CLINICAL RECOMMENDATION FOR THE EYE CARE PROVIDER

ASSESSMENT AND MANAGEMENT OF OCULOMOTOR DYSFUNCTIONS ASSOCIATED WITH TRAUMATIC BRAIN INJURY

Introduction and Background

Several types of visual dysfunctions are common consequences of traumatic brain injury (TBI).[1,2] Blast injury, penetrating injuries and blunt trauma may result in structural damage to the eye, or lesions or swelling in the brain that can interfere with visual pathways. These injuries can lead to visual disturbances that can have a significant functional impact on the lives of Service members and Veterans.[1,2] Between 2000 and Q1 of 2016, over 347,962 TBIs were diagnosed in U.S. forces, with nearly 83 percent categorized as mild TBIs (mTBI).[3] To improve the treatment of Service members and Veterans and to help identify patients who may benefit from rehabilitation, it is important to increase awareness of all aspects of visual dysfunction associated with TBI. One of the most common forms of visual dysfunction following mTBI is oculomotor dysfunction.[4,5,6]

Clinical Recommendation

This clinical recommendation is designed to help guide the assessment, management and rehabilitation of patients with oculomotor dysfunction associated with TBI. It assumes that a comprehensive exam including an ocular health evaluation and refraction (wet and/or dry) was performed by an optometrist or ophthalmologist.* These recommendations include clinical tests that can assess and detect the most common oculomotor dysfunctions associated with TBI. Rehabilitation procedures are also included in order to provide guidance for treatment options.

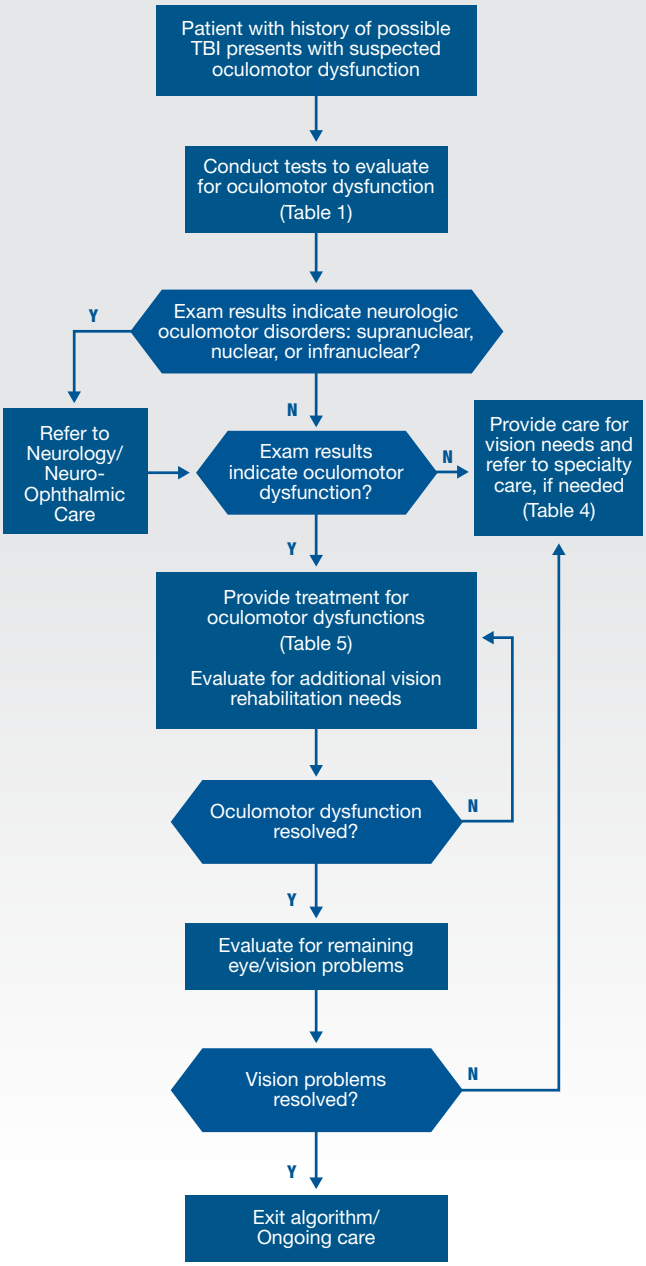
Overview of Evaluation and Rehabilitation for Oculomotor Dysfunction

The algorithm displayed in **Figure 1** outlines the steps and clinical decision points in the eye care and rehabilitation process for patients with oculomotor dysfunctions associated with TBI. While well-established rehabilitation procedures and techniques for oculomotor dysfunction exist, there is limited evidence for the specific procedures and techniques that represent the most effective strategies for the TBI population.[7] This clinical recommendation was reviewed by a team of multidisciplinary experts and includes tests and procedures related to oculomotor assessment, evaluation, referral and rehabilitation that are consistent with current practices for the treatment of TBI.

*For additional details, see VCE Clinical Recommendation for the Eye Care Provider available at vce.health.mil

Disclaimer: This recommendation and its derivative products are provided as clinical and rehabilitative aids and should not replace sound clinical judgment nor standard practice when caring for a patient.

Figure 1: Algorithm for the Care of Oculomotor Dysfunctions Associated with Traumatic Brain Injury



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Eye Care Provider Testing

Table 1 provides recommendations for testing procedures that eye care providers can use to evaluate specific types and severities of oculomotor dysfunction. By first identifying the specific type of oculomotor dysfunction, the eye care provider can determine the appropriate intervention. Using their best corrective lenses, a patient should be given adequate time to complete the specific tests selected by the eye care provider from **Table 1**.

Table 1: Recommended Tests to Evaluate for Oculomotor Dysfunctions*

Oculomotor Parameter	Testing
Eye Alignment	• *Distance and near cover test in multiple positions of gaze and head tilt* • *Phorias (vertical and horizontal)* • Maddox rod • Modified Thorington
Vergence	• *Vergence ranges (vertical and horizontal)* • *Vergence facility*
Convergence Amplitude	• *Near point of convergence* - Repeated measures
Accommodation	• *Push-up method* - Repeated measures • *Minus lens* - Repeated measures • *Accommodative facility (monocular and binocular)* • *Negative relative accommodation/ Positive relative accommodation (NRA/ PRA)* • Near retinoscopy • Accommodative convergence/ accommodation (AC/A) ratio
Eye Movements	• *Ductions* • *Versions* • *Pursuit* • *Saccades* • Developmental eye movement (DEM) • King-Devick
Suppression Check	• *Worth 4 Dot (distance and near)* • Random dot stereopsis
Vestibulo-Ocular Reflex	*(if positive, refer to audiology, otolaryngology, or vestibular PT)* • *Dynamic visual acuity* • *Head thrust* • Low frequency head shake

**Note: not all tests are required; italicized tests provide more comprehensive results as recognized by our expert panel, but selection of tests is left to the clinical judgement of the eye care provider.*

Rehabilitation for Oculomotor Dysfunction

Oculomotor rehabilitation is an accepted treatment of choice for convergence insufficiency and accommodative dysfunction and its efficacy has been demonstrated by studies with success rates between 74 to 95 percent.[7] There are a number of strategies for the treatment of oculomotor dysfunctions, which may be used individually or in combination. The most effective strategy will take into account both the diagnosed condition and patient factors such as motivation and accessibility.[7] Patients with TBI may also have sensory, motor, cognitive and/or psychological problems that can complicate the management of oculomotor dysfunction.[4] Five treatment strategies for oculomotor dysfunction are described in **Table 2**.

Oculomotor dysfunctions following TBI may also affect many of the functional aspects of daily living. This can result in reduced independence in self-care ability as well as increased emotional distress and an additional risk of injury.[8,9] Therefore, a primary goal of rehabilitation is to ultimately improve a patient's quality of life and other functional outcomes. The functional outcome tests listed in **Table 3** below represent the best available ways to measure the improvement and impact of oculomotor rehabilitation when utilized throughout the rehabilitation process. Whenever possible, the same measures should be used for both the initial patient evaluation and subsequent re-evaluations.

Table 2: Treatment Strategies for Oculomotor Dysfunction
Correction of refractive error to improve vision, binocular alignment, and accommodative function
Addition lenses to improve binocular alignment and accommodative function
When necessary, prism therapy to eliminate double vision and restore visual comfort
Office-based oculomotor rehabilitation (with home-reinforcement) using a variety of procedures to improve oculomotor function
When necessary, surgery for associated strabismus or other relevant oculomotor problems

Table 3: Functional Outcome Measures
Improvement or normalization of clinical findings
Tests of oculomotor dysfunction (**Table 1**)
Improvement or normalization of symptom surveys
Brain Injury Visual Symptom Survey (BIVSS)
Convergence Insufficiency Symptom Survey (CISS)
College of Optometrists in Vision Development (COVD) Quality of Life
National Eye Institute Visual Functioning Questionnaire (NEI-VFQ-25) and 10 item Neuro-Ophthalmic Supplement

Recommended Rehabilitation Procedures

Following the evaluation, the eye care provider will have narrowed down the specific type of oculomotor dysfunction, allowing for the appropriate recommendations and pursuit of follow-up actions for the patient.

Patients with oculomotor dysfunction following TBI should be treated early, aggressively and in concert with other rehabilitative specialties such as blind/low vision rehabilitation as well as occupational, physical and speech/language therapies. The patient's motivation, psychological state, cognitive abilities and possible hearing or speech impairments may also pose challenges to active in-office oculomotor rehabilitation.[7] Additional treatments to address the individual needs of patients include prescription lenses, prisms, occlusion or home-based oculomotor rehabilitation. The degree to which these therapeutic options will be required can be determined in the first few office visits.

Table 4 lists providers to whom the patient may be referred if the clinical condition(s) require additional specialized management or if the diagnosis is beyond the scope of the eye care provider.

Table 5 lists recommended treatments for some of the more specific oculomotor dysfunctions that may have been identified in the assessment process. Please note, the list of conditions should not be considered all-inclusive.

Table 4: Referral to Appropriate Facility-Specific Provider	
Audiology/Otolaryngology/ Vestibular PT	Speech/Language Therapy
Blind/Low Vision Rehabilitation	Neurology/Neuro-Ophthalmic Care
Occupational Therapy	Psychology/Psychiatry/Neuro-Psychiatry
Physical Therapy	

Table 5: Treatment Options for Common Oculomotor Dysfunctions Associated with TBI*

Condition	Primary Treatment	Secondary Treatment
Accommodative Insufficiency / Ill-Sustained Accommodation	**Plus powered lenses**	**Oculomotor rehabilitation** (Follow sequential program) • Phase One - Gross convergence - Positive fusional vergence (ramp) - Monocular accommodative therapy (minus lens therapy) • Phase Two - Voluntary convergence - Negative and positive fusional vergence (ramp) - Monocular accommodative therapy (plus and minus lens therapy) • Phase Three - Negative and positive fusional vergence - Binocular accommodative facility (plus to minus lens therapy) with speed
Accommodative Excess	**Oculomotor rehabilitation** (Follow sequential program) • Phase One - Negative fusional vergence (ramp) - Monocular accommodative therapy (plus lens therapy) • Phase Two - Negative and positive fusional vergence (ramp) - Monocular accommodative therapy (plus and minus lens therapy) • Phase Three - Negative and positive fusional vergence - Binocular accommodative facility (plus to minus lens therapy) with speed	

Table 5: Treatment Options for Common Oculomotor Dysfunctions Associated with TBI* (cont'd.)

Condition	Primary Treatment	Secondary Treatment
Convergence Insufficiency†	**Oculomotor rehabilitation** (Follow sequential program) • Phase One - Gross convergence - Positive fusional vergence (ramp) - Monocular accommodative therapy (minus lens therapy) • Phase Two - Voluntary convergence - Negative and positive fusional vergence (ramp) - Monocular accommodative therapy (plus and minus lens therapy) • Phase Three - Negative and positive fusional vergence (jump vergence) - Binocular accommodative facility (plus to minus lens therapy) with speed	**Prism lenses** **Extraocular muscle surgery**
Convergence Excess	**Plus powered lenses**	**Oculomotor rehabilitation** (Follow sequential program) • Phase One - Negative fusional vergence (ramp) - Monocular accommodative therapy (plus lens therapy) • Phase Two - Negative and positive fusional vergence (ramp) - Monocular accommodative therapy (plus and minus lens therapy) • Phase Three - Negative and positive fusional vergence (jump vergence) - Binocular accommodative facility (plus to minus lens therapy) with speed **Prism lenses**
Fusional Vergence Dysfunction	**Oculomotor rehabilitation** (Follow sequential program) • Phase One - Negative fusional vergence (ramp) - Monocular accommodative therapy (plus lens therapy) • Phase Two - Negative and positive fusional vergence (ramp) - Monocular accommodative therapy (plus and minus lens therapy) • Phase Three - Negative and positive fusional vergence (jump vergence) - Binocular accommodative facility (plus to minus lens therapy) with speed **Prism lenses**	
Divergence Insufficiency	**Prism lenses**	**Oculomotor rehabilitation** (Follow sequential program) • Follow therapy for convergence insufficiency • After completing convergence insufficiency program, perform vergence therapy at intermediate distances • Perform vergence therapy at distance **Extraocular muscle surgery**

Table 5: Treatment Options for Common Oculomotor Dysfunctions Associated with TBI* (cont'd.)

Condition	Primary Treatment	Secondary Treatment
Divergence Excess / Basic Exophoria	**Oculomotor rehabilitation** (Follow sequential program) • Follow therapy for convergence insufficiency • After completing convergence insufficiency program, perform therapy at intermediate distances • Perform therapy at distance	**Extraocular muscle surgery**
Basic Esophoria	**Prism lenses**	**Oculomotor rehabilitation** (Follow sequential program) • Follow therapy for convergence excess • After completing convergence excess program, perform therapy at intermediate distances • Perform therapy at distance **Extraocular muscle surgery**
Vertical Phoria	**Oculomotor rehabilitation and prism lenses** • Horizontal fusional vergence therapy • Vertical vergence therapy	**Extraocular muscle surgery**
Saccadic Dysfunction	**Oculomotor rehabilitation** (Follow sequential program) • Phase 1 - Gross saccade and pursuit therapy - Positive and negative fusional vergence (ramp) - Monocular accommodative therapy • Phase 2 - Fine saccade and pursuit therapy - Positive and negative fusional vergence (jump) • Phase 3 - Saccade and pursuit movements with vergence and accommodative changes	
Cranial Nerve (CN) III Palsy	• Diplopia relief while waiting for resolution - Occlusion - Fresnel prism • Ptosis crutch • Near addition to compensate for loss of accommodation	**Extraocular muscle surgery**
CN IV Palsy	• Fresnel prism • Multiple pairs of eyeglasses (distance and near, not bifocal) • Base down yoked prism near lenses • Reading stands • Sector occlusion and/or full field occlusion • Compensatory head position • Have patient scan ahead, instead of down when walking *Prisms likely ineffective for patients with significant torsion*	**Oculomotor rehabilitation** • Horizontal fusional vergence therapy • Vertical vergence therapy **Extraocular muscle surgery**
CN VI Palsy	• Patching for diplopia relief (complete or sector) • Fresnel prism (complete or sector) • Compensatory head posture	**Oculomotor rehabilitation** • Horizontal fusional vergence therapy • Vertical vergence therapy **Medications** **Extraocular muscle surgery**

**Adapted from Scheiman, M. (2011). Understanding and managing vision disorders after traumatic brain injury: A guide for military optometrists. Office of the Surgeon General. Washington, DC.*

†For these conditions and conditions like these, such as strabismus, nystagmus and myokymia, medical intervention and/or extraocular muscle surgery may be indicated in addition to conventional therapies.

Conclusion

This clinical recommendation is based on a review of the literature and consensus of expert opinion. It is intended to provide procedural recommendations pertaining to the evaluation and treatment of patients with oculomotor dysfunction associated with TBI. These recommendations are not a substitute for existing guidance or clinical judgment. As with all clinical decisions, field and operational circumstances may require deviation from these recommendations.

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