

SCREENING FOR OCULOMOTOR DYSFUNCTIONS FOLLOWING TRAUMATIC BRAIN INJURY (TBI)

Purpose: This clinical recommendation (CR) specifies a rapid screening method for use in the eye care environment. Its use helps identify individuals who are affected by certain oculomotor dysfunctions that are prevalent after TBI, and which may negatively affect visual quality of life, post-TBI rehabilitation, return to duty, and reintegration to employment and other life activities.

The use of this CR assumes that a patient has been diagnosed or is suspected of having a TBI, that a refraction has been performed, and that other acute and chronic medical eye conditions have been identified and are being managed (see VCE Clinical Recommendation for the Eye Care Provider: Eye and Vision Care Following Blast Exposure and/or Possible Traumatic Brain Injury).¹

This CR further specifies the detailed clinical methods and expected norms for the oculomotor systems of interest. Patients who fall outside the normative values on testing should be referred for more specialized care (see VCE Clinical Recommendation for the Eye Care Provider: Assessment and Management of Oculomotor Dysfunctions Associated with Traumatic Brain Injury).²

I. Accommodation

Test: Measure the monocular accommodative amplitude via the push-up method.

Testing accommodation in patients over 44 years of age is not performed, because of expected age-related accommodative loss.

Equipment needed:

1. Measuring Device – An ophthalmic near-point ruler (rule/rod) calibrated in both distance (centimeters [cm]) and accommodation (Diopters [D]) is preferable to achieve precision. Eye care providers can use one of the following rulers with a visual target:



Figure 1. Patient view of visual target.

- A. Near-point rule calibrated in cm and D, available commercially
- B. Near-point phoropter rod calibrated in cm and D (note: phoropter rod does not start at 0 cm)
- C. A centimeter ruler. Diopters of accommodation can be calculated using the formula:
 $D=100/\text{distance in cm}.$

2. Visual Target – The standard, best target is a single vertical column of Arial 4-point font that is mounted (or held) to traverse along the lower edge of the near-point ruler measuring device (see Fig. 1) ([click here](#)) for downloadable test font).

Referral Criteria: Anything outside of the normative values for accommodation (Table 1) is an indication for referral.

Procedure:

1. Provide good illumination (60W or better directed at the visual target or lower illumination if the patient demonstrates photophobia during the test).
2. Begin testing with the patient wearing his/her habitual prescription glasses for distance viewing (reading glasses or near add power should NOT be used).

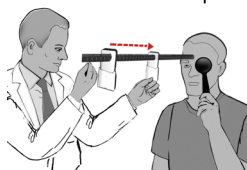


Figure 2.

3. Cover the patient's left eye.
4. Hold the near-point rule with the target below the ruler and with the lower edge of the ruler placed just above the patient's right eye at the level of his/her brow. Begin with the letter target placed toward the end of the ruler (typically 40 cm).

5. Instruct the patient to tell you when the letters first start to blur, but to try to keep the letters clear for as long as possible.

6. Slowly move the target toward the patient at approximately 1-2 cm/sec until the patient reports first blurriness (see Fig. 2). Pause for 1-2 seconds and ask the patient if target stays blurry or becomes clear. If the target becomes clear, continue moving the target closer until it is blurred again. Stop moving the target when the blur does not clear ("sustained blur").
7. Measure the distance from the sustained blur point to the forehead just above the level of the patient's brow (zero measuring point) rounded to the nearest one-half centimeter.
8. Repeat the steps above with the ruler above the left eye and the right eye covered.
9. Record finding and refer if accommodative amplitude falls below age-related normative value.

II. Near Point of Convergence (NPC)

Test: Measure the near point of convergence.

Equipment needed: The same near point rod and target used in the measurement of accommodation (see Section I).

Referral Criteria: Any NPC > 6 cm is considered a receded NPC, and is an indication for a referral.

Procedure:

1. Provide good illumination (60W or better directed at the visual target or lower illumination if the patient demonstrates photophobia during the test).
2. Begin testing with the patient wearing his/her habitual prescription. If the patient has multifocal lenses or reading glasses, testing should be performed through these lenses.
3. The patient should leave both eyes open.
4. Hold the lower edge of the measuring device on the center of the patient's forehead just above the level of his/her brow (so the patient is looking downward at a 15° angle from horizontal at the target). Begin with the target placed at the 40-cm mark on the rule.
5. Instruct the patient to look at the letters and to report when the patient experiences double vision (diplopia) but have the patient try to keep the target one/single as long as possible. Slowly (1-2 cm/sec) move target toward the patient (see Fig. 3). When diplopia is reported by the patient, stop moving the target, pause for 1-2 seconds, and ask the patient: "Do the letters remain double or do they become single again?"
6. If the letters become single within 1-2 seconds, continue slowly moving the target toward the patient until the patient is unable to regain fusion. Do not hold the target in place for longer than 2 seconds.

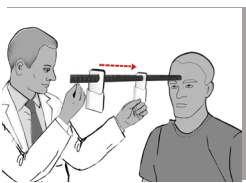


Figure 3.

7. If the letters remain double, this endpoint is the NPC break.
8. If the examiner observes a loss of fusion without a report of double vision, or if either eye turns outwardly, or fixation shifts between right and left eye, the point at which either of the above occurs is considered the NPC break.

9. Measure the distance from the point of NPC break to the center of the patient's forehead just above the eyebrow (zero measuring point) rounded to the nearest half-centimeter.
10. If the patient can maintain fused single vision until the target is against the nose/brow (i.e., NPC break does not occur), the measurement is recorded as "To The Nose or TTN".
11. Record the NPC break and refer if NPC is receded. After the NPC break is recorded, the NPC recovery must be recorded.
12. To start the NPC recovery, begin from the NPC break point and slowly (1-2 cm/sec) move the target away from the patient and instruct the patient to try to regain fusion as quickly as possible. When single vision is reported by the patient, this is the endpoint of the NPC recovery. A normal NPC recovery is less than 8cm.

| Age (yrs) | Monocular Amplitude of Accommodation (Diopters) |
|-----------|---|
| 6-8 | 11-15 |
| 9-12 | 10-14 |
| 13-16 | 9-13 |
| 17-20 | 8-12 |
| 21-24 | 7-11 |
| 25-28 | 6-10 |
| 29-32 | 5-9 |
| 33-36 | 4-8 |
| 37-40 | 3-7 |
| 41-44 | 2-6 |

Table 1. Normative values for Accommodation

*Diopters (D)=100/distance in cm

III. Oculomotor Dysfunction (Saccades/Pursuits)*

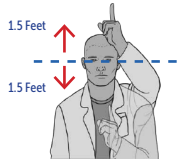
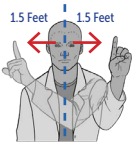
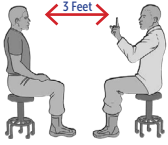
Test: Measure Ocular Pursuits and Saccades

Equipment Needed: None

Referral Criteria: Any abnormal value of the following test and/or any increase in visual symptoms and/or headache, dizziness, nausea, fogginess from the baseline during this testing is an indication for referral for a complete eye TBI examination.

Smooth Pursuits:

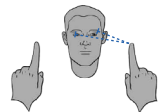
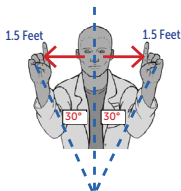
Procedure:



- Sit facing the patient.
- Instruct the patient to perform this test with their eye movements alone, while holding their head in the straight ahead position.
- Hold the tip of your index finger at the patient's midline 3 feet away from the patient.
- While the patient focuses on your fingertip, smoothly move your fingertip 1.5 feet from the patient's midline to your left.
- Then move your fingertip 1.5 feet from the patient's midline to the right (it should take 2 seconds to move this 3 foot distance).
- Perform twice.
- With the patient focused on your fingertip, raise your finger 1.5 feet above the patient's eye level.
- Then lower your fingertip 1.5 feet below the patient's eye level (it should take 2 seconds to move this 3 foot distance). Perform twice.
- Abnormal value - inability to visually follow pursuit and or saccades are substituted for the smooth pursuit eye movements.
- Record the results and refer if appropriate.

Horizontal Saccades:

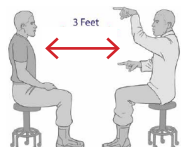
Procedure:



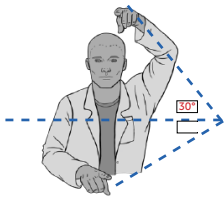
- Sit facing the patient.
- Instruct the patient to perform this test with their eye movements alone, while holding their head in the straight ahead position.
- Hold your left-index fingertip 1.5 feet from the patient's midline and your right-hand index fingertip 1.5 feet from the patient's midline, about 3 feet from the patient (so that the patient must gaze 30° left and 30° right).
- Ask the patient to move his/her eyes from one fingertip to another as quickly as possible.
- Repeat 10 times.
- Abnormal value - saccades are dysmetric (ie: inaccurate because of undershooting, overshooting, or making 2 or more saccades to visually fixate the intended target instead of one accurate saccade).
- Record the results and refer if appropriate.

Vertical Saccades:

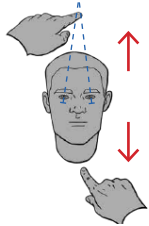
Procedure:



- Sit facing the patient.
- Instruct the patient to perform this test with their eye movements alone, while holding their head in the straight ahead position.



- Hold one index fingertip 1.5 feet above the patient’s midline and the other index fingertip 1.5 feet below the patient’s midline, with both finger tips held about 3 feet away from the patient (so that the patient gazes 30° up and 30° down).
- Ask the patient to move their eyes from one fingertip to another as quickly as possible.
- Perform 10 times.



- Abnormal value saccades are dysmetric (ie: inaccurate because of undershooting, overshooting, or making 2 or more saccades to visually fixate the intended target instead of one accurate saccade).
- Record the results and refer if appropriate.

*The instructional figures in this section are adopted from Vestibular/Oculomotor Motor Assessment (VOMS)

ICD-10 Coding Guidance for Visual Dysfunction following Traumatic Brain Injury³

| Diagnostic position 1: TBI diagnostic code |
|--|
| TBI is coded using the S06 code groups (Intracranial Injury). The digits following the decimal (S06.XXXX) are used to code for Etiology, Location, Severity and Encounter (ELSE coding structure). This coding element can be referenced from either the initial TBI diagnosis encounter or from referring physician encounter. The first 3 digits of ELSE should remain as noted in previous notes. Code Encounter as D for subsequent visit, or S for sequela. Sequela, or late effect, is used for complications or conditions that arise as a direct result of a condition. A sequela is the residual effect on visual function after the Service Member (SM) has recovered from the acute phase of the TBI. If a SM presents for evaluation for visual dysfunction and is still symptomatic from the TBI (headache, XXXX), code as D. If the acute TBI symptoms have resolved, code the encounter as S. |
| Diagnostic position 2: Primary symptom code |
| Code the predominant symptom or finding from major groupings (click here) to see pertinent partial listing of eye codes): |
| Accommodative dysfunction |
| Blindness and low vision |
| Convergence insufficiency |
| Disorders of binocular vision |
| Disorders of pupil function |
| Nystagmus and irregular eye movements |
| Photophobia (There is no specific code under ICD-10, it is recommended that it be coded as "Glare sensitivity-H53.71") |
| Strabismus disorders |
| Subjective visual disturbances |
| Visual field loss |
| Diagnostic position 3: Deployment code, if applicable |
| If applicable; may be referenced from initial provider. |
| Diagnostic position 4: TBI external cause of morbidity code |
| For example, Y36.290D [D: use for subsequent encounter] for war operations involving other explosions and fragments, military personnel, subsequent encounter; may be referenced from initial provider. |
| Diagnostic position 5: Other symptoms codes as applicable |
| Code any additional symptom or finding from major groupings as above. |
| Diagnostic position 6: Personal history of TBI |
| Z87.820 - Personal history of traumatic brain injury; may be referenced from referring provider. |

References

1. Vision Center of Excellence. Clinical Recommendation for the Eye Care Provider: Eye and Vision Care Following Blast Exposure and/or Possible Traumatic Brain Injury. DoD/VA. Available at: <https://vce.health.mil/Providers/ClinicalPracticeRecommendations/Eye-Care-and-TBI>.
2. Vision Center of Excellence. Clinical Recommendation for the Eye Care Provider: Assessment and Management of Oculomotor Dysfunctions Associated with Traumatic Brain Injury. DoD/VA. Available at: <https://vce.health.mil/Providers/ClinicalPracticeRecommendations/Oculomotor>.
3. Reynolds ME, Barker FM, Merezhinskaya N, Oh GT, Stahlman S. Incidence and temporal presentation of visual dysfunction following diagnosis of traumatic brain injury, active component, U.S. Armed Forces, 2006-2018. MSMR. 2019; Vol 26(9) 13-24. MSMR Report available at: <https://health.mil/Reference-Center/Reports/2019/09/01/Medical-Surveillance-Monthly-Report-Volume-26-Number-9>.

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Revised as of 12 May 2022

ICD-10 CODING GUIDANCE FOR OCULOMOTOR DYSFUNCTIONS AND OTHER VISION INJURIES ASSOCIATED WITH TBI

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| Accommodative Dysfunction (paresis of accommodation) | H52.52 |
| Paresis of accommodation, right eye | H52.521 |
| Paresis of accommodation, left eye | H52.522 |
| Paresis of accommodation, bilateral | H52.523 |
| Paresis of accommodation, unspecified eye | H52.529 |
| Accommodative Dysfunction (spasm of accommodation) | H52.53 |
| Spasm of accommodation, right eye | H52.531 |
| Spasm of accommodation, left eye | H52.532 |
| Spasm of accommodation, bilateral | H52.533 |
| Spasm of accommodation, unspecified eye | H52.539 |
| Convergence Insufficiency | H51.11 |
| Visual Field Defects | H53.4 |
| Visual Field defects, Unspecified | H53.40 |
| Scotoma involving Central Area | H53.41 |
| Scotoma involving Central Area, right eye | H53.411 |
| Scotoma involving Central Area, left eye | H53.412 |
| Scotoma involving Central Area, bilateral | H53.413 |
| Scotoma involving Central Area, unspecified eye | H53.419 |
| Scotoma of Blind spot area | H53.42 |
| Scotoma of Blind spot area, right eye | H53.421 |
| Scotoma of Blind spot area, left eye | H53.422 |
| Scotoma of Blind spot area, bilateral | H53.423 |
| Scotoma of Blind spot area, unspecified eye | H53.429 |
| Sector or arcuate defects | H53.43 |
| Sector or arcuate defects, right eye | H53.431 |
| Sector or arcuate defects, left eye | H53.432 |
| Sector or arcuate defects, bilateral | H53.433 |
| Sector or arcuate defects, unspecified eye | H53.439 |

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| Other localized visual field defect | H53.45 |
| Other localized visual field defect, right eye | H53.451 |
| Other localized visual field defect, left eye | H53.452 |
| Other localized visual field defect, bilateral | H53.453 |
| Other localized visual field defect, unspecified eye | H53.459 |
| Homonymous bilateral field defects | H53.46 |
| Homonymous bilateral field defects, right eye | H53.461 |
| Homonymous bilateral field defects, left eye | H53.462 |
| Homonymous unspecified side field defects, bilateral | H53.463 |
| Homonymous bilateral field defects, unspecified eye | H53.469 |
| Heteronymous bilateral field defects | H53.47 |
| Generalized contraction of the visual field | H53.48 |
| Generalized contraction of the visual field, right eye | H53.481 |
| Generalized contraction of the visual field, left eye | H53.482 |
| Generalized contraction of the visual field, bilateral | H53.483 |
| Generalized contraction of the visual field, unspecified eye | H53.489 |
| Subjective Visual Disturbances | H53.1 |
| Subjective Visual Disturbances unspecified | H53.10 |
| Transient vision loss | H53.12 |
| Transient vision loss, right eye | H53.121 |
| Transient vision loss, left eye | H53.122 |
| Transient vision loss, bilateral | H53.123 |
| Transient vision loss, unspecified eye | H53.129 |
| Sudden vision loss | H53.13 |
| Sudden vision loss, right eye | H53.131 |

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| Sudden vision loss, left eye | H53.132 | Blindness right eye category 4, Low vision left eye | H54.114 |
| Sudden vision loss, bilateral | H53.133 | Blindness right eye category 4, Low vision left eye, category 1 | H54.1141 |
| Sudden vision loss, unspecified eye | H53.139 | Blindness right eye category 4, Low vision left eye, category 2 | H54.1142 |
| Visual discomfort | H53.14 | Blindness right eye category 5, Low vision left eye | H54.115 |
| Visual discomfort, right eye | H53.141 | Blindness right eye category 5, Low vision left eye, category 1 | H54.1151 |
| Visual discomfort, left eye | H53.142 | Blindness right eye category 5, low vision left eye, category 2 | H54.1152 |
| Visual discomfort, bilateral | H53.143 | Blindness left eye, low vision right eye | H54.12 |
| Visual discomfort, unspecified eye | H53.149 | Low vision right eye, category 1, Blindness, left eye | H54.121 |
| Visual distortions of shape and size | H53.15 | Low vision right eye, category 1, Blindness, left eye, category 3 | H54.1213 |
| Psychophysical visual disturbances | H53.16 | Low vision right eye, category 1, Blindness, left eye, category 4 | H54.1214 |
| Glare sensitivity (<i>Photophobia*</i>) | H53.71 | Low vision right eye, category 1, Blindness, left eye, category 5 | H54.1215 |
| Blindness and Low Vision | | | |
| Blindness, both eyes | H54.0 | Low vision right eye, category 2, Blindness, left eye | H54.122 |
| Blindness, both eyes, different category levels | H54.0X | Low vision right eye, category 2, Blindness, left eye, category 3 | H54.1223 |
| Blindness right eye category 3 | H54.0X3 | Low vision right eye, category 2, Blindness, left eye, category 4 | H54.1224 |
| Blindness right eye category 3, Blindness left eye category 3 | H54.0X33 | Low vision right eye, category 2, Blindness, left eye, category 5 | H54.1225 |
| Blindness right eye category 3, Blindness left eye category 4 | H54.0X34 | Low vision, both eyes | H54.2 |
| Blindness right eye category 3, Blindness left eye category 5 | H54.0X35 | Low vision, both eyes, different category levels | H54.2X |
| Blindness right eye category 4 | H54.0X4 | Low Vision Right eye, category 1 | H54.2X1 |
| Blindness right eye category 4, Blindness left eye category 3 | H54.0X43 | Low vision right eye category 1, Low vision left eye category 1 | H54.2X11 |
| Blindness right eye category 4, Blindness left eye category 4 | H54.0X44 | Low vision right eye category 1, Low vision left eye category 2 | H54.2X12 |
| Blindness right eye category 4, Blindness left eye category 5 | H54.0X45 | Low Vision Right eye, category 2 | H54.2X2 |
| Blindness right eye category 5 | H54.0X5 | Low vision right eye category 2, Low vision left eye category 1 | H54.2X21 |
| Blindness right eye category 5, Blindness left eye category 3 | H54.0X53 | Low vision right eye category 2, Low vision left eye category 2 | H54.2X22 |
| Blindness right eye category 5, Blindness left eye category 4 | H54.0X54 | Unqualified visual loss, both eyes | H54.3 |
| Blindness right eye category 5, Blindness left eye category 5 | H54.0X55 | Blindness, one eye | H54.4 |
| Blindness, one eye, Low vision other eye | H54.1 | Blindness, one eye, unspecified eye | H54.40 |
| Blindness, one eye, Low vision other eye, unspecified eye | H54.10 | Blindness, right eye, Normal vision left eye | H54.41 |
| Blindness, right eye, Low vision left eye | H54.11 | Blindness, right eye, category 3 | H54.413 |
| Blindness right eye category 3, Low vision left eye | H54.113 | Blindness, right eye, category 3, Normal vision left eye | H54.413A |
| Blindness right eye category 3, Low vision left eye category 1 | H54.1131 | | |
| Blindness right eye category 3, Low vision left eye category 2 | H54.1132 | | |

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| Blindness, right eye, category 4 | H54.414 |
| Blindness, right eye, category 4, Normal vision left eye | H54.414A |
| Blindness, right eye, category 5 | H54.415 |
| Blindness, right eye, category 5, normal vision left eye | H54.415A |
| Blindness, left eye, Normal vision right eye | H54.42 |
| Blindness, left eye, category 3-5 | H54.42A |
| Blindness, left eye, category 3, Normal vision right eye | H54.42A3 |
| Blindness, left eye, category 4, Normal vision right eye | H54.42A4 |
| Blindness, left eye, category 5, Normal vision right eye | H54.42A5 |
| Low vision, one eye | H54.5 |
| Low vision, one eye, unspecified eye | H54.50 |
| Low vision right eye, Normal vision left eye | H54.51 |
| Low vision right eye, category 1-2 | H54.511 |
| Low vision right eye, category 1, Normal vision left eye | H54.511A |
| Low vision right eye, category 2, Normal vision left eye | H54.5A12 |
| Low vision left eye, normal vision right eye | H54.52 |
| Low vision left eye, category 1-2 | H54.52A |
| Low vision left eye, category 1, Normal vision right eye | H54.52A1 |
| Low vision left eye, category 2, Normal vision right eye | H54.52A2 |
| Unqualified visual loss, one eye | H54.6 |
| Unqualified visual loss, one eye, unspecified eye | H54.60 |
| Unqualified visual loss, one eye, right eye, normal vision left eye | H54.61 |
| Unqualified visual loss, one eye, left eye, normal vision right eye | H54.62 |
| Unspecified visual loss | H54.7 |
| Legal Blindness, USA Definition | H54.8 |

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|---|--------|
| Nystagmus and Irregular Eye Movements | |
| Nystagmus | H55.0 |
| Latent nystagmus | H55.02 |
| Visual Deprivation nystagmus | H55.03 |
| Dissociated nystagmus | H55.04 |
| Other forms of nystagmus | H55.09 |
| Deficient saccadic eye movements | H55.81 |
| Other irregular eye movements | H55.89 |
| Disorders of Pupil Function | |
| Anomalies of pupillary function | H57.0 |
| Unspecified anomaly of pupillary function | H57.00 |
| Anisocoria | H57.02 |
| Miosis | H57.03 |
| Mydriasis | H57.04 |
| Other anomalies of pupillary function | H57.09 |
| Disorders of Binocular Vision | |
| Other specified disorders of binocular movement | H51.8 |
| Unspecified disorders of binocular movement | H51.9 |
| Strabismus Disorders | |
| Paralytic strabismus | H49 |
| Other strabismus | H50 |
| Other | |
| <i>Photophobia*</i> (See Glare sensitivity) | H53.71 |

**Photophobia has no specific coding under ICD10. Photophobia can be coded using H53.71, Glare sensitivity. Utilizing this coding methodology, H53.71 in the context of TBI will be interpreted as photophobia for surveillance and analysis purposes.*

This document is a reference for the 2021 International Classification of Disease, Tenth Revision, Clinical Modification (ICD-10-CM) diagnostic medical billing codes effective on October 1, 2020.

<https://icd10cmtool.cdc.gov/?fy=FY2021>

