Chapter 4

VISION ASSESSMENT AND INTERVENTION

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SECTION 1: VISION ASSESSMENT

INTRODUCTION

Vision is the most far-reaching of our sensory systems. Changes to this system can affect patients' ability to participate in therapy as well as to function in everyday life.[1] Combat troops with blast-related concussion/mild traumatic brain injury (c/mTBI) are at risk for visual dysfunction.[2] Occupational therapists are often the first-line clinicians who can identify visual impairment. The occupational therapist's roles include the following[3]:

- evaluating vision function through vision screening and functional observations.
- determining if and how visual impairment may be affecting the patient's functional performance.

If visual impairment is suspected, the occupational therapist:

- refers the patient to the staff optometrist with expertise in vision and traumatic brain injury (TBI) or neuro-ophthalmologist for further evaluation and intervention management,
- educates the patient and the rehabilitation team about how the impairment is affecting the patient functionally, and
- provides both compensatory and remedial (in collaboration with an optometrist) treatment, as appropriate.

Occupational therapists provide a basic vision screening that includes the following elements:

- symptom questionnaire,
- visual acuity,
- visual fields,
- ocular motor (pursuits, saccades, convergence),
- binocular vision, and
- glare/photophobia.

The specific screening tool or method used will be dictated by available resources and therapist's expertise and preferences; assessments included in the toolkit are considered options.

General Instructions for Vision Assessment

- Set up in a well-lit, glare- and clutter-free room. Minimal distractions (physical, visual, or auditory) are optimal.
- Make sure the patient is seated comfortably with his or her head vertically erect.
- If the patient is wearing glasses, ensure they fit properly and that the patient uses the appropriate section of the glasses for the task (Figure 4-1).
  - Upper portion of the lens is for distance.
  - Trifocal for mid-distance (18–24 inches), such as a computer monitor.
  - Lower portion for near distance (~16 inches), for example, reading distance.
  - Some people wear progressive lenses that do not have obvious segments, but placement should be similar.
- Another factor to consider is that many people are now using monovision contacts: one eye is used for distance and the other for near vision. Be sure to ask about this and adapt your assessment accordingly.

Assessment Sequence and Methods

- Begin the assessment with a questionnaire of symptoms to help determine if and how the patient is experiencing visual stress or impairment.
- It is also possible to piece together the areas of assessment with a variety of tests. The order of assessment should follow that of the above list as it moves from basic visual components to more complex tasks (ie, start with acuity to determine if the patient is able to see functionally to participate).

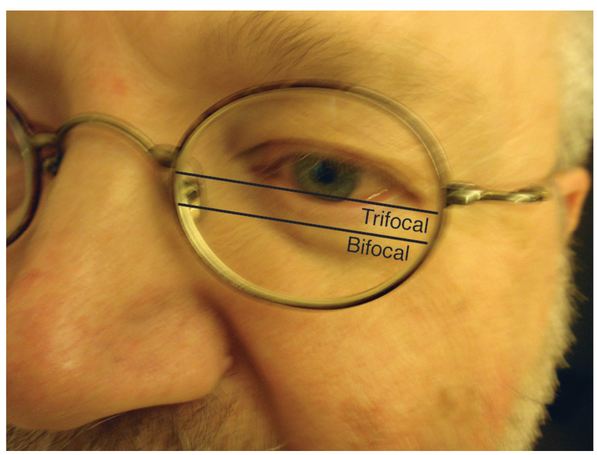

Figure 4-1. Segments in progressive lenses.

TABLE 4-1

RECOMMENDED COMPONENTS OF VISION SCREEN

Components of Vision Screen*	Corrective Lenses Use During Testing
Functional performance/behavioral vision checklist concurrent with or complementary to tests	SM wears corrective lenses (if appropriate)
Symptom self-report: COVD-QOL Outcomes Assessment + photosensitivity interview question	
Far/near acuity: CPAC	
Accommodation: Accommodative Amplitude Test	
Convergence: near point of convergence	
Eye alignment & binocular: eye alignment test	
Saccades: A-DEM	
Pursuits: NSUCO	SM is tested without his/her corrective lenses
Confrontation: finger counting	

* In order of administration
A-DEM: Adult Developmental Eye Movement Test
COVD-QOL: College of Optometrists in Vision Development Quality of Life Assessment
CPAC: Chronister Pocket Acuity Chart
NSUCO: Northeastern State College of Optometry Eye Movement Test
SM: service member

- The occupational therapist observes how the patient is using his or her eyes and the functional implications. The therapist should look for the following:
  - facial expressions, head turning or slanting, squinting;
  - fatigue, frustration, complaints of headaches, etc;
  - complaints of losing one's place when reading;
  - quality of eye movements;
  - smooth versus jerky movements;
  - eyes missing or losing the targets; and
  - over- and undershooting.

These symptoms, along with the patient's ability to perform the tasks or tests, will help the occupational therapist determine whether the patient is experiencing visual impairment.

General Equipment to Have on Hand

- Occluders or eye patches
- Penlight
- Ruler
- Pen and paper
- Dowels with small balls or objects attached to the ends

Preferred Methods

Because the visual system is central to participation in therapy and functioning in everyday life, occupational therapists perform a vision screen on service members with TBI to identify suspected deficits, refer to vision specialists, and better understand patients' functional performance problems. The utility of this process, however, is impeded by the fact that there is no gold standard for a vision screen on adults with TBI. This issue will be resolved if and when psychometric data are collected and published on this population.

To address the need to specify preferred practices until such time, a consensus panel comprised of occupational therapy and optometry vision experts was convened in July 2011 by the US Army Office of the Surgeon General—Rehabilitation and Reintegration Division. The panel was charged with examining existing options and using a modified Delphi process to achieve consensus as to the composition of a brief occupational therapy vision screen for SMs with c/mTBI (Table 4-1); the tools and methods considered are further described in this chapter. Note that, like most assessments in this section, methods endorsed by the panel are considered **practice options** because they have not been fully evaluated on adults with c/mTBI; however, given their selection from many alternatives, those methods recommended by the panel might be considered "better" practice options. Do not underestimate the importance of your own observation skills and look for functional implications.

Additional Resources for Occupational Therapy and Vision

Gillen G. *Cognitive and Perceptual Rehabilitation: Optimizing Function*. St Louis, MO: Mosby; 2009.

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

Zoltan B. *Vision, Perception, and Cognition: A Manual for the Evaluation and Treatment of the Adult With Acquired Brain Injury*. 4th ed. Thorofare, NJ: SLACK Incorporated; 2007.

SYMPTOMS SELF-REPORT: COLLEGE OF OPTOMETRISTS IN VISION DEVELOPMENT QUALITY OF LIFE ASSESSMENT

Purpose/Description

The College of Optometrists in Vision Development Quality of Life Outcomes (COVD-QOL) Assessment was developed in 1995 to describe and measure changes resulting from optometric intervention, including vision therapy. This 30-item, self-report survey addresses four areas: (1) physical/occupational function, (2) psychological well-being, (3) social interaction, and (4) somatic sensation. The short form, the S-COVD-QOL, includes 19 items and test-retest reliability suggests the short form is a satisfactory substitute.[4] This assessment may be used to identify problems, provide treatment, and make referrals. It is **not** intended to replace a comprehensive vision evaluation by an optometrist.

The questionnaire may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist or ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or c/mTBI, and observation of functional performance suggests the possibility of visual dysfunction in a number of domains.

This questionnaire should be used in conjunction with a full vision screen.

Administration Protocol/Equipment/Time

Maples[5] recommended use of this assessment at optometric initial assessment, during therapy, at completion of therapy, and at a predetermined time after intervention. Patients rate each statement on a 0-to-4 scale (with 0 indicating that the symptom is never present and 4 indicating the symptom is always present). The questionnaire is to be completed by the patient or therapist via interview with patient, family members, and caregivers. Administration time is less than 10 minutes. The questionnaire is available at no cost and can be obtained by contacting the College of Optometrists in Vision Development (215 West Garfield Road, Suite 200, Aurora, OH 44202).

Groups Tested With This Measure

The COVD-QOL Assessment has been used in children and adults with various types of vision disorders. Diagnoses including strabismus, amblyopia, TBI, autism spectrum, sports vision, vision skills, vision perception, and reading dysfunction were included in a multisite study, which concluded that patients reported significantly fewer symptoms after vision therapy using the COVD-QOL Assessment.[6] Shin, Park, and Park[7] used the COVD-QOL Assessment with parents and their children ages 9 to 13 years old to explore the prevalence and types of nonstrabismic accommodative or vergence dysfunctions. Farrar, Call, and Maples[8] compared the visual symptoms between attention deficit disorder (ADD)/attention deficit-hyperactivity disorder (ADHD) and non-ADD/ADHD children. There is no literature describing the use of the COVD-QOL Assessment in adults with c/mTBI.

Interpretability

- Norms: not available
- Minimal detectable change 95% (MDC_{95}): 0.193 for the item mean score on the

COVD-QOL. This means a patient's posttreatment score needs to change by at least .193 from the pretreatment score for the 30 items to be 95% confident that true change occurred (rather than measurement error). MDC_{95} was calculated based on Maples.[5]

- Responsiveness estimates: not available

Reliability Estimates

- Internal consistency: not available
- Interrater: not available
- Intrarater: not available
- Test-Retest: Maples[5] determined test-retest by testing 19 optometry students with administrations separated by 2 weeks. Wilcoxon Signed Rank Analysis showed no significant differences. A paired t-test and item analysis were insignificant. Spearman's rho correlation for test-retest of each subject was 0.878. In total, 89% of subjects scored insignificantly different, while 90% of items were found to vary insignificantly.

Validity Estimates

- Content/Face: not available
- Criterion: not available
- Construct: Daugherty, Frantz, Allison, and Gabriel[9] demonstrated quality-of-life changes after vision therapy with subjects diagnosed with binocular vision who ranged from 7 to 45 years of age. White and Major[10] compared subjects with convergence insufficiency and subjects with normal binocular vision using this measure and found two of the 30 items were statistically higher for convergence insufficiency than for normal binocular vision. Farrar, Call, and Maples[8] compared the visual symptoms between ADD/ADHD and non-ADD/ADHD children and noted that 14 of the 33 symptoms were significantly more severe in the ADD/ADHD group.

Selected References

Daugherty KM, Frantz KA, Allison CL, Gabriel HM. Evaluating changes in quality of life after vision therapy using the COVD Quality of Life Outcomes Assessment. *Optom Vis Dev*. 2007;38:75–81.

Maples WC. Test-retest reliability of the College of Optometrists in Vision Development Quality of Life Outcomes Assessment Short Form. *J Optom Vis Dev*. 2002;33:126–134.

Maples WC. Test-retest reliability of the College of Optometrists in Vision Development Quality of Life Outcomes Assessment. *Optometry*. 2000;71(9):579–585.

DYNAMIC FUNCTIONAL TASK OBSERVATION: VISION

Purpose/Description

Functional task observation is a critical component of a comprehensive cognitive and visual assessment. Many standardized tests do not pose the same challenges to patients as trying to function in unstructured tasks or environments; therefore, systematic observation of functional task performance provides unique opportunities to further understand patients' challenges and strengths. By observing patients as they perform functional tasks, occupational therapists assess the extent to which task, environment, and personal characteristics interact to impact performance. Furthermore, therapists modify task and environmental variables to right-fit challenges specific to an individual's goals and to determine under which circumstances the patient's performance is optimized. Occupational therapists design patient-relevant functional tasks and use an observation worksheet, like the Dynamic Functional Task Observation Checklist (Form 4-1), to analyze task and environmental characteristics and to catalog the associated personal characteristics and overall performance.

Recommended Instrument Use: Practice Option

The Dynamic Functional Task Observation Checklist may be used to structure patient performance observations during the assessment phase and throughout the episode of care.

FORM 4-1

SISTER KENNY DYNAMIC VISUAL TASK OBSERVATION CHECKLIST

Task description: ______________________________

Component	Descriptions of characteristics			Notes
Task characteristics	Perceived degree of difficulty		☐ Easy ☐ Moderate ☐ Difficult	
	Perceived degree of familiarity		☐ Familiar ☐ Familiar with new challenges ☐ Unfamiliar	
	Type of instruction provided		☐ Verbal ☐ Written ☐ Demonstrated ☐ Pictorial	
	Physical demands		☐ Sedentary ☐ Active ☐ Gross motor ☐ Fine motor ☐ Other: ☐ Other:	
	Cognitive demands		Attention Memory Executive skills	
	Visual demands	Acuity	Size font	
		Scanning	☐ Scanning	
		Visual attention	Table top Environmental scanning Static Dynamic ☐ Smooth pursuits ☐ Convergence/Divergence Other:	
Environment characteristics	Performance setting		☐ Clinic ☐ Community	
	Stimulus-arousal properties		☐ Little to no distracters ☐ Auditory distracters ☐ Visual distracters	
	Visual/auditory considerations		☐ Lighting needs ☐ Glasses, patches ☐ Hearing device	
	Physical considerations		☐ None ☐ Pain ☐ Decreased endurance ☐ U/E limitations ☐ L/E limitations ☐ Decreased balance	
	Emotional considerations		☐ None ☐ Seems anxious ☐ Seems depressed	
	Self-awareness associated with the task at-hand		☐ Anticipatory ☐ Emergent ☐ Intellectual ☐ Little to none	

(**Form 4-1** *continues*)

Form 4-1 *continued*

Functional observations related to vision	Patient makes accommodations via head position	☐ Tilted to one side ☐ Turned to one side ☐ Other	
	Patient makes accommodations via trunk posture	☐ Leaning in toward activity ☐ Leaning to one side or the other ☐ Other:	
	Patient makes accommodations via eyes	☐ Squinting ☐ Closing one eye ☐ Other:	
	Hand/eye coordination	☐ Reaching accuracy ☐ Ability to write on a line accurately	
Task performance	Task accuracy (use of forms is accurate, writing is legible, organized, found all components without cues)	☐ Totally accurate ☐ Somewhat accurate ☐ Not accurate	
	Activity tolerance	☐ Functional with no breaks ☐ Functional with self-initiated breaks ☐ Impaired, needed breaks and cues to take them ☐ Lethargic/unable ☐ Complaints of eye strain ☐ Complaints of headaches ☐ Other:	
	Self-prediction-reflection of visual challenge and ability to manage	☐ Able to accurately predict performance ☐ Able to reflect on performance ☐ Needed cues to predict performance ☐ Needed cues to reflect on performance	
	Response to feedback	☐ Responsive to feedback; uses feedback ☐ Defensive and reluctant ☐ Refusal to listen/argues	
	Visual strategy use	Strategy: ☐ Independently initiated ☐ Cues required Strategy: ☐ Independently initiated ☐ Cues required Strategy: ☐ Independently initiated ☐ Cues required Strategy: ☐ Independently initiated ☐ Cues required	

Administration Protocol/Equipment/Time

These dimensions vary depending on the task developed by the clinician. See Chapter 9, Performance and Self-Management, Work, Social, and School Roles, for examples of vision-demanding tasks, including the following: job-specific tactical simulation 1 (dynamic visual scanning activity), job-specific tactical simulation 2 (target detection on visual scanning activity), class-A error detection, topographical symbols on a military map, and grid coordinates of a point on a military map.

Groups Tested With This Measure

These methods have not been formally tested on any groups. This description proposes methods by which occupational therapists can standardize observational tasks for their own use.

Interpretability

- Norms: There are no norms for this process, but as individual therapists craft and frequently use a core set of observational tasks, they will readily identify abnormalities, errors, or discrepancies in performance.
- MDC: not applicable
- Responsiveness estimates: not applicable

Reliability and Validity Estimates: not applicable

DISTANCE VISUAL ACUITY TESTING

Purpose/Description

Distance visual acuity testing is used to determine the patient's ability to focus on and distinguish fine detail at a distance of 20 feet.

Recommended Instrument Use: Practice Option

Administration Protocol/Equipment/Time

Equipment required includes Chronister Pocket Acuity Chart (CPAC; Gulden Ophthalmics, Elkins Park, PA), a flip-pocket chart of 22 pages of targets.

Setup

- Provide adequate lighting on the test card.
- Glasses or contacts should be worn during testing if the patient normally wears them. Make sure the patient uses the appropriate glasses and portion of the glasses for the test (ie, if he or she has bifocal, trifocals, or progressive lenses; see Figure 4-1).
- Although visual acuity is traditionally measured with one eye covered, it is recommended that the patient keeps both eyes open during testing, as the goal is to determine if there is a visual acuity problem that could interfere with how the patient functions with both eyes open.

Administration Protocol

- Position the CPAC 20 feet away from the patient. Instruct the patient to verbally identify all the letters on the 20/40 line (note the "40" in lower left corner of the chart).
- To pass the screening, the patient must be able to correctly read three of the four 20/40 letters. Patients who fail the screening should be referred to a vision specialist (email communication, Mitchell Scheiman, OD, Chief, Pediatric/Binocular Vision Service and Professor, Salus University, The Eye Institute of the Pennsylvania College of Optometry, Philadelphia, PA, January 12, 2012). It is unnecessary for the patient to read the larger letters unless the therapist wants to determine exact visual acuity.
- If the patient has problems reading letters, visual acuity may be assessed using the Lea Symbols Test (Good-Lite Co, Elgin, IN).

Groups Tested With This Measure: not available

Interpretability

- Norms: Expect to see at least 20/40 with both eyes together.
- Although 20/20 visual acuity is considered "normal," in a screening format it is only necessary to determine whether a patient has a loss of visual acuity that might interfere with function; thus, for screening purposes, visual acuity worse than 20/40 is used as the criterion for referral.
- MDC: not applicable
- Responsiveness estimates: not applicable

Reliability and Validity Estimates: not available

Selected Reference

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

ACCOMMODATIVE AMPLITUDE TEST

Purpose/Description

Accommodative amplitude is defined as the "closest near focusing response that can be produced with maximal voluntary effort in the fully corrected eye."[11(p128)] An accommodative amplitude screen may be used to identify problems, provide treatment, and make referrals. It is not intended to replace a comprehensive vision evaluation by an optometrist.

Recommended Instrument Use: Practice Standard

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist or ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or c/mTBI and observation of functional performance suggests the possibility of visual dysfunction in a number of domains.

This test can be used in conjunction with a full vision screen to assess for accommodation problems.

Administration Protocol/Equipment/Time

See below for the modified push-up method instructions. Administration time is less than 2 minutes. Equipment needs include a fixation stick such as the Gulden fixation stick, eye patch, and ruler. Positioning is important and the occupational therapist should try to find the best position that permits the patient to attend and concentrate on the task. The patient's head will ideally be vertically erect. If the patient wears corrective lenses, they should be used during this test.

Modified Push-Up Method

Preliminary Steps

- If glasses have been prescribed for both far and near distance, the glasses should be worn for this test; however, if glasses were only prescribed for reading, they should not be used for this test. In addition, if the patient wears a bifocal or progressive lens, the patient's accommodative amplitude must be measured through the top portion of the glasses, not the reading portion of the glass.
- Make sure there is no glare and that illumination is adequate.
- Position the patient to optimize attention.

Testing

- Place patch over the patient's left eye.
- Hold the fixation stick with the 20/30 target about 1 inch in front of the patient's right eye (use the small single letter on top of the stick).
- Slowly move the fixation stick away from the eye until the patient can identify the letter (it does not have to be perfectly clear).
- Measure distance from eye to target when the patient can identify the letter.

Scoring

- Record the distance from the patient's eye to the target when the patient can identify the letter (Exhibit 4-1).
- Divide 40 by this number to determine the patient's amplitude of accommodation (eg, if the patient can see the letter at 8 inches: $40 \div 8 = 5D$).
- Use norms tables to interpret results (see Interpretability).

Groups Tested With This Measure

Green et al[12] used the push-up accommodative amplitude method as a measure of accommodation when testing 12 adult patients with c/mTBI compared to 10 control subjects with no visual impairment. A significant difference between the mean push-up accommodative amplitudes was indicated for subjects with c/mTBI when compared to age-appropriate normative values. Conclusions indicated use of the push-up accommodative amplitude method as a visual screening tool for

EXHIBIT 4-1

ACCOMMODATION RESULTS

Distance at which patient can identify letter: _____ inches

40 / (# of inches) = 40 / _____ = _____ D* (amplitude of accommodation)

Possible impairment of accommodation: Yes____ No ____

*Compare this result with the expected amplitude of accommodation by age.
Expected mean amplitude: 18.5D – [0.30D × (age in years)] or, for expected mean amplitude, see Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

hospital technical and therapy staff, including occupational therapists. Chen and O'Leary[13] showed high reliability between the conventional and modified push-up methods testing children and adults. Rouse, Borsting, and Deland[14] evaluated interrater and intrarater reliability of the monocular push-up accommodative amplitude with children and found reliability repeatable in children.

Interpretability

- Norms: Hofstetter created formulas for the expected mean accommodative amplitudes based on normative data of Duane and Donders.[11(p396)]
- Expected mean amplitude: 18.5D – [0.30D × (age in years)]. Also, see Scheiman[15] for expected values of amplitude of accommodation by age.
- If the patient's amplitude of accommodation is more than 2D below the expected finding, it is considered a problem. If a patient's amplitude of accommodation is greater than expected, it suggests the patient has excellent accommodation.
- MDC: not available
- Responsiveness estimates: not available

Reliability Estimates

- Internal consistency: not available
- Interrater: Good interrater reliability with children indicated by intraclass correlation (ICC) ranges 0.81 to 0.85.[14]
- Intrarater: Intrarater within-session reliability was excellent with children with ICC's ≥ 0.88.[14] Rouse and colleagues also determined fair-to-good between-session intrarater reliability with ICC 0.89 and 0.69.[14]
- Test-Retest: Repeatability of the modified push-up method for two occasions was high for both monocular and binocular testing with young adult subjects.[13]

Validity Estimates

- Content/Face: not available
- Criterion: Chen and O'Leary[13] compared the modified push-up to the conventional push-up method with children and adult subjects and found the tests to be interchangeable.
- Construct: Green et al[12] found significant difference between the mean push-up accommodative amplitudes for subjects with c/mTBI when compared to age-appropriate normative values.

Selected References

Chen AH, O'Leary DJ. Validity and repeatability of the modified push-up method for measuring the amplitude of accommodation. *Clin Exp Optom.* 1998;81:63–71.

Green W, Ciuffreda KJ, Thiagarajan P, Szymanowicz D, Ludlam DP, Kapoor N. Accommodation in mild traumatic brain injury. *J Rehabil Res Dev*. 2010;47(3):183–199.

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

NEAR POINT OF CONVERGENCE

Purpose/Description

Convergence is defined as the ability to maintain eye alignment as an object approaches the eyes. This test of near point convergence (NPC) may be used to identify problems, provide treatment, and make referrals. It is not intended to replace a comprehensive vision evaluation by an optometrist.

Recommended Instrument Use: Practice Standard

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or complicated c/mTBI and observation of functional performance suggests the possibility of visual dysfunction in a number of domains.

This test can be used in conjunction with a full vision screen to assess for convergence.

Administration Protocol/Equipment/Time

Equipment needed includes a penlight or pencil and a ruler. Administration time is less than 2 minutes.

Procedure

- Stand or sit face to face with the patient in a location that optimizes the patient's ability to attend to the task.
- Begin with the pencil tip or penlight approximately 12 inches away from the patient at eye level. Ask if the patient sees one pencil or penlight. If not, move the pencil or penlight further away until the patient sees one pencil.
- Slowly move the pencil tip or penlight toward the patient at eye level and between the patient's eyes.
- Instruct the patient to keep his/her eyes on the tip of the pencil or penlight for as long as possible.
- Ask the patient to tell you when he/she sees a split image (ie, two pencil tips).
- Once diplopia occurs, move the pencil tip or penlight toward the patient another inch or two and then begin to move it away.
- Ask the patient to try to see "one" again.
- Watch the eyes carefully and observe whether they stop working together as a team. One eye will usually drift out.

Scoring

The therapist should record the distance (in inches) between the patient and pencil point or penlight at which the patient reports double vision and the distance at which the patient reports recovery of single vision (Exhibit 4-2).

Normal performance. When the eyes lose alignment, it is referred to as a "break." When a break occurs, one will eye drift outward, and when the patient recovers fusion, the eyes will move back into alignment.[15] Patients with normal convergence will report double vision and lose alignment when the pencil tip or penlight moves toward them to within 2 to 4 inches of their eyes.[15] Those with normal convergences will recover single vision when the target is 4 to 6 inches as it is moved away from them.[15]

Abnormal performance. Patients with significant problems with binocular vision may or may not actually report double vision because some

EXHIBIT 4-2

NEAR POINT OF CONVERGENCE RESULTS

Breaking point*: _____
Recovery of fusion†: _____
Possible impairment of convergence: Yes____ No ____

*As identified by patient or observation of break by therapist, clinical cutoff value of 5 cm or ~ 2 inches
†As identified by patient or observation of eye realignment by therapist, clinical cutoff value of 7 cm or ~ 3.5 inches

may be able to suppress the eye that turns out. Therefore, the therapist must watch the patient's eyes to determine when the break and recovery occur.

Groups Tested With This Measure

NPC testing is used in both children and adults in routine eye care examinations and during vision screenings. Scheiman et al[16] investigated normative data for adults and determined clinical cut off values. Reliability of the NPC test has been established with elementary school children.[14] Thiagarajan et al report a significant difference of NPC break and recovery values were found between c/mTBI and normal groups.[17(p460)]

Interpretability

- Norms: In a study involving optometric diagnosing, Scheiman and colleagues[16] suggested the value of 5 cm (~ 2 inches) for the NPC break and 7 cm (~ 3–3.5 inches) for the convergence recovery in adults using an accommodative target or a penlight with red and green glasses.
- MDC: not available
- Responsiveness estimates: not applicable

Reliability Estimates

- Internal consistency: not available
- Interrater: Rouse and colleagues report excellent interrater reliability with children.[14]
- Intrarater: Rouse and colleagues report excellent within-session intrarater reliability of the NPC, with ICC 0.94 to 0.98 and good between-session reliability, with ICC 0.92 to 0.89.[14] Subjects were children.
- Test-Retest: not available

Validity Estimates

- Content/Face: not available
- Criterion: not available
- Construct: not available

Selected References

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

Scheiman M, Gallaway M, Frantz KA, et al. Nearpoint of convergence: test procedure, target selection, and normative data. *Optom Vis Sci.* Mar 2003;80(3):214–225.

Thiagarajan P, Ciuffreda KJ, Ludlam DP. Vergence dysfunction in mild traumatic brain injury (mTBI): a review. *Ophthalmic Physiol Opt.* 2011;31:456–468.

BINOCULAR VISION: EYE ALIGNMENT TEST

Purpose/Description

Binocular vision is the ability of the visual system to fuse or combine the information from the right and left eyes to form one image.[1] The images that arrive from each eye must be identical, and for this to occur, both eyes must be aligned so they point at the same object at all times. The terms "heterophoria" and "phoria" are used to describe eyes that turn in, out, or up.[15] There are three common types of phoria: (1) exophoria (eyes have a tendency to turn out), (2) esophoria (eyes have tendency to turn in), and (3) hyperphoria (one eye has a tendency to turn up).[1] The Eye Alignment Test employs the methods of the Modified Thorington method and may be used to identify problems, provide treatment, and make referrals. It is not intended to replace a comprehensive vision evaluation by an optometrist.

Recommended Instrument Use: Practice Option

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or c/mTBI and observation of functional performance suggests the possibility of visual dysfunction in a number of domains.

This test can be used in conjunction with a full vision screen to screen for accommodation problems.

Administration Protocol/Equipment/Time

This test is only performed once with the Maddox rod before the right eye. It is not necessary to repeat the test. Administration time is less than 5 minutes. As stated in several studies, including Goss et al,[18] this test is quick and simple to perform and easy for patients to understand.

Equipment

Adult Screening Kit (Gulden Ophthalmics, Elkins Park, PA), which includes eye alignment near card, Maddox rod, penlight, and the Chronister Pocket Acuity Card.

Setup

If the patient typically wears corrective lenses for reading, they should be used for this test. Position the patient to optimize concentration, preferably sitting comfortably.

Procedure

- Place the penlight into the black plastic holder behind the eye alignment card.
- Examiner should hold the Maddox rod horizontally before the right eye.
- Hold the eye alignment card 16 inches from the patient, perpendicular to the face, with the light at eye level.
- Tell the patient to look at the light and report through which letter or number the red line is passing. If the patient is unable to verbally respond, ask him/her to point to where the red line is passing.
- Orient the Maddox rod vertically before the right eye.
- Tell the patient to look at the light and report through which letter or number the red line is passing. If the patient is unable to verbally respond, ask him/her to point to where the red line is passing.

Scoring

Record the letter or number reported by the patient for both horizontal and vertical alignment (Exhibit 4-3). Compare this to the norms printed on the lower right-hand side of the eye alignment card.

Expected Findings

- Exophoria less than 8
- Esophoria less than 4

Possible Problems

- The patient only sees the red line or the white light, but never both together. This indicates suppression.
- The patient sees the red line moving (it is unstable). This indicates a possible accommodative problem (unstable accommodation).
- The patient reports that the red line is not horizontal or vertical (it is oblique). This indicates the examiner is not holding the Maddox rod horizontally or vertically.

Groups Tested With This Measure

This test has been studied on healthy young adults[18–20] and children.[21] There are no published data on use of this test with adults with c/mTBI.

Interpretability

- Norms: not available for adults
- MDC: not appropriate
- Responsiveness estimates: not available

EXHIBIT 4-3

EYE ALIGNMENT TEST RESULTS

Horizontal alignment*: ______
Vertical alignment†: ______
Possible impairment of eye alignment: Yes ____ No ____

*As identified by patient, clinical cutoff value of less than 8 for exophoria (left of center), and less than 4 for esophoria (right of center)
†As identified by patient, clinical cutoff value of less than 2

Reliability Estimates

- Internal consistency: not appropriate
- Interrater: Strong interrater correlation found with the modified Thorington method (r = 0.92).[19]
- Intrarater: Among the subjective tests, the modified Thorington test was the most repeatable.[22] However, no difference between the results of the various tests was "statistically significant" for repeatability.
- Test-Retest: not available

Validity Estimates

- Content/Face: not available
- Criterion: Antona and colleagues compared the modified Thorington test with three others (von Graefe technique, Maddox rod test, and prism cover test) and concluded that due to the low level of agreement observed between these tests, interchangeability is not recommended in clinical practice.[22]
- Construct: not available

Selected References

Antona B, Gonzalez E, Barrio A, Barra F, Sanchez I, Cebrian JL. Strabometry precision: intra-examiner repeatability and agreement in measuring the magnitude of the angle of latent binocular ocular deviations (heterophorias or latent strabismus). *Binocul Vis Strabolog Q Simms Romano.* 2011;26(2):91–104.

Goss DA, Moyer BJ, Teske MC. A Comparison of Dissociated Phoria Test Findings with Von Graefe Phorometry & Modified Thorington Testing. *J Behav Optom.* 2008;19(6):145–149.

Lyon DW, Goss DA, Horner D, Downey JP, Rainey B. Normative data for modified Thorington phorias and prism bar vergences from the Benton-IU study. *Optometry.* Oct 2005;76(10):593–599.

Rainey BB, Schroeder TL, Goss DA, Grosvenor TP. Inter-examiner repeatability of heterophoria tests. *Optom Vis Sci.* Oct 1998;75(10):719–726.

Scheiman M. *Understanding and Managing Vision Deficits*. Thorofare, NJ: SLACK Incorporated; 1997.

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

SACCADES: DEVELOPMENTAL EYE MOVEMENT TEST

Purpose/Description

The Developmental Eye Movement (DEM) test is a number-naming saccadic eye movement test that was originally developed to address saccadic movements in children. There is a need for a similar assessment in adults, as saccadic eye movements are also a concern in adults with acquired brain injuries such as stroke or TBI, and one has been developed. However, it is not available publically and there are questions whether the adult test may be considered a parallel test to the DEM due to the use of double digit numbers which may make a difference in test performance.[23] Due to the lack of support that is truly evidence based, it is recommend to use the DEM using the age 13 norms, even if the test will under-identify impairment in saccadic eye movements.[24]

The purpose of this test is to assess fixational and saccade activity during reading and nonreading tasks. Saccade control is the ability of the eye to move from one point of interest to another after an appropriate period of fixation.[24] These rapid, jumping movements enable the subject's image to be projected onto the fovea of the eye, the sharpest point of visual acuity highly concentrated with receptors and nerve cells. Saccadic and fixational activity is important for word recognition and for processing larger units of printed language.[24]

Recommended Instrument Use: Practice Option

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or c/mTBI and observation of

functional performance suggests the possibility of visual dysfunction in a number of domains.

The vertical subtest is used to evaluate automaticity of number calling (language function) and evaluate children at risk for reading disability (this skill is significantly correlated with reading achievement).[25] The test can be used in conjunction with a full vision screen to screen for accommodative and binocular vision problems.

Administration Protocol/Equipment/Time

One of the main advantages of the DEM is the ease of administration without the need for sophisticated instrumentation. Therefore, it is a useful instrument for patients with decreased attention and concentration.[24] The oculomotor performance is assessed by verbal naming speed and accuracy. The DEM is composed of two parts, the horizontal and vertical tests. Both tests require rapid, continuous naming.

The DEM consists of timing the patient reading aloud 80 double-digit numbers arranged vertically and the same numbers arranged horizontally. The vertical test uses two test plates with two columns on each page and 20 evenly spaced numbers in each column. The test plate for the horizontal test is comprised of 16 rows with five unevenly spaced numbers in each row. After adjusting for errors, the horizontal time is divided by the vertical time. The resulting ratio score is a comparison of the speed of reading material that compares performance of a number-naming task with a higher saccadic eye movement component (ie, the horizontal test results) to performance of the same number naming task with a lower saccadic eye movement requirement (ie, the vertical test results). This comparison allows for adjustment for number-naming speed and results in a measurement of the efficiency of horizontal saccadic eye movements.

Equipment

- DEM test (consists of three subtests)
- Vertical test A (contains 40 single digits)
- Vertical test B (contains 40 single digits)
- Horizontal test C (contains 80 single digits)
- Stopwatch

Setup and Procedure

- The patient views the test cards at 40 cm (~ 16 inches) away
- Ask the patient to call out the numbers on vertical tests A and B as quickly as possible from top to bottom without using his or her finger.
- Record time and errors (addition, omission, substitution).
- Ask the patient to call out the numbers on the horizontal test C as quickly as possible without using his or her finger. The patient calls out the numbers across the page.
- Record time and errors (addition [*A*], omission [*O*], substitution).
- Calculate the score to determine whether or not to refer the patient to a vision specialist.

Scoring

- *V* equals the total completion time for vertical tests A and B (in seconds).
- Determine the horizontal adjusted (*HA*) response time as follows (where horizontal time [*HT*] is in seconds): $HT \times 80/(80 - O + A)$.
- Determine the ratio score by dividing the *HA* time by the vertical time (ratio = HA/V).
- Compare the service member's score to the referral cut point based on the age 13 norm (Exhibit 4-4). Refer accordingly.

Groups Tested With This Measure

The DEM was initially normed and administered to 556 elementary school students ranging in age from 6-13 years.[25] The authors were unaware of any sample selection biases.[25] Tassinari and DeLand addressed its reliability and associated symptomatology.[25] This instrument has not been tested on adults with c/mTBI.

Interpretability

- Norms: determined by using the norms for age 13 by Garcia et al[25] (see Exhibit 4-4). Service members whose ratio scores are one standard deviation above the mean (eg, above the cut point) should be referred to a vision specialist.
- MDC: not available
- Responsiveness estimates: not available

Reliability Estimates

- Internal consistency: Garcia et al found that the correlations between all subtests were

EXHIBIT 4-4

DEVELOPMENTAL EYE MOVEMENT TEST RESULTS

Test A Vertical: ______ seconds
Test B Vertical: ______ seconds
Adjusted Vertical Time (*V*) = (tests A + B) = ____ seconds
Test C – Horizontal (*HT*): ____ seconds
Errors: additions (*A*) ____ omissions (*O*) ____ substitutions ____ transposition ____
Horizontal Adjusted Time (*HA*) = $HT \times 80 / (80 - O + A)$ =
Ratio score: $HA \; / \; V$ = ____
Compare score to cut point below*: Possible impairment of saccades: Yes____ No ____

*Clinical cutoff value is a ratio score greater than 1.22. Cutoff for screening is determined as 1 standard deviation above the mean norm for age 13 (ratio mean = 1.12, standard deviation = 0.10 [no adult norms available]).
Data source: Richman JE. *DEM Manual: The Developmental Eye Movement Test: Examiner's Manual*. Version 2.0. Mishawaka, IN: Bernell Corporation; 2009.

significant (P < 0.001) except vertical time and ratio score (r = – 0.05)[25]
- Interrater: Testing the interrater reliability found vertical time, r = 0.81, horizontal time, r = 0.91, ratio r = 0.57 (P < 0.01).[25]
- Intrarater: Testing the intrarater reliability found vertical time, r = 0.89, horizontal time, r = 0.86, ratio r = 0.57 (P < 0.01).[25]
- Test-Retest: There are several studies that address this in children with varying results. Vertical time, r = 0.85; horizontal time, r = 1.89; ratio scores (corrected for attenuation), r = 0.66.[25] There are two reliability studies that show poor test-retest reliability for vertical, horizontal, and ratio.[26]

Validity Estimates

- Content/Face: not available
- Criterion: not available
- Construct: The Wide Range Achievement Test was compared to the DEM. The results indicated moderate to high negative correlations with all DEM subtests that were significant at the P < 0.001 level (vertical time r = – 0.79; horizontal time r = – 0.78; ratio = – 0.55).[25]

Selected References

Garcia RP, Richman JE, Nicholson SB, Gaines CS. A new visual-verbal saccade test: The Developmental Eye Movement test (DEM). *J Behavioral Optom.* 1990;61:124-135.

Powell JM, Birk K, Cummings EH, Col MA. The need for adult norms on the Developmental Eye Movement test. *J Behavioral Optom.* 2005;16(2):38–41.

Tassinari JT, DeLand P. Developmental Eye Movement test: reliability and symptomatology. *Optometry.* Jul 2005;76(7):387–399.

PURSUITS AND SACCADES: NORTHEASTERN STATE UNIVERSITY COLLEGE OF OPTOMETRY OCULOMOTOR TEST

Purpose/Description

The Northeastern State University College of Optometry (NSUCO) Oculomotor Test is a direct observational test for screening saccades and pursuits to determine if a patient demonstrates impairment with these visual skills. Saccades are quick eye movements that occur when the eyes fix on various targets in the visual field,[27] and pursuits are "eye movements that maintain continued fixation on a moving target."[27(p241)]

The purpose of this standardized test is to assess four aspects of pursuits and saccades, including: (1) ability (sustaining power), (2) accuracy, (3) degree of head movement the patient uses to perform the task, and (4) degree of body movement. It may be used to identify problems, provide treatment, and make referrals; it is not intended to replace a comprehensive vision evaluation by an optometrist/ophthalmologist.

Recommended Instrument Use: Practice Option

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

1. the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
2. the patient has mild-to-moderate brain injury or c/mTBI and observation of functional performance suggests the possibility of visual dysfunction in a number of domains.

This test can be used in conjunction with a full vision screen to assess saccades and pursuits and can be used for patients ages 5 to adulthood.

Administration Protocol/Equipment/Time

Required equipment includes two small (approximately a 1/2-inch diameter), colored, reflective spheres (balls) mounted on dowel sticks. Administration time is less than 5 minutes. The limited verbal interaction required by the examiner together with objective observations enables this to be an advantageous direct observational test.

Groups Tested With This Measure

Although the NSUCO Oculomotor Test is widely used with adult patients, it has not been formally tested on adults with or without brain injury. It has been tested extensively on children up to the age of 14, including interrater and intrarater reliability, and test-retest reliability,[28] construct validity,[29,30] and norms.[31]

Interpretability

This test has not been normed on adults. Because oculomotor development is believed to plateau by age 14, clinicians may consider using the norms reported by Maples, Atchley, and Ficklin (Tables 4-2 and 4-3). To do so, the clinician assigns a score of 1 through 5 based on the scoring criteria, then compares each score to the failure criteria. Scores that fall below the minimal levels may indicate impairment. Beyond assigning scores, therapists may use the NSUCO Oculomotor Test as a venue for observing patient performance in areas of ability, accuracy, and head and body movement and use these observations to decide whether to refer the patient to a vision specialist for more in-depth evaluation.

- MDC: not available; however, repeat testing over time with changes in performance would give different scores.
- Responsiveness estimates: not available

Reliability Estimates

- Internal consistency: not available
- Interrater: 21 elementary students tested with 24 student clinicians scoring:
  - Average exact agreement of the four scores of the pursuits test: 73.5%.[28]
  - Average exact agreement of the four scores of the saccades test: 75%.[28]
- Intrarater: 21 elementary students tested with 24 student clinicians scoring:
  - Average exact agreement of the four scores of the pursuits test: 90%.[28]

TABLE 4-2

SACCADES: NORMS FOR INDIVIDUALS 14 YEARS OF AGE AND OLDER*

	SACCADES			
	Ability	**Accuracy**	**Head Movement**	**Body Movement**
Male	Less than 5	Less than 4	Less than 3	Less than 5
Female	Less than 5	Less than 3	Less than 4	Less than 5

*Scores indicate failure.

Adapted with permission from: Maples WC, Atchley J, Ficklin T. Northeastern State University College of Optometry's oculomotor norms. *J Behav Optom*. 1992;3:149.

TABLE 4-3

PURSUITS: NORMS FOR INDIVIDUALS 14 YEARS OF AGE AND OLDER*

	PURSUITS			
	Ability	**Accuracy**	**Head Movement**	**Body Movement**
Male	Less than 5	Less than 5	Less than 4	Less than 5
Female	Less than 5	Less than 4	Less than 4	Less than 5

*Scores indicate failure.
Adapted with permission from: Maples WC, Atchley J, Ficklin T. Northeastern State University College of Optometry's oculomotor norms. *J Behav Optom*. 1992;3:149.

- ◦ Average exact agreement of the four scores of the saccades test: 83%.[28]
- Test-Retest: 21 elementary students tested with two paired scores on each scale (8 observations × 21 patients = 168 possible significant differences). 87% reliability with 22 significant differences found at the .05 level.[31]

This test did not show significant improvement on retest except for improvement in saccade head movement.[31]

Validity Estimates

- Content/Face: not available
- Criterion: not available
- Construct: NSUCO Oculomotor Test was used to compare academic performance in normal, learning-disabled, and gifted children. The difference between gifted and learning-disabled children was statistically significant in two tests out of eight; however, three tests approached significance. Gifted and normal children were found to be very similar.[29,31] The NSUCO Oculomotor Test was also used to compare good readers and poor readers in a third grade class as determined by the Gates McGinitie or Science Research Association Achievement Reading Test Achievement Reading Test. Videotapes were made of the oculomotor behavior of both good readers (average 1 year, 9 months above grade placement) and poor readers (average 1 year, 3 months below grade placement). All eight categories for pursuits and saccades tested at a significantly different performance at the 0.5 level or better.[30,31]

Selected References

Maples WC, Atchley J, Ficklin TW. Northeastern State University College of Optometry's oculomotor norms. *J Behav Optom.* 1992;3:143–150.

Maples WC, Ficklin TW. Inter-rater and test-rater reliability of pursuits and saccades. *J Am Optom Assoc.* 1988;59:549-552.

Quintana LA. Assessing Abilities and Capacities: Vision, Visual Perception and Praxis. In: Radomsk MV, Trombly Latham CA, eds. *Occupational Therapy for Physical Dysfunction*. Philadelphia, PA: Lippincott, Williams & Wilkins; 2008:234–259.

Standard Setup

- Posture: position patient standing, with feet shoulder-width apart, directly in front of the examiner.
- Head: no instructions are given to the patient to move or not to move his or her head.
- Target characteristics: small (approximately 1/2-inch diameter), colored, reflective spheres (balls) mounted on dowel sticks. One target is used for pursuits, two for saccades.

Movement of the Target

Directional

- Saccades are performed in the horizontal meridian only.
- Pursuits are performed rotationally, both clockwise and counterclockwise.

Extent

- Saccade extent should be at approximately 4 inches on each side of the patient's midline (8 inches total).
- Pursuit path should be approximately 8 inches in diameter. The upper and lower extent of the circular path should coincide with the patient's midline.
- Test distance from the patient: no more than 15.5 inches and no less than the Harmon distance (the distance from the subject's middle knuckle to his or her elbow).
- Ocular condition: binocular only
- Age of the patient: 5 years to adult[31]

Instructions

- 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."
- Pursuits: "Watch the ball as it goes around. Try to see yourself in the ball. Don't ever take your eyes off the ball."[31]

Scoring

- **Ability**: can the patient keep his or her attention under control to complete five round trips for saccades and two clockwise and then two counterclockwise rotations for pursuits?
  - **Saccades**
    1. Completes less than two round trips
    2. Completes two round trips
    3. Completes three round trips
    4. Completes four round trips
    5. Completes five round trips
  - **Pursuits**
    1. Cannot complete 1/2 rotations in either the clockwise or counterclockwise direction
    2. Completes 1/2 rotation in either direction
    3. Completes one rotation in either direction
    4. Completes two rotations in one direction but less than two rotations in the other direction
    5. Completes two rotations in each direction
- **Accuracy (pursuits and saccades are graded alike)**: can the patient accurately and consistently fixate so no noticeable correction is needed in the case of saccades, or track the target so no noticeable refixation is needed when doing pursuits?
  - **Saccades**
    1. Large over- or undershooting is noted one or more times.
    2. Moderate over- or undershooting is noted one or more times.
    3. Constant slight over- or undershooting is noted (greater than 50% of the time).
    4. Intermittent slight over- or undershooting is noted (less than 50% of the time).
    5. No over- or under-shooting is noted.
  - **Pursuits**
    1. No attempt to follow the target, or requires greater than 10 refixations
    2. Refixations 5–10 times
    3. Refixations 3–5 times
    4. Refixations 2 times or less
    5. No refixations
- **Head and body movement:** can the patient accomplish the saccade or pursuit test without moving his or her head or body? Both saccade and pursuit scoring use the same criteria for this aspect of the testing.
  1. Large movement of the head or body at any time
  2. Moderate movement of the head or body at any time
  3. Slight movement of the head or body greater than 50% of the time
  4. Slight movement of the head or body less than 50% of the time
  5. No movement of the head or body

Record results and compare to norms (Exhibit 4-5, see Tables 4-2 and 4-3).[31]

EXHIBIT 4-5

PURSUITS AND SACCADES: NORTHEASTERN STATE COLLEGE OF OPTOMETRY EYE MOVEMENT TEST

	Pursuits	Saccades
Ability		
Accuracy		
Head Movement		
Body Movement		

Data source: Maples WC, Atchley J, Ficklin TW. Northeastern State University College of Optometry's oculomotor norms. *J Behav Optom.* 1992;3:143–150.

CONFRONTATION FIELD TEST

Purpose/Description

Visual field deficit is a visual concern associated with acquired brain injury.[15] Confrontation field testing enables the therapist to screen for gross peripheral visual field loss.

Recommended Instrument Use: Practice Option

There are several confrontation field tests and the choice of tests may affect the likelihood of identifying a visual field defect.[32] The confrontation field test should be used as a screen only because it lacks adequate sensitivity[33]; therefore, if the screening results are negative but the patient's behavior suggests field loss, he or she should still be referred to a vision specialist.[15] This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or complicated c/mTBI and observation of functional performance suggests the possibility of visual dysfunctional in a number of domains.

Administration Protocol/Equipment/Time

Required equipment includes two eye patches/occluders and a target white sphere, 3 mm or less in diameter, mounted on a nonglossy wand. Administration time is less than 5 minutes.

Groups Tested With This Measure

Kerr et al[32] investigated the accuracy of confrontation visual field testing with adult subjects with visual deficit etiologies including: glaucoma, optic neuropathies, optic neuritis, glioma, stroke, and chiasmal tumors. Trobe et al[33] compared various finger and color confrontation tests in identifying chiasmal and optic nerve visual field defects. Subjects included persons with chiasmal hemianopias and neuropathy-related nerve-fiber-bundle defects. Age was not specified. Shahinfar, Johnson, and Madsen[34] reported specificity on various visual field defects, including hemianopias. This test has not been validated on adults with c/mTBI.

Interpretability

Kerr et al[32] investigated the accuracy of confrontation visual field testing and concluded that when performed individually, confrontation visual field tests are insensitive at detecting visual field loss. When confrontation tests were combined, sensitivity improved. Finger counting combined with static finger wiggle achieved 44.6% sensitivity and 97.2% specificity. Use of a kinetic red target resulted in the highest sensitivity and specificity.

- Norms: there are no norms for this test and total score is not calculated.
  - In Part 1, the patient should be able to see the target at approximately the same point at which you can see it. If there appears to be a significant discrepancy,

  a visual field deficit may be present and a referral is necessary for a more precise measurement of the patient's visual field.
  - In Part 2, you are testing the patient's ability to see two objects simultaneously. Patients with visual neglect will have problems with the task even if they do well with Part 1.
- MDC: not available
- Responsiveness estimates: not available

Reliability Estimates: not available

Validity Estimates

- Content validity: not available
- Criterion validity: Kerr et al[32] found confrontation testing to be insensitive to detecting visual field loss as compared to automated perimetry.
- Construct validity: not available

Selected References

Kerr NM, Chew SS, Eady EK, Gamble GD, Danesh-Meyer HV. Diagnostic accuracy of confrontation visual field tests. *Neurology.* 2010;74(15):1184–1190.

Shahinfar S, Johnson LN, Madsen RW. Confrontation visual field loss as a function of decibel sensitivity loss on automated static perimetry. Implications on the accuracy of confrontation visual field testing. *Ophthalmology.* Jun 1995;102(6):872–877.

Trobe JD, Acosta PC, Krischer JP, Trick GL. Confrontation visual field techniques in the detection of anterior visual pathway lesions. *Ann Neurol.* 1980;10:28–34.

Administration Protocol

Part 1

Preparation

1. Patch the patient's left eye; patch your right eye.
2. Sit approximately 20 inches opposite the patient; your left eye should be directly opposite the patient's right eye. Optimally, there should be a dark, uniform wall behind the patient.
3. Provide instructions to the patient. Tell the patient that you will show various finger counts with your hand from the side. Ask the patient to report as soon as he or she sees your hand and how many fingers you are holding up, while continuing to look directly at your left eye.

Testing

1. Start at the 12-o'clock position and slowly move your hand (3-finger count) until the patient first reports seeing it (the object should be placed evenly between the therapist and the patient).
2. Compare the patient's response to yours. If the patient cannot see the target as soon as you can, it is an indication of a possible problem.
3. Move clockwise to the 2-, 4-, 6-, 8-, and 10-o'clock positions and repeat procedures 1 and 2.
4. Record approximately where the patient reports seeing the target in each orientation tested.
5. Patch the patient's right eye; patch your left eye.
6. Sit opposite the patient. Your right eye should be directly opposite the patient's left eye.
7. Repeat the testing procedure described in Steps 1-4.
8. Record results (Exhibit 4-6).

Part 2

Preparation

1. Patch the patient's left eye; patch your right eye.
2. Sit approximately 20 inches opposite the patient; your left eye should be directly opposite the patient's right eye. Optimally, there should be a dark, uniform wall behind the patient.

Testing

1. Extend your arms so your hands are in the 3- and 9-o'clock positions. Your fingers should be positioned so that you can see them from your open eye. Instruct the

EXHIBIT 4-6

CONFRONTATION FIELD TEST RESULTS

Part 1

Position	**Right Eye**		**Left Eye**	
	Does the patient see the target when expected? (Y/N)	If no, # of approximate degrees from center, patient sees the object	Does the patient see the target when expected? (Y/N)	If no, # of approximate degrees from center, patient sees the object
12				
2				
4				
6				
8				
10				

Part 2

Right Eye	**Left Eye**
Does the patient see the correct # of fingers? (Y/N)	Does the patient see the correct # of fingers? (Y/N)

patient to tell you how many fingers you are holding up with each hand.

2. Patch the patient's right eye; patch your left eye.
3. Repeat Step 1.
4. Record results (see Exhibit 4-6).

Confrontation Field Test Results

- In Testing Part 1 the patient should be able to see the target at approximately the same point at which you can see it. If there appears to be a significant discrepancy, a visual field deficit may be present and a referral is necessary for a more precise measurement of the patient's visual field.
- In Testing Part 2, you are testing the patient's ability to see two objects simultaneously. Patients with visual neglect will have problems with the task even if they do well with testing Part 1.

STEREO RANDOT TEST

Purpose/Description

The Stereo Randot Test is used to screen for stereopsis (binocular vision). This test requires the patient to identify forms (geometric forms or animals) from random dot backgrounds while wearing polarized 3-D viewing glasses. It may be used to identify problems, provide treatment, and make referrals; it is not intended to replace a comprehensive vision evaluation by an optometrist.

Recommended Instrument Use: Practice Option

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or c/mTBI and observation of

functional performance suggests the possibility of visual dysfunction in a number of domains.

This test can be used in conjunction with a full vision screen to assess for stereopsis.

Administration Protocol/Equipment/Time

Equipment needs include the Stereo Randot Test kit (available through Bernell VTP. www.stereooptical.com/products/stereotests#randot). Administration time is less than 2 minutes.

Groups Tested With This Measure: not available

Interpretability

- Norms: normal stereo is expected in all adults. The patient should be able to identify all of the simple forms correctly. A patient who has a constant strabismus will be unable to identify any of the forms. Patients with less severe problems, such as intermittent strabismus and heterophoria, will generally have a normal response. It is possible for a patient with acquired brain injury to report double vision on this task, which would suggest that a strabismus is present.
- MDC: not applicable, no expected change in performance
- Responsiveness estimates: not applicable

Reliability and Validity Estimates: not available for adults

Setup

The patient must be able to position his or her head vertically (without tilting) to correctly perform this test. If not, do not use this test.

Administration Protocol

Clinicians are advised to follow the administration protocol specified in the Stereo Randot Test kit's Instruction Manual. In general, this test is administered as follows.

1. Ask the patient to put on the 3-D viewing glasses (over prescription lenses, if need be). Hold the Test upright 16 inches from the patient's eyes. Ask what the patient sees. If the patient has stereopsis, he or she will report seeing geometric forms (depending upon the version of the test selected by the clinician). Give the patient 20 to 30 seconds to try to see the targets.
2. If the patient has difficulty, make sure the head is not tilted to the side.
3. It is helpful to have a drawing available of the test forms (located on the front of the instruction manual). If the patient struggles with the task, you can show the possible forms. Of course, it is more convincing if the patient, without prior knowledge of the forms, is able to identify all correctly (Exhibit 4-7).

Expected Results

Normal performance: The patient should be able to identify forms correctly; however, it should be noted that patients with less severe problems, such as intermittent strabismus and heterophoria, will generally have a normal response.

Abnormal performance: Those with constant strabismus will be unable to identify any of the forms. It is possible for a patient with acquired brain injury to report double vision on this task, suggesting possible strabismus.

BRAIN INJURY VISUAL ASSESSMENT BATTERY FOR ADULTS

Purpose/Description

The Brain Injury Visual Assessment Battery for Adults (biVABA) is a battery of tests used to screen visual processing following brain injury. Results enable therapists to make appropriate referrals and address functional limitations.[35] The biVABA is not intended to replace a comprehensive vision evaluation by an optometrist/ophthalmologist.

EXHIBIT 4-7

STEREO RANDOT TEST RESULTS

Able to identify all forms correctly?
Yes ____ No ____

Correct: ____ / 6

Recommended Instrument Use: Practice Option

This test may be a helpful inclusion in an initial occupational therapy evaluation when:

- the patient has not had a comprehensive visual assessment by an optometrist/ophthalmologist to identify visual impairments, and
- the patient has mild-to-moderate brain injury or complicated concussion/mTBI and observation of functional performance suggests the possibility of visual dysfunction.

The biVABA is also appropriate for anyone who has experienced a brain injury from any cause, including cerebrovascular accident, TBI, brain tumor, anoxia, or anyone who has experienced trauma to the eye.[35] The biVABA can be used for patients ages 14 years and above without modification.

Administration Protocol/Equipment/Time

The biVABA is comprised of a battery of subtests that includes a clinical observation checklist and assessments of visual acuity (distance and reading), contrast sensitivity function, visual field, oculomotor function, visual attention, and scanning. Administration takes approximately 60 minutes.

Detailed administration and scoring procedures are available for purchase from the developer (visABILITIIES Rehab Services, Inc; www.visabilities.com) and are not included in this Toolkit. Clinicians should refer to the biVABA's test booklet and manual for additional information regarding psychometric properties and score interpretation.

Groups Tested With This Measure

The biVABA has not been tested on adults with TBI, and only the visual search section of the biVABA has been empirically tested. The seven subtests used to assess visual search have been included in two studies: they were field tested on 25 subjects between ages 16 and 83 to determine usual search patterns and norms[35,36] and to describe the performance and types of search patterns of the subtests in 81 participants.[37]

Interpretability

The manual provides result interpretation, including descriptions of normal testing reactions. For example, for acuity, 1M print is standard-sized print (newspaper); for pupillary responses, the normal pupil shape is described and an approximate size for pupils in a well-illuminated room is given. See manual for interpretations of patient responses.

- Norms: Analysis of norms of descriptive search strategies and cut-off percentiles are given for the seven subtests of the visual scanning section (see full detailed discussion in product manual).
- MDC: not available
- Responsiveness estimates: not available

Reliability and Validity Estimates

Most of the subtests that comprise the biVABA have previously been evaluated for reliability and validity.[36]

- The biVABA includes three standard visual screening tests that are accepted by ophthalmologists as valid and reliable assessment tools (the Lea Numbers Intermediate Acuity test, the Lea Low Contrast Acuity test, and the Damato Campimeter).
- The Warren text card is a modification of the Lighthouse Near Vision Reading Card.
- The screening for oculomotor performance is composed of standard screening tests that are routinely used by ophthalmologists and neurologists.
- The design copy test is adapted from the literature.
- The visual search subtests use a cancellation test format that has been studied and used extensively in research and has very good validity established by research.

SECTION 2: VISUAL INTERVENTIONS

INTRODUCTION

Vision is the most far-reaching of our sensory systems. Changes to this system can affect patients' ability to participate in therapy as well as function in everyday life.[15] Brahm and colleagues[2] suggest that combat troops with blast-related c/mTBI are at risk for visual dysfunction. Occupational therapists are often the first-line clinicians who are able to identify possible visual impairment. The occupational therapist's roles include evaluating vision function through vision screening and functional observations and determining whether and how visual impairment may be affecting the patient's functional performance.

If visual impairment is suspected, the occupational therapist is responsible for:

- referring the patient to a staff optometrist with expertise in vision and TBI for further evaluation and intervention management,
- educating the patient and the rehabilitation team about how the impairment is affecting the patient functionally,
- providing compensatory treatment,
- providing remedial therapy under the supervision of an optometrist with expertise in vision and TBI, and
- providing various activities that will address visual impairments while working on other impairments.

General Instructions for Treating Visual Impairments

Always make sure the patient has the best corrected vision (ie, wearing the correct glasses) for participating in therapy and that the correction fits well (see General Instructions for Vision Assessment for instructions on best fit and use of bifocals and trifocals). Decide what kind of environment is best for the impairment and focus of the treatment (determined by the patient's level of impairment and distractibility). The environment should be:

- well lit with no glare;
- clutter-free, unless the patient is working on more complex visual tasks; and
- quiet, unless the patient is working on more complex tasks.

Determine whether the patient should be seated, standing, or performing a task that involves walking.

Compensatory Approaches to Visual Deficit

- Modify the task or the environment to maximize the patient's ability to participate.
- Educate the patient about the impairment.
- Teach and practice methods to compensate for the deficit.

Grading the Tasks, Activity Analysis

- Density: low density to high density (eg, start with two columns of letters, one on each side of the page, then progress to 10 columns of letters; Figure 4-2)
- Structure: task (ie, start with organized simple structure and move towards random; Figure 4-3)
- Speed: start with slow, deliberate movement; slowly increase speed (use a metronome, if desired)

Other Suggestions for Oculomotor Therapy

- Enable the patient to achieve early success.
- Emphasize accuracy then work on speed (saccadic and pursuit activities).
- For saccades activities, work from large to small eye movements.
- For pursuits activities, progress from small to large eye movements.
- Work on eyes individually until eyes are equal in ability, then work on eyes together.
- Eliminate head movements during pursuit and saccadic eye movements for activities that can be accomplished without head movement.
- Increase the complexity of the tasks to work toward automatic eye movements. Options include adding a metronome, balance board, or cognitive task that incorporates eye movements.

Selected References

Brahm KD, Wilgenburg HM, Kirby J, Ingalla S, Chang CY, Goodrich GL. Visual impairment and dysfunction in combat-injured servicemembers with traumatic brain injury. *Optom Vis Sci.* Jul 2009;86(7):817–825.

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

Warren M. A hierarchal model for evaluation and treatment of visual perception dysfunction in adult acquired brain injury, Part II. *Am J Occup Ther.* 1993;47:55–66.

Figure 4-2. Examples of high-density **(a)** and low-density **(b)** visual stimuli.

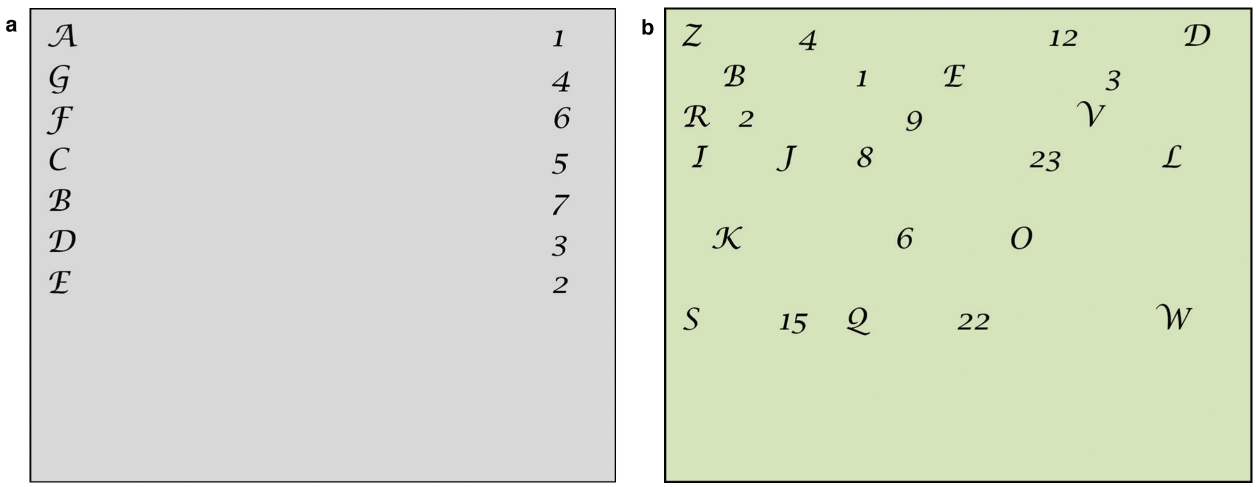

Figure 4-3. Examples of structured **(a)** and unstructured **(b)** visual stimuli.

Other Resources for Occupational Therapy and Vision

Gillen G. *Cognitive and Perceptual Rehabilitation: Optimizing Function*. St Louis, MO: Mosby; 2009.

Zoltan B. *Vision, Perception, and Cognition: A Manual for the Evaluation and Treatment of the Adult With Acquired Brain Injury*. 4th ed. Thorofare, NJ: SLACK Incorporated; 2007.

POOR ACUITY

Purpose/Background

Acuity refers to clarity of vision and the ability to see detail. When acuity is affected, a patient may have difficulty reading, doing fine motor tasks that involve hand-eye coordination, recognizing faces, and the like. Impaired acuity may be connected to reduced central vision and visual field loss. For some patients, treatment may be as simple as wearing glasses correctly or referral to an eye doctor, other patients may have some damage to the eye or eye system that may limit the amount of corrected prescription options available to make a patient functional again.

Visual impairment is acuity less than 20/60 (normal being 20/20).[36] The legal definition of blindness in the United States is visual acuity of 20/200 or worse (or severely restricted peripheral vision). Blindness is defined as visual acuity worse than 20/400.[39]

Strength of Recommendation: Practice Option

Although there are no formal studies that indicate which interventions are best, the interventions that follow are included in textbooks and literature related to low vision.

Interventions

- Refer the patient to an eye specialist (optometrist or ophthalmologist). The patient needs to be evaluated for appropriate prescription to maximize vision clarity.
- If the patient has significant acuity impairment, he or she may need to be referred to a low-vision specialist.
- Educate the patient on proper use of glasses and about impairment.
- Teach the patient compensatory strategies, such as
  - increasing illumination,
  - increasing contrast,
  - increasing size (enlargement or magnification),
  - decreasing background pattern or clutter, and
  - organizing the environment.
- Provide sensory substitution using assistive devices.

Selected References

Answers.com. Visually Impaired webpage. http://www.answers.com/topic/visually-impaired. Accessed June 17, 2013.

Gillen G. *Cognitive and Perceptual Rehabilitation: Optimizing Function*. St Louis, MO: Mosby; 2009.

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

Warren M. Evaluation and treatment of visual deficits. In: Pedretti LW, Early MB, eds. *Occupational Therapy: Practice Skills for Physical Dysfunction*. 5th ed. St Louis, MO: Mosby; 2001: 386–421.

Education

Encourage Proper Use of Glasses

- Patient should wear the appropriate glasses for the task (eg, distance, reading, and computer distance glasses).
- Be sure the patient's glasses fit correctly.
- Be sure the patient uses the appropriate portion and focal distance (working distance) for the glasses. Some people wear progressive lenses, which will not have obvious segments, but placement should be similar (see Figure 4-1).
  - Upper portion is for distance
  - Trifocal for mid-distance (18–24 inches; eg, computer monitor)
  - Near distance
- Some people now wear monovision contacts in which one eye is used for distance and the other for near vision. This will affect how patients use their eyes and how to approach treatment.

Compensatory Techniques and Teaching

The following are compensatory techniques that can be used in the clinic for a patient with poor visual acuity as well as to teach the patient to better function outside the clinic.

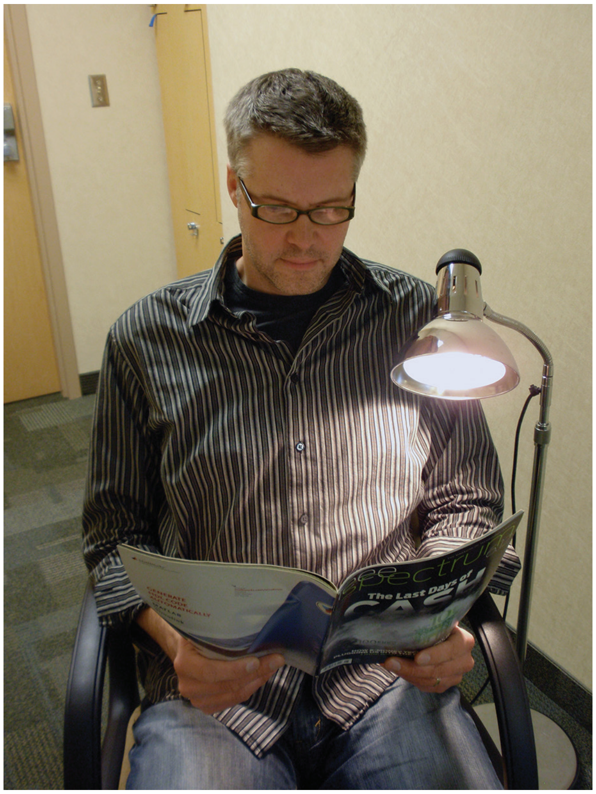

Figure 4-4. Task lamp should be placed below the patient's glasses and directed onto the table, reading material, or task.

Increase Illumination

- Increase the amount of light.
- Determine the best lighting option for the patient that also minimizes glare (eg, incandescent bulbs, halogen, fluorescent [may have flicker effect], and full spectrum).

Figure 4-5. Increase contrast for food preparations and put bright tape or textured stickers on dials.

- If possible, place the light below patient's glasses or optical device to prevent glare off the glass (Figure 4-4).
- Sometimes task lamps are better than room lights.

Increase Contrast

Increase contrast by, for example, placing black coffee in a white mug, butter on a dark plate, contrasting colored tape on the edge of steps, colored soap on a white sink (Figures 4-5, 4-6, and 4-7).

Decrease Background Pattern

- Use solid colors for tablecloth or bedspread to more easily find items set on top of it.

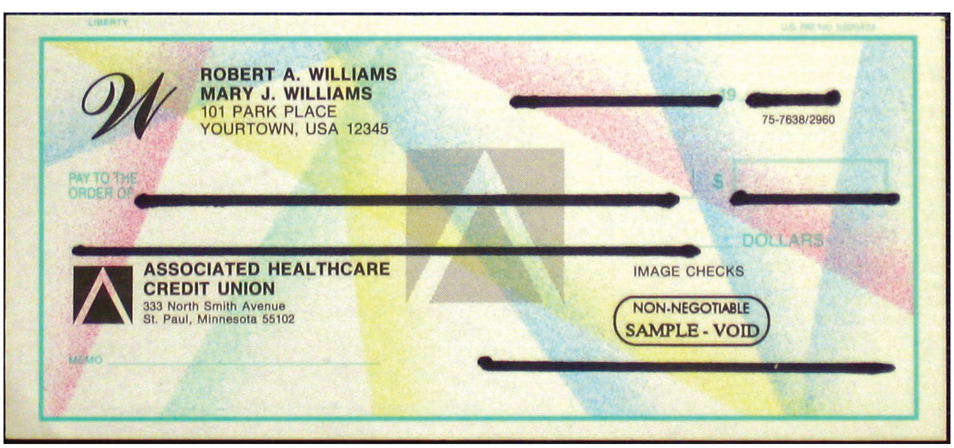

Figure 4-6. Add thick, dark lines to checks and other forms.

- Use plain dishes and solid-colored placemats.
- Simplify junk drawers.

Decrease Clutter and Organize Environment

- Put items away.
- Organize storage places.

Increase Size

- Enlarge print.
- Use thick markers (see Figure 4-6).
- Enlarge computer font.

Magnify

- Use handheld devices and determine the best focal distance of the device (the distance of the lens from the object or reading material with the best clarity; the light rays converge).
- Teach patient methods to maintain the distance.
- Use hand or finger to stabilize the hand held device
- Use handheld stand magnifier that maintains distance (good for patients with incoordination and ataxia).

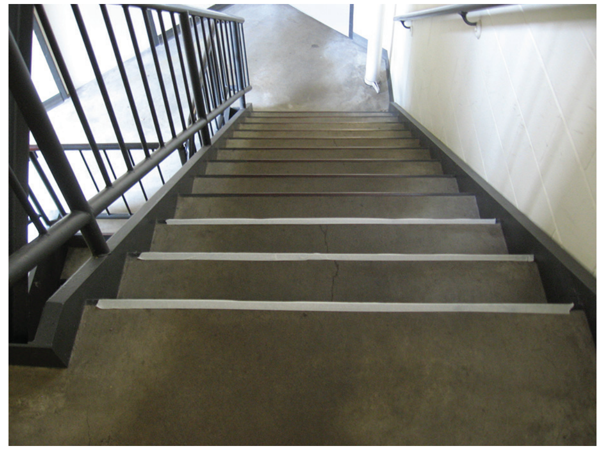

Figure 4-7. Add contrasting colored stripes to edges of stairs.

Use Visual Markers

- For reading, use a ruler under the line being read.
- For dials on appliances, put bright tape or textured stickers on the most commonly used settings (see Figure 4-5).

IMPAIRED PURSUITS

Purpose/Background

Patients with c/mTBI may demonstrate impairment with pursuits during the occupational therapy vision screen. This could be due to a variety of issues, including (but not limited to) motor control, poor innervation, damage to cranial nerves, and poor visual attention. The occupational therapist's roles are as follows:

- identify the potential impairment and how it is affecting the patient functionally,
- refer the patient to a staff optometrist with expertise in vision and TBI,
- educate the patient about the impairment and its functional implications,
- provide compensatory intervention, and
- provide basic range-of-motion exercises for the eye and opportunities within therapy to address visual pursuits during various activities while addressing other areas of treatment.

It is not recommended that occupational therapists spend more than 5 to 10 minutes doing vision exercises unless more time has been recommended by a staff optometrist with expertise in vision and TBI. Although the exercises will not harm the patient, the optometrist will be able to determine whether the exercises will be beneficial or unnecessary to the diagnosis.

Occupational therapy intervention emphasizes the functional implications of possible vision impairment. Therapists address impairments by grading functional activities and monitoring patients' ability and success.

Strength of Recommendation: Practice Option

There is minimal to no objective research demonstrating that the use of eye exercises will benefit pursuit dysfunction for patients with c/mTBI; however, basic range-of-motion or functional activities that use these skills will not harm a patient and may improve function.

Intervention Methods

- Refer patient to an eye specialist for assessment and treatment.
- Provide education.
  - Provide individualized information to the patient about his or her vision strengths and weaknesses and potential strategies.
  - Provide compensatory strategies to maximize function.
  - Assign basic vision exercises, as appropriate.
  - Introduce therapeutic activities that include visual pursuits while addressing other areas of occupational therapy intervention.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR PURSUITS

Education

What are Pursuits?

Pursuits are "eye movements that maintain continued fixation on a moving target."[27(p241)]

Examples include:

- following a ball with your eyes in sports,
- watching people or animals walk or run,
- following an electrical cord from an appliance to an outlet with just your eyes, and
- watching a pen or pencil while writing.

Examples of visual pursuits when the object is stationary and the person is moving include:

- reading a sign or looking at a house while driving by in a car (on a bike, etc), and
- looking in the mirror while turning your head to fix your hair.

When an eye has impaired pursuits, it is difficult to:

- follow moving objects (eg, you lose sight of the ball while watching sports),
- locate which cord goes to which appliance from a power strip, or
- follow the pen while writing.

Compensatory Options

Compensatory options for pursuits are similar to the techniques used for low vision and poor acuity and include:

- increasing illumination, contrast, and size of print (enlarging);
- decreasing clutter and background pattern; and
- using visual markers (eg, using a guide or finger to assist in looking at different objects).

CLINICIAN TIP SHEET: TREATMENT IDEAS FOR PURSUITS

There is minimal to no objective research demonstrating that eye exercises will benefit visual pursuit impairment for patients with c/mTBI; however, basic eye exercises or functional activities will not harm a patient and may assist in improving function (see Range-of-Motion Exercises). If the patient complains of dizziness or nausea with range-of-motion exercise, stop the exercise and find a less visual task to work on. If the patient has not been referred to an eye specialist already, he or she should be.

Following the exercise is a list of treatment suggestions that use visual pursuit skills while addressing other treatment areas as well (Exhibit 4-8). These activities could be easily incorporated into treatment while addressing other impairments.

General Suggestions

- Start with only one eye at a time (cover the other eye with a patch) until both eyes are doing the exercise equally. Once eyes are able to do the task at the same quality, perform with both eyes.
- Have patient keep his or her head still and focus on moving the eye (or eyes).
- Start with small movements and progress to larger movements.
- This should only take about 5 minutes of session time unless recommended by a staff optometrist with expertise in vision and TBI.

Range-of-Motion Exercises

Using a target (eg, a small ball or object on a dowel or penlight) and an eye patch or occluder, move the target slowly back and forth several times into all directions of view (eg, make a "+" and an "X").

IMPAIRED SACCADES

Purpose/Background

Patients with c/mTBI may demonstrate impairment with saccades during the occupational therapy vision screen. This could be due to a variety of issues, including (but not exclusively) motor control, poor innervation, damage to cranial nerves, and poor visual attention. The occupational therapist's role is as follows:

- identify the potential impairment and how it is affecting the patient functionally,
- refer the patient to an optometrist with expertise in vision and TBI,
- educate the patient about the impairment and its functional implications,
- provide compensatory intervention, and
- provide basic eye exercises and opportunities within therapy to address visual inefficiencies during various activities while also addressing other areas of treatment.

It is not recommended that occupational therapists spend more than 5 to 10 minutes doing vision exercises unless more time has been specifically recommended by a staff optometrist with expertise in vision and TBI. Although the exercises will not harm the patient, the optometrist will be able to determine whether the exercises will be beneficial or unnecessary to the diagnosis.

Occupational therapy intervention emphasizes the functional implications of possible vision impairment. Therapists address impairments by grading functional activities and monitoring patients' abilities and successes.

Strength of Recommendation: Practice Option

There is minimal to no objective research demonstrating that eye exercises will benefit visual saccade impairment for patients with c/mTBI; however, basic eye exercises or functional activities will not harm a patient and may improve oculomotor control and movement (and thus function).

Intervention Methods

- Refer patient to eye specialist for assessment and treatment.
- Education: provide individualized information to the patient about his or her vision strengths and weaknesses and potential strategies.
- Provide compensatory strategies to maximize function.
- Assign basic vision exercises, as appropriate.
- Use therapeutic activities that include visual saccades while also addressing other areas of treatment.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR SACCADES

Education

What are Saccades?

Saccades are quick eye movements that occur when the eyes fix on various targets in the visual field.[27] Examples include:

- reading (the eye jumps from one group of words and letters to the next);
- looking up information on displays, charts, or phone books;
- looking at photos or paintings; and
- driving (looking from one object or car to the next).

When an eye has impaired saccades, a patient may:

- lose his or her place when reading or searching for information;
- miss or skip words, lines, or letters; and
- not see significant objects when looking for them.

Compensatory Options

- Use a guide or finger to assist in looking at different objects or when reading.
- Increase print size.
- Decrease clutter.

CLINICIAN TIP SHEET: TREATMENT IDEAS FOR SACCADES

Basic Saccade Exercise

General Setup

- Start with only one eye at a time (cover other eye with patch) until both eyes are doing the exercise equally. Once eyes are able to do the task at the same quality, perform the exercise with both eyes together.
- Have the patient keep his or her head still and focus on moving the eye (or eyes).
- Start with large movements and progress to smaller movements.

Procedure

- Use two targets (eg, a small ball or object on a dowel, penlight, or fingers) and an eye patch or occluder. Ask the patient to look back and forth between the two targets.
- Start slowly, holding the gaze for several seconds, and move back and forth between targets. As patient improves, gradually increase speed.
- Move targets so patient moves gaze into different directions of view (eg, have the targets as if at the end points of a plus sign and an X; move side to side, up and down, diagonal).
- This should only take up about 5 minutes.

Alternate Saccadic Exercise

General Setup

- Start with one eye at a time (cover the other eye with a patch) until both eyes are doing the exercise equally. Once eyes are able to do task at the same quality, perform with both eyes together.
- Have patient keep his or her head still and focus on moving the eye (or eyes).
- Start with large movements and progress to smaller movements.

Procedure

- Use columns of numbers or letters on paper (small distance saccades) or on a grease board (larger distance saccades) and an eye patch or occluder.
- Have patient read the two columns left to right, moving from top to bottom.
- As needed, have the patient use fingers or other anchors, progressing to no anchors.
- Use stopwatch to document progress.
- Change speed using a metronome.
- Start with two columns, then increase the number of columns.
- This should only take about 5 minutes.

Incorporate activities that challenge saccadic movement into the therapy recommendations (Exhibit 4-9).

IMPAIRED ACCOMMODATION

Purpose/Background

Patients with c/mTBI may demonstrate impaired accommodation. They may report discomfort and eye strain with near tasks, blurred vision, visual fatigue, or difficulty changing focus from near to far and far to near. The occupational therapist's role is to:

- identify the potential impairment and how it is affecting the patient functionally,
- refer the patient to a staff optometrist or ophthalmologist with expertise in vision and TBI,
- educate the patient about the impairment and its functional implications,
- provide compensatory intervention if needed, and
- provide basic eye exercises and opportunities within therapy to address the impaired accommodation.

It is not recommended that occupational therapists spend more than 5 to 10 minutes doing vision exercises unless more time has been specifically recommended by an optometrist. Although the exercises will not harm the patient, the optometrist will be able to determine if the exercises will be beneficial or unnecessary to the diagnosis.

EXHIBIT 4-8

FUNCTIONAL ACTIVITIES TO ADDRESS PURSUITS

Paper-and-Pencil Tasks

- Line scrambles
- Mazes
- Computer games (slow-moving objects)
- Remote control car (move through obstacle course)

Also Improves

  - Attention span
  - Hand-eye coordination
  - Problem solving
  - Preplanning

Penlight on the Wall

- Trace a shape or movement outlined on the wall
- Identify letters or numbers on the wall

Also Improves

  - Hand-eye coordination
  - Upper extremity strength and coordination

Ball Games

- Bounce against a wall and catch
- Ball on a string (track and hit)
- Play catch
- Balloon volleyball (tracking and bursting bubbles)
- Beanbag toss

Also Improves

  - Hand-eye coordination
  - Upper extremity strength and coordination
  - Bilateral hand tasks

Dynavision (West Chester, OH; see Clinician Tip Sheet: Dynavision in Supplementary Therapeutic Activity Options section for information about the Dynavision)

- Mode C (outer circle tracking)

Also Improves

  - Upper extremity strength and coordination

EXHIBIT 4-9

FUNCTIONAL ACTIVITIES TO ADDRESS SACCADES

Copy Tasks

- Telephone numbers
- Words
- Sudoku
- Write checks from list
- Enter checks in register

Also Improves

  - Attention span
  - Hand-eye coordination
  - Hand writing
  - Problem solving
  - IADL tasks

Card Games

- Solitaire: table or computer
- War: use metronome to increase speed
- Jigsaw puzzles: begin simple and large and progress
- Computer games: slow

Also Improves

  - Hand-eye coordination
  - Upper extremity strength and coordination
  - Bilateral hand tasks
  - Problem solving
  - Preplanning

Dynavision (West Chester, OH)

- Mode A
- Mode B
- Mode A with digits

Also Improves

  - Hand-eye coordination
  - Upper extremity strength and coordination
  - Reaction time
  - Divided attention (mode A with digits)

IADL: instrumental activities of daily living

Strength of Recommendation: Practice Option

The compensatory interventions included in this section are found in Scheiman, *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*.[15]

Intervention Methods

Refer patient to eye specialist for assessment and treatment. See Clinician Tip Sheet for education, instructions in compensatory strategies, and exercises.

Selected Reference

Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 3rd ed. Thorofare, NJ: SLACK Incorporated; 2011.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR IMPAIRED ACCOMMODATION

Education

What is Impaired Accommodation?

Accommodation is the ability of the eyes to focus at various distances (including shifting from one distance to another). According to Scheiman and Wick, "it also permits the individual to maintain clear focus at the normal reading distance."[40(p697)] There is a natural decline in accommodative ability from childhood through adulthood. This decline reaches a critical level at about the age of 40 to 45 years, which is the age when most adults begin to notice blurred vision with reading.

If someone demonstrates impaired accommodation (as evidenced by discomfort and eye strain with near tasks, blurred vision, visual fatigue with near tasks, or difficulty changing focus from near to far and far to near), he or she may have impaired accommodation. This may occur due to impaired innervation.

Symptoms of Impaired Convergence

- Complaints of discomfort and eye strain with visual tasks
- Complaints of blurriness
- Eye rubbing
- Complaints of visual fatigue with near tasks
- Easy fatigue with visual tasks
- Inattention with visual tasks
- Difficulty concentrating on tasks
- Difficulty with tasks that require sustained close work

Symptoms may occur at different times and intervals (ie, all the time, at different times of day, intermittently, or only when fatigued).

Functional Implications

- Reading or near tasks may be difficult (eg, inability to maintain focus)
- Vision blurriness
- Difficulty adjusting visual distances (eg, while driving, looking at the road then looking at the dashboard)
- Inattention with visual tasks

Compensatory Strategies

Specific Accommodation Compensatory Strategies

- If glasses are prescribed, ensure compliance with wear.
- If bifocals have been prescribed, ensure patient does close work while using the bottom of the bifocal.
- Larger print may help relieve symptoms until treatment is complete.
- Take frequent breaks.[15(p140)]

General Compensatory Strategies

The compensatory options are similar to the techniques used for low vision and poor acuity. Refer to Poor Acuity, Compensatory Techniques and Teaching for further detail. Other options include the following:

- increase illumination, contrast, or print size (enlarge);
- decrease clutter and background pattern;
- use visual markers;
- use a guide or finger to assist in looking at different objects, or rulers or anchors to avoid losing place;
- avoid glare;
- limit time doing visual tasks that take concentration; and
- take frequent breaks.

IMPAIRED CONVERGENCE

Purpose/Background

Patients with c/mTBI may demonstrate impaired convergence. The patient may complain of eye strain, headache, or difficulties with near tasks. The occupational therapist's role is to:

- identify the potential impairment and how it is affecting the patient functionally,
- refer the patient to a staff optometrist with expertise in vision and TBI,
- educate the patient about the impairment and its functional implications,
- provide compensatory intervention if needed, and
- provide basic eye exercises and opportunities within therapy to address the impaired convergence.

It is not recommended that occupational therapists spend more than 5 to 10 minutes doing vision exercises unless more time has been recommended by a staff optometrist with expertise in vision and TBI. Although the exercises will not harm the patient, the optometrist will be able to determine if the exercises will be beneficial or unnecessary to the diagnosis.

Strength of Recommendation: Practice Option

The compensatory interventions included in this section are widely presented in textbooks and literature related to vision deficits. There is minimal to no objective research demonstrating that eye exercises will benefit complaints of impaired convergence for patients with c/mTBI; however, there is strong evidence that intervention improves convergence in children and adults,[41] including one randomized controlled trial that reported success in alleviating symptoms of convergence insufficiency in young adults, as it affected reading and close-up work.[42]

Intervention Methods

Refer patient to an eye specialist for assessment and treatment. See clinician tip sheet for education and instructions in compensatory strategies and basic eye exercises.

Selected References

Lavrich JB. Convergence insufficiency and its current treatment. *Curr Opin Ophthalmol.* 2010;21(5):356–360.

Scheiman M, Mitchell GL, Cotter S, et al. A randomized clinical trial of vision therapy/orthoptics versus pencil pushups for the treatment of convergence insufficiency in young adults. *Optom Vis Sci.* Jul 2005;82(7):583–595.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR IMPAIRED CONVERGENCE

Education

What is Impaired Convergence?

Normally when eyes are working together they are able to converge and focus (fuse) on a single item or object and maintain the fusion as the object moves closer to the eyes, until it is about 2 to 4 inches from the eye. The eyes should be able to fuse again when the object is moved 4 to 6 inches away. If someone demonstrates impaired convergence (as evidenced by one eye moving laterally away, complaints of double vision, or significant eye strain when bringing the target close to the eyes), he or she may have impaired convergence.

If a patient is able to converge and maintain fusion up close but complains of double vision as an object moves out, the patient may have impaired divergence (difficulty allowing the eyes to maintain fusion with distance tasks). The treatment suggestions in Diplopia (below) will address impaired divergence. Referral to an eye specialist is recommended.

Impaired convergence may be due to poor innervation or motor control, or may result from a longstanding eye muscle problem that becomes decompensated after TBI.

Symptoms

- Double vision or blurriness with up-close tasks
- Headaches or difficulty with near tasks
- Words moving when trying to read
- Eye strain
- Squinting one eye
- Difficulty concentrating on tasks
- Turning the head to see an object clearly

Symptoms may occur at different times and intervals (eg, all the time, at different times of day, intermittently, only when fatigued). Impaired convergence may occur when looking into different fields of vision, as well (eg, straight ahead, to one side or another, in the superior or inferior fields, or any combination or direction).

Functional Implications

- Stationary objects may appear to move.
- Reading may be difficult (eg, skipping over words, losing one's place).
- Headaches and blurriness may occur.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR IMPAIRED CONVERGENCE

Compensatory Strategies

Patching

Patching is a short-term method to manage impaired convergence so the patient is able to function. If the patient does not complain of the aforementioned symptoms, patching is inappropriate; however, if a patient is having difficulty with reading or near tasks due to double vision, headaches, and the like, this may be a task-specific compensatory technique allowing patients to read or perform other up-close tasks.

To determine which eye is dominant, ask the patient to roll up a standard-sized sheet of paper to create a paper spyglass. Ask the patient to "spy" an object on the other side of the room, then watch which eye the patient automatically uses to do so. The patient will automatically select his or her dominant eye to use with the spyglass.

Patching should only be done during the times when the patient complains of difficulty performing near tasks (eg, intermittently or when fatigued). Unless a patient has poor acuity in one eye or is unable to adequately move one eye, alternate which eye is patched each day. Patches may be translucent or opaque. There are three options for patching (Figure 4-8):

1. Partial patching: nasal field of nondominant eye.
2. Partial patching: central spot patching on nondominant eye.
3. Full occlusion (less frequently recommended): reduces vision to single eye, thereby eliminating double vision. However, patient loses peripheral vision, will sustain eye fatigue, and there are safety concerns due to vision loss.

NOTE: Intervention for impaired convergence that involves patching must be directed/guided by an eye care provider.

General Compensatory Strategies

The compensatory options are similar to the techniques used for low vision or poor acuity, as follows:

- Increase illumination, contrast, or print size (enlarge).
- Decrease clutter and background pattern.
- Use visual markers, such as a guide or finger to assist in looking at different objects, or rulers or anchors to avoid losing place when reading.
- Avoid glare.
- Limit time doing visual tasks that take concentration and take frequent breaks.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR IMPAIRED CONVERGENCE

Treatment Ideas

Although there is minimal research demonstrating that eye exercises will benefit impairment convergence for patients with c/mTBI, there is strong evidence supporting its effectiveness with children and adults.[41,42] Basic eye exercises or functional activities will not harm a patient and may improve function. If the patient reports dizziness or nausea with this exercise, stop the exercise and find a less visually demanding task to work on.

NOTE: Occupational therapists incorporate eye exercises into their treatment plans in consultation with and under supervision of optometrists with expertise in TBI.

Pencil Pushups

This exercise uses both eyes together. Our eyes must come together smoothly and evenly when we do near activities, such as reading or needlework.

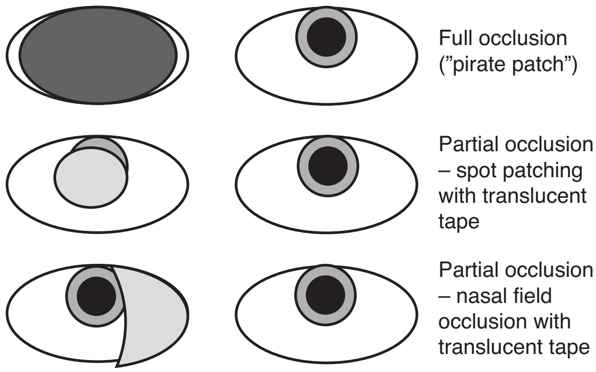

Figure 4-8. Visual occlusion options for diplopia. Full visual occlusion (eg, "pirate patch"; top image) will result in the person seeing one image, but secondary complications include loss of peripheral vision, body image issues, and so on. Partial occlusion can be done with spot patching with translucent tape (middle) and occluding the nasal field of the nondominant eye (bottom image).

1. Hold a target (pen, small ball or object on a dowel, penlight) at arm's length directly in front of the patient's nose. Slowly move the pencil in toward the nose. Stop when two pencils are seen or when one eye moves away.
2. Slowly move the pencil away several inches beyond the point the two images turn into one (or the deviated eye moves back into focus on the target and the eyes are fused on the target together). The goal is to keep the eyes turning in and focusing on the pencil as it is moved closer to the nose. The image of the pencil should stay single as it moves all the way to the nose (within 2 to 4 inches of the eyes).
3. Repeat the exercise 5 times, then rest for 1 to 2 minutes and begin again.

The therapist must be sure the patient's eyes are moving in and converging on the target. If one eye deviates, stop and bring the target back until the eyes are fused on the target again. Do not have a patient do this alone if he or she is not aware of the eyes losing fusion. If the patient complains of double vision throughout the range, this exercise is inappropriate.

DIPLOPIA

Purpose/Background

Patients with c/mTBI may report double vision. The complaints of double vision may be intermittent, located in various locations of the visual field, or come about when doing different kinds of tasks. The occupational therapist's roles are to:

- Identify the potential impairment and how it is affecting the patient functionally.
- Refer the patient to a staff optometrist with expertise in vision and TBI who will be able to tell if it is a monocular or binocular issue.
- Educate the patient about the impairment and its functional implications.
- Provide compensatory intervention.
- Provide basic eye exercises and opportunities within therapy to address the double vision.

It is not recommend that occupational therapists spend more than 5 to 10 minutes doing vision exercises unless more time has been specifically recommended by a staff optometrist with expertise in vision and TBI. Although the exercises will not harm the patient, the optometrist will be able to determine if the exercises will be beneficial or unnecessary to the diagnosis.

Strength of Recommendation: Practice Option

The compensatory interventions included in this section are widely presented in textbooks and literature related to vision deficits. There is minimal to no objective research demonstrating that the use of eye exercises will alleviate complaints of double vision for patients with c/mTBI; however, basic eye exercises or functional activities will not harm a patient and may improve oculomotor control and movement (and thus function).

Intervention Methods

Refer patient to an eye specialist for assessment and treatment. See clinician tip sheet for education and instructions in compensatory strategies and basic range-of-motion exercises.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR DIPLOPIA

Education

What is Double Vision?

Normally when the eyes are working together, they are able to converge and focus (fuse) on a single item or object. If someone reports double vision that disappears when one eye is closed, the patient most likely has binocular diplopia and may be unable to hold both eyes focused on an item or object at the same time; thus, the brain receives two different images. If the double vision does not disappear with closing one eye, it is monocular; intervention in this realm is outside the occupational therapist's scope of practice. Either way, the patient should be seen by an eye care professional. The most likely cause of double vision is misalignment of the eyes, which may be due to poor innervation of eye muscles, poor oculomotor control, inflammation, muscle adhesions, or obstructions.

Symptoms

- Double vision
- Blurriness
- Difficulty with near tasks
- Words moving when reading
- Headaches with near tasks
- Eye strain
- Squinting one eye
- Difficulty concentrating on tasks
- Turning the head to see an object clearly

Symptoms may occur at varying times and intervals (eg, all the time, at different times of day, intermittently, only when fatigued, only when doing near tasks, only when looking in the distance, or when looking near and far). Double vision also may occur when looking into different fields of vision (eg, straight ahead, to one side or another, in the superior or inferior fields, or any combination or direction).

Functional Implications

- Decreased depth perception.
- Stationary objects may appear to move.
- Reading may be difficult (eg, skipping over words, losing one's place).
- Headaches and blurriness may occur.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR DIPLOPIA

Compensatory Strategies

Patching

Patching is a short-term method to manage diplopia so the patient is able to function (see Figure 4-8). The three patching options include:

1. Partial patching: nasal field of nondominant eye.
2. Partial patching: central spot patching on nondominant eye.
3. Full occlusion (less frequently recommended): reduces vision to single eye, thereby eliminating double vision. However, patient loses peripheral vision, will sustain eye fatigue, and there are safety concerns due to vision loss.

To determine which eye is dominant, ask the patient to roll up a standard-sized sheet paper to create a paper spyglass. Ask the patient to "spy" an object on the other side of the room and watch which eye the patient automatically uses to do so. The patient will automatically select his or her dominant eye to use with the spyglass.

Patching can be translucent or opaque and should only be done when the patient reports double vision (may be intermittent or occur when the patient is fatigued) or all the time if one eye is noticeably out of alignment. Unless a patient has poor acuity in one eye or is unable to adequately move one eye, alternate the eye that is patched daily.

General Compensatory Strategies

The compensatory options are similar to the techniques used for low vision or poor acuity, including:

- increase illumination, contrast, or print size (enlarge);
- decrease clutter and background pattern;
- use visual markers, such as a guide or finger, to assist in looking at different objects or rulers or anchors to avoid losing place when reading;
- avoid glare; and
- limit time doing visual tasks that take concentration and take frequent breaks.

VISUAL FIELD LOSS

Purpose/Background

Individuals with TBI may experience visual field loss.[43] Although visual field loss is typically not associated with c/mTBI, clinicians need to understand this issue in case their patients have experienced complicated mTBI or more severe injuries. Loss of vision in the visual field can be disorienting and gives a narrower scope of useable vision. A person may miss details or not see critical information or objects. Once the loss of vision is identified and defined, the occupational therapist's role is to educate the patient and teach compensatory techniques so the patient can participate in therapy and function in his or her everyday life.

Strength of Recommendation: Practice Option

There is little empirical literature to inform practice in this area. Riggs and colleagues[43] did a systematic review of the literature and found only two articles for visual field deficits after stroke met their criteria for inclusion, neither of which had strong recommendations due to lack of functional outcomes and study limitations. A study by Warren and colleagues[37] addressed the types of search strategies used by healthy adults.

Intervention Methods

- Refer patient to eye specialist for assessment (visual field test).
- Educate patient.
- Teach patients to use compensatory techniques for field loss such as:
  - use of anchors and rulers,
  - visual search strategies,
  - large- and small-scale eye movements,
  - increased head turns, and
  - increased attention to detail.
- Employ activities for engaging patients to address visual field loss.

Selected References

Riggs RV, Andrews K, Roberts P, Gilewski M. Visual deficit interventions in adult stroke and brain injury: a systematic review. *Am J Phys Med Rehabil.* Oct 2007;86(10):853–860.

Warren M, Moore JM, Vogtle LK. Search performance of healthy adults on cancellation tests. *Am J Occup Ther.* Sep-Oct 2008;62(5):588–594.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR VISUAL FIELD LOSS

Education

It is essential that patients with visual field loss understand what has happened to their vision and how it will interfere with various activities.

What is a Visual Field Loss?

Visual fields are the total area visible to an eye that is fixating straight ahead, measured in degrees from fixation.[44] Visual field loss is the loss of vision in a specified area of vision. The area of the injury or lesion along the visual pathway determines the field loss location. Visual field loss can be in any area of the visual field and can be different in each eye.

Functional Implications of Specific Types of Field Loss

- Central field loss: leads to decreased acuity
- Superior field loss: results in difficulty seeing signs, reading, and writing; inability to find higher placed items
- Inferior field loss: causes difficulty with mobility (clearing curbs, steps, rugs, low furniture), slower paced walking with shortened stride, walking behind others, trailing behind others, and poor balance
- Lateral field loss: leads to bumping into things, missing items on the side affected
- Loss in any field: results in difficulty reading and writing, misidentification of details or long words, and difficulty finding or being aware of objects in the affected field.

Compensatory Strategies

Because visual field loss can be disorienting and confusing for patients, it may be necessary to teach patients how to use their vision again with the new impairment (for more on teaching and learning methods, see Chapter 7: Cognitive Assessment and

Intervention, specifically Techniques to Promote Patient Engagement and Learning). For treatment activity ideas see Table 4-4.

Techniques to Teach the Patient

- Visual search strategies (to maximize organization and efficiency), including left-to-right for reading. Start in at the far end of the affected side, use a circular pattern for larger scanning activities.
- Large-scale eye movements for mobility and scanning in the environment.
- Small-scale eye movements for reading and near tasks.
- Increased head turns, especially into the affected area.

Increased Attention to Detail

- Promotes ensuring that patient sees into the area affected.
- Watching the pen or pencil when writing.

Using Anchors and Rulers

- Use a ruler to keep track of each line being read.
- Use a bright colored line or ruler vertically at the edge of the text on the side of the missing field to ensure finding the edge of the text.

Approaching Treatment Tasks

Grading the Tasks Using Activity Analysis

- Density: low density to high density (eg, start with two columns of letters, one on each side of the page, and progress to ten columns of letters)[38]

TABLE 4-4

DIFFERENCES BETWEEN FIELD CUT AND NEGLECT

Field cut	Neglect
• Awareness emerges early • Compensatory strategies observed early, easily taught • Early eye movement to affected side • Organized	• Lack of awareness more persistent • Compensatory strategies are hard to learn, may not be effective • Rightward gaze preference • Random

Data source: Gillen G. *Cognitive and Perceptual Rehabilitation: Optimizing Function*. St Louis, MO: Mosby; 2009.

- Structure: task organization (ie, start with organized, simple structure and move toward random)
- Speed: start with slow, deliberate movement and work toward increasing speed.

Size of Treatment Tasks

- Large tasks (full room and larger, 5 feet or more away)
- Small tasks (paper, pencil, and tabletop)

Scanning Patterns of Healthy Adults

Warren and colleagues[37] found the scanning pattern predominantly used by healthy adults were structured patterns, with a strong tendency for left to right, and top to bottom scanning patterns.

VISUAL NEGLECT AND INATTENTION

Purpose/Background

Individuals with TBI may experience visual neglect or inattention.[45] Although not typically associated with c/mTBI, clinicians need to understand this issue in case their patients have experienced complicated mTBI or more severe injuries.

Neglect is a failure to report, respond, or orient to novel or meaningful stimuli on the contralesional side of a brain lesion that cannot be attributed to sensory or motor dysfunction.[46] A person may bump into doorframes when ambulating, read only partial lines or words, miss details, or not see critical information or objects. Once the neglect or inattention is identified, the occupational therapist's role is to educate the patient and teach compensatory techniques so the patient may participate in therapy and function in everyday life.

Strength of Recommendation: Practice Option

There is little empirical literature to inform practice in this area. Bowen[47] did a systematic review of the literature and only found 12 articles for visual field deficits after stroke that met criteria for inclusion. He found the rehabilitation treatments that targeted neglect demonstrated test improvement (eg, finding visual targets or marking midpoints of lines); however, the functional implications for performing everyday activities or independent living skills were unclear. A study by Warren and colleagues[37] addressed the types of search strategies used by healthy adults.

Intervention Methods

- Refer patient to an eye specialist for assessment.
- Provide patient education.
- Teach the patient compensatory strategies, including:
  - use of anchors and rulers,
  - visual search strategies (organized and efficient),
  - large- and small-scale eye movements,
  - increased head turns, and
  - increased attention to detail.
- Employ activities for engaging patients to address neglect and inattention.

Selected References

Bowen A, Lincoln N. Cognitive rehabilitation for spatial neglect following stroke. *The Cochrane Library.* 2009;4.

Cherney LR. Unilateral neglect: a disorder of attention. *Semin Speech Lang.* 2002;23(2):117–128.

Cockerham GC, Goodrich GL, Weichel ED, et al. Eye and visual function in traumatic brain injury. *J Rehabil Res Dev.* 2009;46:811–818.

Gillen G. *Cognitive and Perceptual Rehabilitation: Optimizing Function*. St Louis, MO: Mosby; 2009.

Heilman KM, Watson R, Valenstein E. Neglect and related disorders. In: Heilman KM, Valenstein E, eds. *Clinical Neuropsychology*. 3rd ed. New York, NY: Oxford University Press; 1993: 279–336.

Mesulam MM. Attention, confusional states and neglect. In: Mesulam MM, ed. *Principles of Behavioral Neurology*. Hove, England: Erlbaum; 1985: 173–176.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR VISUAL INATTENTION AND NEGLECT

Education

It is essential that patients with visual neglect (with or without a visual field loss) understand what has happened to their vision and how it will interfere with various activities.

The Difference Between Visual Field Loss and Visual Neglect

Inattention/Neglect is a failure to report, respond, or orient to novel or meaningful stimuli on the contralesional side of a brain lesion that cannot be attributed to sensory or motor dysfunction.[46]

Visual Field Deficit is an area visible to the eye when it is fixated straight ahead. It is measured in degrees from fixation.[44] Visual field loss is the loss of vision in a specified area of vision. The area of the injury or lesion along the visual pathway determines the field loss location.

Spatial Domains of Neglect

- Personal body space. Patients tend to ignore the left side (contralesional side) of their body, which can result in a deficit in grooming or dressing.
- Peripersonal space. Neglect is observed with tabletop pencil-and-paper tasks in near space within reach or grasp.
- Extrapersonal space. Neglect is observed with environmental scanning in far space beyond reach.[48]

Categories of Attentional Deficits

- Action-intentional disorders (motor neglect): failure or decreased ability to move into contralesional space
- Inattention (sensory neglect): lack or decreased awareness of sensory stimulation in contralesional space

- Memory and representational deficits: deficit of the internal representation of the contralesional space or limbs[46,49]

Functional Implications of Neglect

- Not paying attention to or "seeing" people and objects on patient's left side (specifically, left neglect)
- Missing the food on the left side of the plate
- Not being aware of the person sitting or standing to patient's left side
- Not being able to find objects to the left side of the sink or counter
- Reading: starting to read in the middle of a line, missing the beginning letters of a word, or losing one's place when reading
- Ambulating: bumping into doorways or furniture, not looking to the left when crossing the street

CLINICIAN TIP SHEET: TREATMENT APPROACH TO VISUAL INATTENTION AND NEGLECT

Insight and awareness are key to a patient's compensation with neglect (which is challenging; patients lack insight and awareness due to the decreased attention).[50]

Response to Treatment and Education

Treatment activities and compensatory strategies are similar to visual field deficits; however, therapists need to adapt treatment approaches to allow for increased treatment duration and frequency of repetition (see Table 4-4). For treatment activity ideas see Table 4-5.

Techniques to Teach the Patient

Visual Search Strategies

To maximize organization and efficiency, teach patients the following techniques:

- reading left to right,
- starting in at the far end of the affected side, and
- using a circular pattern for larger scanning activities.

Large-scale eye movements are useful for mobility and scanning in the environment. Small-scale eye movements help with reading and near tasks. Increasing head turns is helpful especially into affected area.

Increased Attention to Detail

- Promotes ensuring that the patient sees into the area affected.
- Encourage patient to watch the pen or pencil when writing.

Using Anchors and Rulers

- Use a ruler to keep track of each line being read.
- Use a brightly colored line or ruler vertically at the edge of the text on the side of the missing field to ensure finding the edge of the text.

Approaching the Treatment Tasks

Grading the Tasks Using Activity Analysis

- Density: low density to high density (eg, start with two columns of letters, one on each side of the page, and progress to ten columns of letters).
- Structure: organization of the task (ie, start with organized simple structure and move towards random).
- Speed: start with slow, deliberate movement and work toward increasing speed.[38]

Size of Treatment Tasks

- Large tasks (full room and larger, 5 feet or more away)
- Small tasks (paper, pencil, and tabletop)

Scanning Patterns of Healthy Adults

Warren and colleagues[37] found the scanning pattern predominantly used by healthy adults was structured patterns, with a strong tendency for left to right and top to bottom scanning patterns.

TABLE 4-5

ACTIVITIES TO ENGAGE PATIENTS

Visual Scanning Activity	Works On
• Paper-and-pencil activities (cancellation tasks, reading, mazes, word search puzzles, crossword puzzles) • Prereading and writing exercises*	Near scanning for return to reading (books, maps, etc)
• Easel or table with card matching • Card and games on a table • Find items on shelf or cupboard • Jigsaw puzzles (spread out on table) • Hitting a ball against a wall turned sideways so the visual field loss is towards the wall • Dynavision† • NVT Scanning Device‡ • Neurovision Rehabilitator§	Mid-distance scanning for IADLs (meal preparation, bill paying, shopping, etc)
• Identify all objects in a room • Walk down a hallway and identify what is on the wall (or place sticky notes with numbers or letters on them) • Walk through obstacle course • Do a scavenger hunt of objects in the clinic	Distant activities for looking far and for mobility

IADLs: instrumental activities of daily living
* From visABILITIES Rehab Services Inc (Hoover, AL). Includes various paper pencil activities.
† From Dynavision (West Chester, OH). All modes.
‡ From Neuro Vision Technology Systems (Torrensville, SA, Australia).
§ The Neuro-Vision Rehabilitator (http://nvrvision.com).

GLARE/PHOTOPHOBIA MANAGEMENT

Purpose/Background

Patients with c/mTBI may report photophobia.[51] They can be sensitive to specific kinds of lights (eg, fluorescent lights may cause a flicker effect) or different weather conditions (eg, bright sun or clouds), among other things, which can lead to complaints of headaches, light intolerance, squinting, and frequent eye closing. Occupational therapists can have a role in identifying patients with these complaints and providing options that minimize symptoms and help patients participate in therapy and everyday activities.

Strength of Recommendation: Practice Option

There is no specific evidence to inform intervention for photophobia associated with c/mTBI. However, a small study conducted by Jackowski and colleagues[51] demonstrated visual function (reading) improvement with the use of light-filtering lenses for patients following TBI who reported photophobia (N=14). It should be noted that the study was conducted indoors only.

Intervention Methods

- Refer patient to eye specialist for assessment and treatment.
- Educate patient.
- Teach compensatory strategies.

Selected Reference

Jackowski MM, Sturr JF, Taub HA, Turk MA. Photophobia in patients with traumatic brain injury: uses of light filtering lenses to enhance contrast sensitivity and reading rate. *Neurorehabilitation.* 1996;6:194–201.

CLINICIAN TIP SHEET: INTERVENTION METHODS FOR GLARE/PHOTOPHOBIA

Education

Photophobia can be a common complaint after TBI. The mechanism is not clear at this time.

Compensatory Strategies

The patient should be referred to an eye specialist; however, an occupational therapist can help the patient be as functional as possible using compensatory strategies. Some options include the following:

- Tinted glasses (color and density need to be tried to determine optimal visual clarity and comfort). For indoors,[51] use three photochromatic filters (Corning Photochromic Filters CPF450, 527-S, and 550-S; Corning, Inc, Avon Cedex, France) which significantly improved ($P < 0.01$) the reading rates of the TBI subjects with photophobia. Outdoor settings were not tested. These are commercially available at eyeglass stores. Other options include NoIR and UVShield sunglasses (NoIR Medical Technologies, South Lyon, MI).
- Encourage the patient to wean off tinted glasses over time.
- Encourage use of baseball hats and visors; have some available in the clinic for trial or use.
- Limit overhead light use and use task lights.

SUPPLEMENTARY THERAPEUTIC ACTIVITY OPTIONS

Purpose/Background

When working with patients on vision, it is helpful to have a variety of tasks that can be graded in terms of complexity, size, and distance. The tasks selected for the patient should be easy enough to ensure some success, but challenging enough to promote improvement. Once the patient demonstrates some preliminary competence with compensatory techniques, the activities should begin to reflect real-life tasks and situations the patient will encounter in everyday life.

Strength of Recommendation: Practice Options

Intervention Methods

- Dynavision 2000 Light Training Board (West Chester, OH) for visual field deficits.
- Prereading and writing exercises.
- Neuro Vision Technology (NVT) Scanning Device (NVT Systems Pty Ltd, Torrensville, SA).
- Neurovision Rehabilitator (NVR; www.nvrvision.com).

CLINICIAN TIP SHEET: DYNAVISION

General Information

According to the Dynavision (West Chester, OH) Website:

> Originally designed as a device to improve the visuomotor skills of athletes, the Dynavision™ 2000 Light Training Board has been adapted to provide the same training benefits to persons whose visual and motor function has been compromised by injury or disease. For persons with visual and visuomotor impairment the apparatus is used to train compensatory search strategies, improve oculomotor skills such as localization, fixation, gaze shift, and tracking, increase peripheral visual awareness, visual attention and anticipation, and improve eye-hand coordination and visuomotor reaction time. For persons with motor impairment it can be used to increase active upper extremity range of motion and coordination, muscular and physical endurance and improve motor planning. It has been successfully used to improve function in children and adults with limitations from stroke, head injury, amputation, spinal cord injury, and orthopedic injury. Currently there are over 400 units in rehabilitation hospitals across the United States.[52]

Applicability to Service Members

According to Mary Warren:

> One of the great advantages of the device [Dynavision] as a tool specifically for the rehabilitation of wounded Soldiers is its competitive nature. Dynavision drills are presented as games of skill by instructing the persons to strike as many lighted buttons as possible within the

allotted time. This challenges the client to give their best effort each time. The device records and analyzes performance showing the client where deficiencies exist to enable the client to improve performance on the board. Clients can compare their performance and compete with each other. Because the device was designed for athletes, the lights can be programmed to move at very high speeds and it is impossible to beat the board, which draws out the competitive nature of young men.[53]

Dynavision has also been used in vision rehabilitation for individuals with brain injury (primarily stroke).[54–56]

Use and Options

Dynavision can be used for mid-distance scanning skills and is programmable to start with easier to more challenging tasks. The visual impairments it may be used to address include saccades, pursuits, visual field deficits, and visual neglect and inattention.

Dynavision has four modes of operation:

1. Mode A: self-paced task. One button at a time randomly lights up and stays on until it is pushed. Patient tries to locate and push the lit-up button as quickly as possible.
2. Mode B: apparatus paced. A button will randomly light up for a selected period of time (1 second or less) before the next light comes on. Patient tries to locate and push the button before the next one comes on.
3. Mode C: visual tracking task. A single light "moves" around the edges of the ring of lights, periodically changing direction (the speed of the buttons changing light can be selected at 1 second or less). The patient visually tracks the light.
4. Mode A, B, or C with digital flash option. During the task (selected by mode), digits (select from 1 to 7 digits at a time) are flashed on a screen at eye height. Patient calls out the numbers as they are flashed while performing the other tasks (divided attention).

Tasks may be set for a duration of 30, 60, or 240 seconds and may be varied by size and area (eg, select any one or more the four quadrants, select the inner [three rings], middle [four rings], or full [five rings] board). Task results can be printed out (including total hits and reaction time).

Reliability Studies

- Test-retest reliability: tested with Mode B using two apparatus-paced tasks. Moderate reliability with correlation coefficient ranging from 0.71 (for 76 subjects) to 0.73 (for 41 subjects) and paired correlation coefficients ranging from – .75 to 0.93.[57]
- Test-retest reliability: tested reliability of three tasks of difficulty graded extremely high (.88, .92, and .97).[58]

Selected References

Klavora P, Gaskovski P, Forsyth RD. Test-retest reliability of the Dynavision apparatus. *Percept Mot Skills.* Aug 1994;79(1 Pt 2):448–450.

Klavora P, Gaskovski P, Martin K, et al. The effects of Dynavision rehabilitation on behind-the-wheel driving ability and selected psychomotor abilities of persons after stroke. *Am J Occup Ther*. Jun 1995;49(6):534–542.

Traumatic Brain Injury Related Vision Issues: Hearing Before the Subcommittee on Oversight and Investigations of the Committee on Veterans' Affairs, Before the U.S. House of Representatives, 110th Cong, Second Session. Application of the Dynavision 2000 to Rehabilitation of Soldiers With Traumatic Brain Injury. Written testimony of Mary Warren. April 2, 2008.

CLINICIAN TIP SHEET: PREREADING AND WRITING EXERCISES

General Information

According to Mary Warren:

> These exercises consist of reproducible worksheet activities designed to provide patients with practice making the precise eye movements needed to accurately identify letters and numbers and to write legibly on line. The exercises are appropriate for persons with scotomas (a blind or partially blind area in the visual field) secondary to neurological impairment (hemianopsia).
>
> The pre-reading drills consist of letter and number combinations printed in four different M unit sizes to accommodate acuities ranging as low as 20/200. The exercises emphasize letters and numbers which are easily misread when not seen clearly such as, V and W and 6 and 8. They are intended to increase accuracy in identifying letters and numbers and to increase confidence in reading ability prior to attempting to read actual text. The pre-writing worksheets consist of tracing exercises to promote reintegration of the eye directing the hand in movement.
>
> The exercises can be incorporated within treatment to improve the visual skills needed for reading performance and also be used as homework to supplement treatment programs. However, no empirical evidence is available about the outcomes associated with these exercises.[59]

Use and Options

These exercises can be used for near scanning. The font size and density of the letters vary to provide simple to complex tasks. The exercises are used to address saccades, visual field deficits, and visual neglect or inattention. Examples of the exercises are available at: www.visabilities.com.

CLINICIAN TIP SHEET: NEURO VISION TECHNOLOGY SCANNING DEVICE

General Information

According to the manufacturer's website:

> The NVT Vision Rehabilitation System aims to promote independent living for people with a Neurological Vision Impairment by:
>
> - Assessment of visual and perceptual deficits that impact on activities of daily living.
> - Training in compensatory scanning strategies.
> - Transfer of scanning skills to Mobility in a dynamic environment.
>
> This is a unique program of interest to all staff working in the area of rehabilitation of Acquired Brain Injury.[60]

Neuro Vision Technology Scanning Device Use: Practice Option

The exercises can be used for mid-distance scanning skills. Various programs differ in complexity. Although research is currently underway (email communication, Allison Hayes, Manager Training and Research, Neuro Vision Technology Pty Ltd, Torrensville, South Australia, Australia, December 16, 2009), no empirical evidence is currently available about the outcomes associated with the NVT Scanning Device. This device and program were developed for research. It addresses visual field deficits and visual neglect and inattention and is available through the developer's website (www.neurovisiontech.com.au).

CLINICIAN TIP SHEET: NEUROVISION REHABILITATOR

General Information

The NVR is a computer-based, instrumented vision therapy system that uses Wii (Nintendo, Kyoto, Japan) hardware to address deficits in visual processing.[61] The system includes a Bluetooth-integrated (Bluetooth, Kirkland, WA) balance board, an infrared head sensor, a controller sensor receiver, a wireless remote controller ("hand shooter"), and NVR software system. Additionally, a computer, projector, and screen are needed.

NVR Use: Practice Option

Using remotes and sensors, the NVR provides interactive, multisystem challenge and feedback that integrates vision with auditory, proprioceptive, balance, and visuomotor control.[62] There are five software treatment modules: (1) visual motor enhancer, (2) ocular vestibular integrator, (3) dynamic ocular motor processing, (4) visuomotor integrator, and (5) fixation anomalies.

Allen Cohen, one of the NVR developers,

created three treatment protocols (which are described in the operations manual). The first phase of treatment aims to enhance the stability of the visual input system. The goal of phase two is to develop fusional sustenance, and the goal of phase three is to develop speed of visual information processing and stability of visual performance.[61] No empirical evidence is currently available about the outcomes associated with the NVR and adults with c/mTBI.

Available through the developer's website (www.nvrvision.com).

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