits.
- Early detection of vision abnormalities may predict risk of severe head impacts.

### Visual Symptoms in TBI Patients

- 95% of patients with visual complaints from TBI have normal fundoscopic findings.
- Normal acuity (20/20) does not rule out impaired oculomotor or eye teaming skills.

### Impact on Daily Life and Cognition

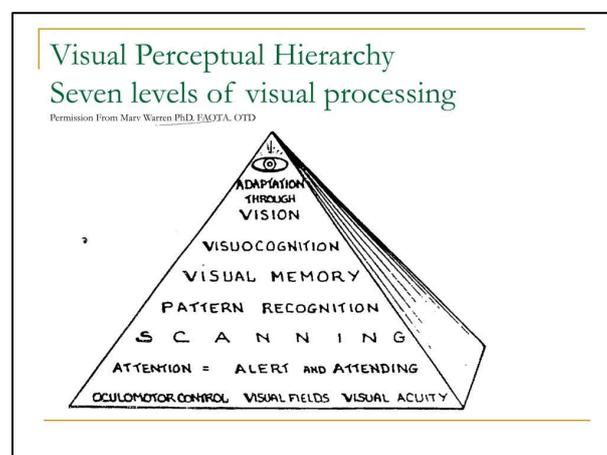
- Poor oculomotor function correlates with more post-concussive symptoms and ADL problems.
- Convergence insufficiency (~42%) is common in athletes post-sport-related concussion.
- These athletes show worse neurocognitive impairment and higher symptom scores.

### Effort and Higher-Level Skills

- Individuals with visual deficits require more effort for basic actions (e.g., focusing/fusing words).
- This compromises higher-level skills like comprehension, attention, short-term visual memory, and executive function.

### Visual Skill Hierarchy

- Illustrated by the Mary Warren Triangle.



## Incidence for Vision Screening Post-TBI

Category	Details
<b>Common Visual Impairments Post-TBI</b>	<ul style="list-style-type: none"> <li>• Blurred vision</li> <li>• Difficulty with reading</li> <li>• Diplopia/eye strain</li> <li>• Dizziness in crowded environments</li> <li>• Visual field impairments</li> <li>• Photosensitivity</li> <li>• Color blindness</li> </ul>
<b>Incidence Specific to mTBI</b>	<p><b>High prevalence in:</b></p> <ul style="list-style-type: none"> <li>• Saccades</li> <li>• Pursuits</li> <li>• Vergence (convergence)</li> <li>• Accommodation</li> <li>• VOR</li> <li>• Photosensitivity</li> </ul>
<b>Recommendations</b>	
<b>Direct Observation</b>	<ul style="list-style-type: none"> <li>• Observe for vision dysfunction behaviors</li> <li>• Consider time-dependency of symptoms.</li> </ul>
<b>Questionnaires/Surveys</b>	<ul style="list-style-type: none"> <li>• COVD QOL outcomes assessment</li> <li>• CISS (<i>score &gt;21</i>)</li> <li>• Goodrich, et al. history questions</li> <li>• The Visual Interview</li> <li>• Vestibular Disorders Activities of Daily Living Scale</li> <li>• Vestibular Activities and Participation Measure</li> </ul>
<b>Far Acuity</b>	<ul style="list-style-type: none"> <li>• Chronister Portable Acuity Test</li> <li>• Snellen Acuity Chart</li> <li>• Refer to OD if vision is <i>20/40</i> or worse.</li> </ul>
<b>Near Acuity/Reading</b>	<ul style="list-style-type: none"> <li>• Chronister Portable Acuity Test reading card</li> <li>• Refer to OD if vision is <i>20/40</i> or worse.</li> </ul>
<b>Accommodation</b>	<ol style="list-style-type: none"> <li>1. Patch left eye</li> </ol>

Category	Details
Testing	<ol style="list-style-type: none"> <li>2. Hold target about 1 inch in front of right eye</li> <li>3. Move target away and identify letter</li> <li>4. Measure and record distance</li> <li>5. Divide 40 by the measurement</li> <li>6. Repeat for right eye.</li> </ol>

## Recommendations for Motor Fusion Testing/Eye Alignment Testing

### Near Point of Convergence

1. Use a 20/30 letter target or pencil tip placed above the nose between the eyes.
2. Move the target toward the patient at 1-2 cm/s, encouraging them to keep the target single.
3. Measure the subjective break (when the target becomes double) in centimeters.
4. Slowly move the target away until subjective recovery (target is single again) and measure in centimeters.
5. If no diplopia is reported, note the point where eyes lose and regain alignment.
6. If eyes lose alignment without reported diplopia, this may indicate suppression.
7. **Norms:** 5 cm break, 7 cm recovery

### Eye Alignment Test

1. Cover tests
2. Modified Thorington test using Bernell Muscle Imbalance Measure card tests (near and far)

### Tests

- Developmental Eye Movement test
- NSUCO Oculomotor Test of saccades (test without corrective lenses)
- King-Devick
- **Scoring:** Based on ability, accuracy, and head/body movement during saccades.

## Pursuits

### Tests

- NSUCO test of pursuits (test without corrective lenses)
- **Scoring:** Based on ability, accuracy, and head/body movement during pursuits.

## Visual Scanning/Tracking

### Tests

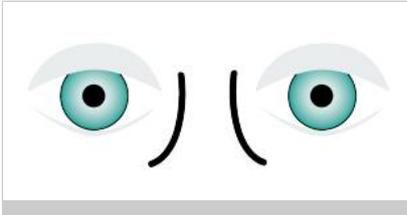
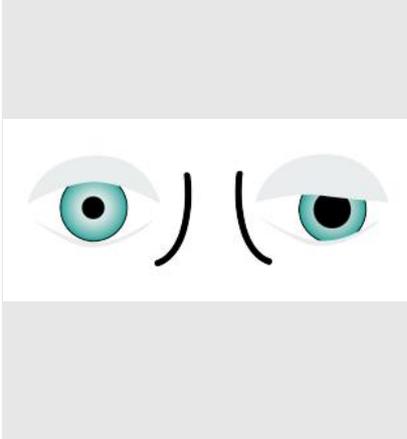
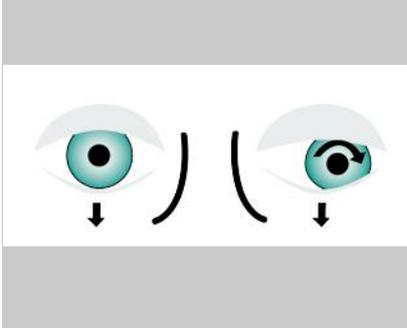
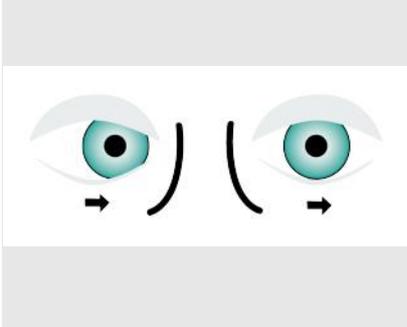
- OSU Visual Tracing test
- Groffman Visual Tracing Test (by Sidney Groffman, OD)

## Visual Fields

### Tests

- Confrontation field testing (finger counting) - test without corrective lenses
- Screens for extinction phenomenon accompanying unilateral brain damage.

## Nerve Palsy Symptoms and Examination Findings

Nerve Palsy	Symptoms	Typical Examination Findings	Differential Diagnosis
<b>Normal</b>	N/A		N/A
<b>Oculomotor (CN III)</b>	Diplopia, horizontal and vertical		<ul style="list-style-type: none"> <li>Posterior circulation aneurysm</li> <li>Brainstem lesion</li> <li>Microvascular ischemia (if pupil spared)</li> <li>Cavernous sinus disease</li> </ul>
<b>Trochlear (CN IV)</b>	Torsional ("tilted") diplopia worse on downward gaze		<ul style="list-style-type: none"> <li>Brainstem lesion</li> <li>Posterior circulation aneurysm</li> <li>Cavernous sinus disease</li> </ul>
<b>Abducens (CN VI)</b>	Horizontal diplopia on lateral gaze to the ipsilateral side		<ul style="list-style-type: none"> <li>Elevated intracranial pressure</li> <li>Cavernous sinus disease</li> <li>Brainstem lesion</li> </ul>

## Appendices

### Appendix A: Expected Amplitude of Accommodation by Age

Age (Years)	Amplitude of Accommodation (Diopters)
10	14
15	12
20	10
25	8
30	7
35	6
40	5
45	4
50	3
55	2
60	1

## **Appendix B: Rapid Confrontation Screening for Peripheral Visual Field Defects and Extinction**

### **Procedure:**

- The clinician stands in front of the patient, with the patient covering one eye.
- The clinician presents fingers in four different positions (panels A through D).
- The combinations of fingers shown are examples; the clinician always presents either one or two fingers on each hand.
- The patient responds with the total number of fingers seen: always "two", "three", or "four". The correct response is never "one".

### **Schematics:**

- Panels A through D illustrate the positions from the clinician's perspective.
- Patient's eye and covering hand are shown in the grey oval.

### **Example Positions:**

1. **Panel A:** Clinician holds up one finger on the left hand and one finger on the right hand.
2. **Panel B:** Clinician holds up two fingers on the left hand and one finger on the right hand.
3. **Panel C:** Clinician holds up one finger on the left hand and two fingers on the right hand.
4. **Panel D:** Clinician holds up two fingers on the left hand and two fingers on the right hand.

### **Patient Responses:**

- **Correct Response Examples:**
  - Panel A: "Two"

- Panel B: "Three"
- Panel C: "Three"
- Panel D: "Four"

This method ensures a quick and effective screening for peripheral visual field defects and extinction phenomena.