

EYE AND VISION CARE FOLLOWING BLAST EXPOSURE AND/OR POSSIBLE TRAUMATIC BRAIN INJURY



Introduction and Background

The use of explosive devices is a common method of attack in military conflicts and can result in complex injuries to those involved. Blast waves, shrapnel and blunt force can result in structural damage to the eye itself and cause lesions or swelling in the brain that may interfere with vision.^{1,2,3,4} Over 307,283 new cases of traumatic brain injury (TBI) have been reported in U.S. forces from 2000 through 2014 Q2.⁵ Data suggest that as many as 75 percent of patients experiencing a TBI may also have associated visual dysfunctions, with additional cases of eye injuries caused by blast exposure.² The resulting visual dysfunctions can have a significant functional impact on the lives of Service members and Veterans.^{3,6,7} To improve patient outcomes, it is important to increase awareness and establish recommendations for the management of eye injuries and visual dysfunctions associated with TBI and blast exposure.

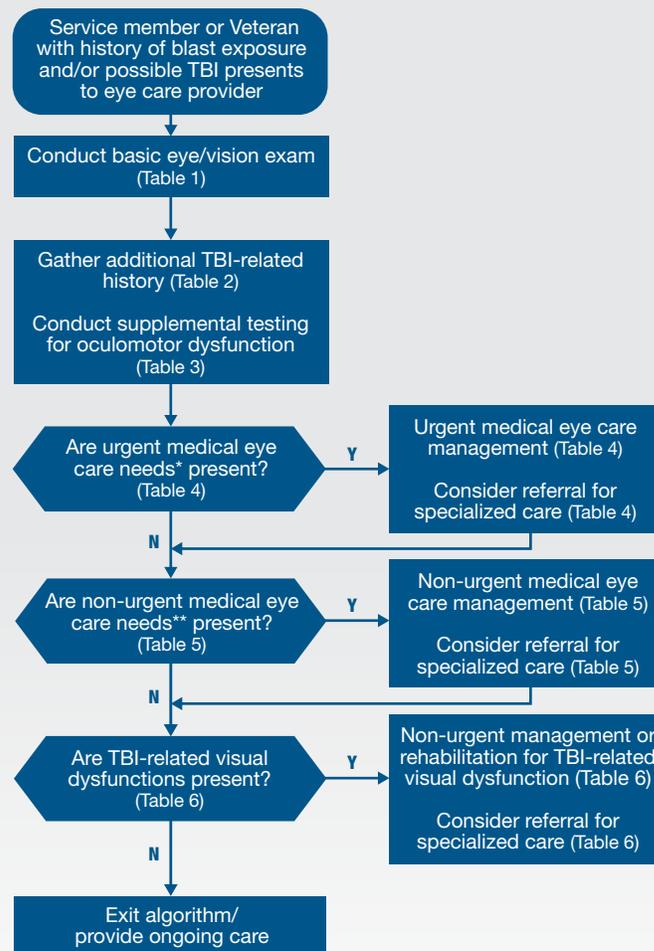
Clinical Recommendation

This clinical recommendation is designed to help guide eye care providers (optometrists and ophthalmologists) treat patients with eye and vision problems following a possible TBI or blast exposure. The recommendations include tests to help eye care providers screen and assess for the most common ocular injuries as well as visual dysfunctions caused by, or associated with TBI. Management, rehabilitation and referral considerations are also provided for specific medical conditions and TBI-related visual dysfunctions. These recommendations should not replace sound clinical judgment or standard practice when caring for a patient.

Summary of Algorithm of Care

The “Algorithm for Eye and Vision Care Following Blast Exposure and/or Possible TBI” (Figure 1) is intended to assist eye care providers evaluate, manage and refer patients presenting with eye or vision problems following a possible TBI or blast exposure. The process begins when a Service member or Veteran presents to an eye care provider as the result of a self-referral or referral from another provider. The algorithm includes recommended eye and vision tests for a basic exam as well as questions to obtain a TBI-related history. It also includes medical conditions that indicate the need for either urgent or non-urgent care management or referral to specialty care. This algorithm covers the recommended evaluation, management and rehabilitation procedures for the initial eye care assessment and is not intended to be used for long-term care.

Figure 1: Algorithm for Eye and Vision Care Following Blast Exposure and/or Possible Traumatic Brain Injury



*Urgent medical eye care needs: Conditions indicating possible ocular, cranial nerve or structural brain injury, which may be sight- or life-threatening, that require immediate management by the eye care provider and/or referral to more specific specialized care

**Non-urgent medical eye care needs: Potentially chronic eye or visual conditions for which management by the eye care provider or referral to more specific specialized care may be addressed over a course of time



Basic Eye Exam

Table 1 includes eye/vision tests recommended as basic components of an exam by an eye care provider regardless of a specific history of blast exposure, head injury, concussion or TBI. It is recommended that these routine tests be augmented as needed, depending on provider specialty as well as the individual patient and environmental factors, particularly those related to possible blast exposure or TBI.

Table 1: Basic Eye/Vision Examination by an Eye Care Provider

Basic Eye/Vision Exam
History*
Visual acuity
Refractive error measurement
External exam
Pupillary testing
Extraocular muscle (EOM) testing/pursuits
Cover test (distance and near)
Confrontation visual field testing
Tonometry
Slit lamp biomicroscopy: Anterior segment, cornea, macula, lens and optic nerve
Binocular indirect ophthalmoscopy (BIO) with scleral depression**
Gonioscopy**
<p><i>*It is recommended that assessment of medical history also include the question, "Have you been exposed to blast or sustained a head injury, concussion or traumatic brain injury (TBI)?" A positive response to this question would be a sufficient rationale to ask TBI-related ocular history questions and conduct supplemental testing.</i></p> <p><i>**If patient history indicates exposure to blast, head injury, concussion and/or TBI</i></p>

In-Depth TBI Evaluation

TBI-Related Ocular History and Additional Testing

If the response regarding a possible TBI-associated event is positive, it is recommended that additional questions be asked during the basic eye exam to obtain a more complete history. **Table 2** presents recommended questions used to obtain a detailed ocular history for a Service member or Veteran who has been exposed to a blast or sustained a head injury or TBI.⁶ It is also recommended that gonioscopy and a dilated retinal exam with scleral depression be performed to rule out occult ocular injury.⁷

Supplemental Testing for Oculomotor Dysfunction

Oculomotor dysfunctions are some of the most common forms of vision problems associated with blast, head injury and TBI.^{7,8,9} Using results from the basic eye exam and TBI-related history questions as a point of reference, an eye care provider may have reason to suspect a possible TBI. To better evaluate TBI-related visual dysfunctions, it is recommended that the provider apply a targeted set of tests to detect the possible presence and type of oculomotor dysfunction. The specific tests listed in **Table 3** include those recommended for use during the exam to help guide additional management and care by the eye care provider.⁸

Table 2: TBI-Related Ocular History Questions[†]

TBI-Related Ocular History Questions
Did you have any neurological problems or symptoms before your TBI (multiple sclerosis, stroke, brain tumor, severe headaches, other)?
When did your TBI occur (on what date)?
Did you lose consciousness during or after your TBI incident?
Were you disoriented or confused during or after your TBI incident?
Do you bump into objects and walls more now than before your injury?
Were your eyes, eyelids or area around your eyes injured when your TBI event occurred?
Do you cover or close one eye at times since your injury?
Have you noticed a change in your vision since your injury?
Are you more sensitive to light, either indoors or outdoors, since your injury?
Have you had any double vision since your injury?
Have you noticed any changes in your peripheral vision since your injury?
Is your vision blurry at distance or near since your injury?
Have you noticed a change in your ability to read since your injury?
Do you lose your place while reading more now than before your injury?
How long can you read continuously before you need to stop?
Do you get headaches during/after reading more now than before your injury?
Do you have more difficulty remembering what you have read now than before your injury?
<p>[†]Goodrich G., Martinsen, G. (2013). Development of a mild traumatic brain injury-specific vision screening protocol: a Delphi study. <i>Journal of Rehabilitation Research & Development</i>, 50(6), 757-768.</p>

Table 3: Supplemental Testing for Oculomotor Dysfunction Problems in the Basic Eye Examination by an Eye Care Provider[†]

Supplemental Testing for Oculomotor Dysfunction
Distance cover test – unilateral and alternate (free space) ^{††}
Near cover test – unilateral and alternate (free space) ^{††}
Versions (EOMs) and/or pursuits ^{††}
Accommodation
Saccades
Near point of convergence (NPC)
Repeated NPC (any method)
<p>[†]Goodrich G., Martinsen, G. (2013). Development of a mild traumatic brain injury-specific vision screening protocol: a Delphi study. <i>Journal of Rehabilitation Research & Development</i>, 50(6), 757-768.</p> <p>^{††}If not already completed as part of basic eye/vision exam</p>

Medical Eye Conditions

Whether or not a provider has confirmed a possible TBI, a patient's history and possible blast exposure may indicate the need for additional screening for various ocular injuries and vision problems. Due to the wide range of possible ocular injuries and TBI-related visual dysfunctions, it is recommended that the eye care provider evaluate the patient to identify or rule out specific conditions. Depending on the results from the exam as well as the possibility that a medical condition may present acutely, the patient may require urgent care management. Chronic medical conditions that require ongoing or follow-up care may also be present. **Table 4** includes a list of medical conditions that may require urgent management or immediate referral to specialized care. **Table 5** lists additional medical conditions considered to be non-urgent that may be chronic or require medical management over a course of time. Both **Tables 4** and **5** also include testing, evaluation and management procedures for the eye care provider to consider during treatment as well as options for referral to specialty care.

Urgent medical eye care needs:

Conditions indicating possible ocular, cranial nerve or structural brain injury, which may be sight- or life-threatening, that require immediate management by the eye care provider and/or referral to more specific specialized care

Non-urgent medical eye care needs:

Potentially chronic eye or visual conditions for which management by the eye care provider and/or referral to more specific specialized care may be addressed over a course of time

Table 4: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Urgent Medical Eye Care

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Acute Proptosis <ul style="list-style-type: none"> • Compartment syndrome • Orbital cellulitis/abscess • Retrobulbar hemorrhage • Thyroid related orbitopathy 	<ul style="list-style-type: none"> • Imaging (CT, MRI) • Ultrasonography • Axial length measurement • Forced ductions • Fundus exam • Exophthalmometry • Refraction (hyperopic shift) • Thyroid function testing (r/o) 	<ul style="list-style-type: none"> • Lateral canthotomy/cantholysis • IOP control • Antibiotics/steroids • Orbital decompression • Abscess/sinus drainage 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care • Otorhinolaryngology care
Adnexal dysfunctions <ul style="list-style-type: none"> • Eyelid retraction • Lagophthalmos • Orbicularis muscle weakness • Trichiasis 	<ul style="list-style-type: none"> • Eyelid function • Evaluate for eyelid and/or conjunctival scarring or wound repair issues • Imaging (CT, MRI) • Ice pack test or tensilon testing 	<ul style="list-style-type: none"> • Tarsorrhaphy • Botulinum toxin injection(s) • Correction of lid retraction • Gold eyelid weights • Lid spring • Nerve transposition • Eyelid reconstruction/scar excision • Ocular lubrication • Eyelash epilation 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care • Neuro-ophthalmic care • Neurology care
Afferent pupillary defect	<ul style="list-style-type: none"> • Color vision testing • OCT • IOP check • Imaging (CT, MRI) • STS, FTA-ABS, VDRL (r/o syphilis) • Platelet count, temporal artery biopsy 	<ul style="list-style-type: none"> • Refer if abnormal testing/imaging • Steroids • Observation (if not referred for neurological care) 	<ul style="list-style-type: none"> • Neuro-ophthalmic care • Neurology care • Neurosurgery care
Corneal abrasion (no open globe)	<ul style="list-style-type: none"> • Fluorescein dye 	<ul style="list-style-type: none"> • Ocular lubrication • NaCl eye eye drops (for recurrent erosion post abrasion) • Bandage contact lens 	<ul style="list-style-type: none"> • Cornea/external eye disease care
Corneal laceration (penetrating)	<ul style="list-style-type: none"> • Seidel test • Imaging (CT, MRI*) <p><i>*MRI contraindicated with suspected metallic intraocular foreign body</i></p>	<ul style="list-style-type: none"> • Rigid corneal shield • Corneal laceration repair 	<ul style="list-style-type: none"> • Cornea/external eye disease care

Table 4: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Urgent Medical Eye Care (cont.)

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Dislocated/displaced crystalline lens or intraocular lens (IOL) implant	<ul style="list-style-type: none"> Ophthalmic ultrasound (contraindicated if open globe injury or corneal laceration exist) Gonioscopy 	<ul style="list-style-type: none"> Lensectomy IOL implantation IOL removal/repositioning 	<ul style="list-style-type: none"> Cornea/external eye disease care
Displaced LASIK flap	<ul style="list-style-type: none"> Slit lamp evaluation 	<ul style="list-style-type: none"> Flap replacement Epithelial ingrowth removal Epithelial keratectomy Reposition flap/bandage contact lens 	<ul style="list-style-type: none"> Cornea/external eye disease care Refractive surgical care
Endophthalmitis	<ul style="list-style-type: none"> Vitreous tap and/or anterior chamber paracentesis with culture and sensitivity testing 	<ul style="list-style-type: none"> Fortified topical antibiotic eye drops Intravitreal/systemic antibiotics Vitrectomy 	<ul style="list-style-type: none"> Vitreo-retinal care Cornea/external eye disease care
Facial nerve palsy	<ul style="list-style-type: none"> Eyelid function Evaluation of facial muscles Imaging (CT, MRI) Ice pack test or tensilon test Lyme disease testing (r/o) 	<ul style="list-style-type: none"> Tarsorrhaphy Botulinum toxin injection(s) Correction of lid retraction Gold eyelid weights Lid spring Nerve transposition Ocular lubrication 	<ul style="list-style-type: none"> Ophthalmic plastic and reconstructive surgery care Neuro-ophthalmic care Neurology care
Headache (unremitting)	<ul style="list-style-type: none"> Imaging (CT, MRI) Angiography IOP check or gonioscopy Blood pressure check CBC, platelet count, temporal artery biopsy Lumbar puncture Sinus evaluation 	<ul style="list-style-type: none"> Glaucoma treatment and/or iridotomy Antibiotics Treatment for high blood pressure Filter evaluation 	<ul style="list-style-type: none"> Emergency room care Neuro-ophthalmic care Neurology care Neurosurgery care Glaucoma care Otorhinolaryngology care
Hyphema (without evidence of corneal laceration or open globe)	<ul style="list-style-type: none"> Determine extent of hyphema and document daily changes in size IOP check Gonioscopy 	<ul style="list-style-type: none"> Dilating drops Topical corticosteroid drops IOP control Anterior chamber washout 	<ul style="list-style-type: none"> Cornea/external eye disease care Glaucoma care
Ocular surface foreign body (possibly penetrating)	<ul style="list-style-type: none"> Seidel test Eyelid eversion, fornix and conjunctiva evaluation (defer if open globe injury) Imaging (CT, MRI*) <p><i>*MRI contraindicated with suspected metallic intraocular foreign body</i></p>	<ul style="list-style-type: none"> Rigid corneal shield Foreign body removal Rust ring removal Bandage contact lens 	<ul style="list-style-type: none"> Cornea/external eye disease care
Ocular trauma (blunt, no open globe)	<ul style="list-style-type: none"> IOP check Imaging (CT, MRI) Ophthalmic ultrasound (contraindicated if open globe injury or corneal laceration exist) Gonioscopy Binocular indirect ophthalmoscopy 90 or 78 diopter lens slit lamp exam Palpate orbital/periorbital area 	<ul style="list-style-type: none"> Observation (unless obvious injury present) 	<ul style="list-style-type: none"> Vitreo-retinal care Cornea/external eye disease care Glaucoma care Neuro-ophthalmic care
Ocular trauma (penetrating)	<ul style="list-style-type: none"> Imaging (CT, MRI*) <p><i>*MRI contraindicated with suspected metallic intraocular foreign body</i></p> <ul style="list-style-type: none"> Cornea/globe laceration Intraocular foreign body 	<ul style="list-style-type: none"> Rigid corneal shield Foreign body removal Repair open cornea/globe 	<ul style="list-style-type: none"> Vitreo-retinal care Cornea/external eye disease care Glaucoma care

Table 4: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Urgent Medical Eye Care (cont.)

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Periocular trauma <ul style="list-style-type: none"> • Facial laceration • Facial/orbital fracture • Lid laceration 	<ul style="list-style-type: none"> • Imaging (CT, MRI) • Eyelid function • Probe/irrigate lacrimal system • Palpate orbital/periorbital area • Forced ductions 	<ul style="list-style-type: none"> • Facial laceration repair • Eyelid/tear duct laceration repair • Probe/intubate tear system • Fracture repair • Orbital reconstruction 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care • Maxillofacial surgery care • Facial plastic surgery care • Otorhinolaryngology care • Plastic surgery care
Ptosis or ocular motility abnormality	<ul style="list-style-type: none"> • Eyelid function • Forced duction testing and active force generation testing • Ocular motility • Ice pack test or tensilon testing • Imaging (CT, MRI) • Parks 3-step test • Cover-testing in 9 positions of gaze 	<ul style="list-style-type: none"> • Ptosis correction • Myasthenia gravis treatment • Fresnel prisms • Muscle surgery • Monocular occlusion to eliminate diplopia • Botulinum toxin injection(s) • Ptosis crutch 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care • Neuro-ophthalmic care • Neurology care • Neurosurgery care • Pediatric and adult strabismus surgical care
Retinal break, hole or detachment	<ul style="list-style-type: none"> • Peripheral retina exam/scleral depression • Pupillary responses test • Fluorescein angiography • Ophthalmic ultrasound (contraindicated if open globe injury or corneal laceration exists) 	<ul style="list-style-type: none"> • Argon laser treatment • Retinal detachment repair • Vitrectomy • Long-term follow-up care • Observation (if not referred to specialty care) 	<ul style="list-style-type: none"> • Vitreo-retinal care • Low vision rehabilitation care (if treatment is unsuccessful)
Soft tissue necrosis <ul style="list-style-type: none"> • Necrotizing fasciitis • Steven's-Johnson syndrome • Toxic epidermal necrolysis 	<ul style="list-style-type: none"> • Culture workup • Blood work • Orbicularis function • Lagophthalmos • Fluorescein dye • IOP check 	<ul style="list-style-type: none"> • Bandage therapeutic contact lens • Artificial tear ointments/gels/drops • Suture tarsorrhaphy • Symblepharon ring • Topical/systemic antibiotic • Debridement • Symblepharon lysis • Probe/intubate tear system • Hyperbaric oxygen 	<ul style="list-style-type: none"> • Burn and/or wound care • Ophthalmic plastic and reconstructive surgery care • Cornea/external eye disease care • Custom therapeutic contact lens care
Traumatic optic neuropathy	<ul style="list-style-type: none"> • Imaging (CT, MRI) • Visual fields • Color vision testing • Pupil evaluation • Filter evaluation 	<ul style="list-style-type: none"> • Observation • Prescription lens filters/tints 	<ul style="list-style-type: none"> • Neuro-ophthalmic care • Neurology care • Neurosurgery care
Vision loss (sudden, unexplained)	<ul style="list-style-type: none"> • Pupil evaluation • Dilated fundus exam/scleral depression • Visual fields • OCT • Carotid Doppler • Echocardiogram • Angiography • CBC, platelet count, temporal artery biopsy • Imaging (CT, MRI) • IOP check 	<ul style="list-style-type: none"> • Anterior chamber paracentesis • Hyperbaric oxygen therapy • IV tissue plasminogen activator • Selective intra-arterial thrombolytic therapy • Steroids • Retinal detachment repair • Vitrectomy 	<ul style="list-style-type: none"> • Emergency room care • Vitreo-retinal care • Neuro-ophthalmic care • Neurology care • Interventional radiology care
Vitreous hemorrhage	<ul style="list-style-type: none"> • Peripheral retina exam/scleral depression • Ophthalmic ultrasound (contraindicated if open globe injury or corneal laceration exists) 	<ul style="list-style-type: none"> • Argon laser treatment • Retinal detachment repair • Vitrectomy 	<ul style="list-style-type: none"> • Vitreo-retinal care

Abbreviations: CBC = complete blood count; CT = computed tomography; FTA-ABS = fluorescent treponemal antibody absorption test; IOL = intraocular lens; IOP = intraocular pressure; IV = intravenous; LASIK = Laser-Assisted In Situ Keratomileusis; MRI = magnetic resonance imaging; NaCl = sodium chloride; OCT = optical coherence tomography; r/o = rule out; STS = serologic test for syphilis; VDRL = venereal disease research laboratory test

Table 5: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Non-Urgent Eye Medical Care and/or Rehabilitation

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Cataract	<ul style="list-style-type: none"> • Refraction • Ocular biometry 	<ul style="list-style-type: none"> • Prescription eyeglasses/spectacles • Contact lenses • Lensectomy/IOL implantation 	<ul style="list-style-type: none"> • Cataract surgery
Corneal abrasion	<ul style="list-style-type: none"> • Foreign body exam • Seidel sign • Fluorescein testing 	<ul style="list-style-type: none"> • Antibiotic therapy • Bandage soft contact lens 	<ul style="list-style-type: none"> • Cornea/external eye disease care
Corneal scarring	<ul style="list-style-type: none"> • Corneal topography • Refraction 	<ul style="list-style-type: none"> • Prescription eyeglasses/spectacles • Contact lenses • Lamellar keratoplasty • Penetrating keratoplasty 	<ul style="list-style-type: none"> • Cornea/external eye disease care • Custom therapeutic contact lens care
Iridodialysis	<ul style="list-style-type: none"> • Gonioscopy • OCT • IOP check 	<ul style="list-style-type: none"> • Manage IOP • Manage dislocated lens • Surgical repair of iridodialysis 	<ul style="list-style-type: none"> • Glaucoma care • Cornea/external eye disease care • Custom therapeutic contact lens care
Loss of eye(s)	<ul style="list-style-type: none"> • Socket evaluation • Condition and size of prosthesis • Evaluation of eyelid position 	<ul style="list-style-type: none"> • Clean and refit prosthesis • Socket reconstruction • Patient education on prosthesis and socket care • Prescription eyeglasses with polycarbonate lenses • Prescription safety eye protection 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care • Ocular prosthesis care • Blind rehabilitation care • Low vision rehabilitation care
Nystagmus	<ul style="list-style-type: none"> • Visual fields • Imaging (CT, MRI) 	<ul style="list-style-type: none"> • Prescription eyeglasses with prism • Muscle surgery • Botulinum toxin injection(s) 	<ul style="list-style-type: none"> • Neuro-ophthalmic care • Neurology care • Pediatric and adult strabismus surgical care • Low vision rehabilitation care • Vestibular audiology care (ENT and/or PT) • Custom therapeutic contact lens care
Ocular surface disease	<ul style="list-style-type: none"> • Trichiasis • Lid margin disease • Dry eye syndrome 	<ul style="list-style-type: none"> • Fluorescein/rose bengal/lissamine green testing • Schirmer testing • Eyelash evaluation • Eyelid margin evaluation 	<ul style="list-style-type: none"> • Cornea/external eye disease care • Custom therapeutic contact lens care
Ocular surface foreign body (non-penetrating)	<ul style="list-style-type: none"> • Seidel sign • Ophthalmic ultrasound • Imaging (X-ray, CT) 	<ul style="list-style-type: none"> • Foreign body removal • Topical antibiotic eye drops • Bandage contact lens 	<ul style="list-style-type: none"> • Cornea/external eye disease care
Optic nerve pallor	<ul style="list-style-type: none"> • Color vision testing • OCT • Visual fields • Imaging (CT, MRI) • FTA-ABS, STS, VDRL (r/o syphilis) • IOP check 	<ul style="list-style-type: none"> • Observation • Filter evaluation 	<ul style="list-style-type: none"> • Glaucoma care • Neuro-ophthalmic care • Neurology care
Proptosis	<ul style="list-style-type: none"> • Imaging (CT, MRI) • Ultrasonography • Axial length measurement • Exophthalmometry • Forced ductions • Dilated fundus exam • Refraction (hyperopic shift) • Thyroid function testing (r/o) 	<ul style="list-style-type: none"> • Orbital reconstruction • Tumor removal • Orbital decompression • Consider pseudoproptosis 	<ul style="list-style-type: none"> • Ophthalmic plastic and reconstructive surgery care

Abbreviations: CT = computed tomography; ENT = ear, nose and throat; FTA-ABS = fluorescent treponemal antibody absorption test; IOL = intraocular lens; IOP = intraocular pressure; MRI = magnetic resonance imaging; OCT = optical coherence tomography; PT = physical therapy; STS = serologic test for syphilis; VDRL = venereal disease research laboratory test

TBI-Related Visual Dysfunctions

Following identification or rule out of urgent and non-urgent medical conditions, it is recommended that the eye care provider conduct additional screening for specific TBI-related visual dysfunctions and conditions commonly seen following blast exposure, head injury or TBI. In addition to the initial testing for oculomotor dysfunctions and in consideration of known medical eye care needs, it is recommended that the eye care provider screen for additional TBI-related visual dysfunctions including vision loss, visual field loss and/or other conditions that affect vision. **Table 6** includes the

recommended testing, management and referral considerations for specific TBI-related visual dysfunctions. These recommendations were established to help enable eye care providers to identify and manage visual dysfunctions associated with TBI that affect the quality of life and functional outcomes of Service members and Veterans. These recommendations are provided under the assumption that all existing medical conditions listed in **Tables 4** and **5** continue to be managed by the eye care provider and referrals are made as needed.

Table 6: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Non-Urgent Care and/or Rehabilitation for TBI-Related Oculomotor Problems and/or Visual Dysfunctions

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Accommodative dysfunction <ul style="list-style-type: none"> Accommodative excess Accommodative infacility Accommodative insufficiency Accommodative spasm 	<ul style="list-style-type: none"> Accommodative amplitude testing Accommodative facility testing Accommodative accuracy (monocular estimate method) testing 	<ul style="list-style-type: none"> Prescription eyeglasses/spectacles with or without prism Accommodative amplitude training 	<ul style="list-style-type: none"> Oculomotor rehabilitation care
Depth perception abnormalities <ul style="list-style-type: none"> Impaired stereoscopic vision 	<ul style="list-style-type: none"> Stereopsis testing Unilateral cover and alternate cover testing Parks 3-step test Vergence testing Cyclophoria testing Associated phoria/fixation disparity testing 	<ul style="list-style-type: none"> Prescription eyeglasses/spectacles with or without prism Vergence training Strabismus surgery 	<ul style="list-style-type: none"> Oculomotor rehabilitation care Pediatric and adult strabismus surgical care Neuro-ophthalmic care
Eye movement disorders <ul style="list-style-type: none"> Abnormal pursuits Abnormal saccades Nystagmus Oscillopsia 	<ul style="list-style-type: none"> Developmental eye movement testing Maddox rod testing King-Devick testing Eye movement recording study 	<ul style="list-style-type: none"> Prescription eyeglasses/spectacles with or without prism Prescription contact lenses Oculomotor training Botulinum toxin injection(s) 	<ul style="list-style-type: none"> Oculomotor rehabilitation care Neuro-ophthalmic care Custom therapeutic contact lens care Vestibular audiology care (ENT and/or PT)
Loss of visual function <ul style="list-style-type: none"> Blindness Low vision Visual field loss Visual neglect 	<ul style="list-style-type: none"> Low vision assessment Mobility assessment Visual field testing Visual neglect assessment Foveal field testing Imaging (CT, MRI) Glare and contrast sensitivity testing 	<ul style="list-style-type: none"> Prescription eyeglasses/spectacles with or without prism Prescription optical low vision devices Prescription optical and electronic visual field expanders or enhancement devices Mobility aids and training Low vision aids and training 	<ul style="list-style-type: none"> Blind rehabilitation care Low vision rehabilitation care
Ocular alignment disorder <ul style="list-style-type: none"> Convergence insufficiency Convergence excess Fusional vergence dysfunction Other heterophoria Strabismus (paretic and non-paretic) 	<ul style="list-style-type: none"> Parks 3-step test Unilateral cover and alternate cover testing Vergence testing Cyclophoria testing Vertical deviation testing Saccades testing Forced ductions testing and active force generation testing Imaging (CT, MRI) 	<ul style="list-style-type: none"> Prescription eyeglasses/spectacles with or without prism Vergence therapy Occlusion Strabismus surgery Botulinum toxin injection(s) 	<ul style="list-style-type: none"> Oculomotor rehabilitation care Pediatric and adult strabismus surgical care Neuro-ophthalmic care Custom therapeutic contact lens care
Photophobia/glare sensitivity	<ul style="list-style-type: none"> Glare assessment Corneal topography Tear film evaluation Cataract assessment 	<ul style="list-style-type: none"> Tinted prescription eyeglasses/spectacles Tinted prescription contact lenses Special prescription lens filters/tints Pharmacotherapy 	<ul style="list-style-type: none"> Neuro-ophthalmic care Neurology care Psychology care Psychiatry care Pain management care

Table 6: Testing, Evaluation, Management and Referral Considerations for Conditions That May Require Non-Urgent Care and/or Rehabilitation for TBI-Related Oculomotor Problems and/or Visual Dysfunctions (cont.)

Condition/Presentation	Additional Testing and Evaluation Considerations	Management Considerations	Referral Considerations
Reading difficulties <ul style="list-style-type: none"> • Eye strain • Difficulty with visual memory in reading • Headache • Loss of reading place • Lack of sustained reading ability • Words appear to jump when reading 	<ul style="list-style-type: none"> • Refractive analysis • Accommodative testing • Unilateral cover and alternate cover testing • Phoria testing • Vergence testing • Developmental eye movement testing • King-Devick testing • Eye movement recording study • Ocular motility testing 	<ul style="list-style-type: none"> • Prescription eyeglasses/spectacles with or without prism • Convergence training • Vergence therapy 	<ul style="list-style-type: none"> • Oculomotor rehabilitation care • Pediatric and adult strabismus surgical care

Abbreviations: CT = computed tomography; ENT = ear, nose and throat; MRI = magnetic resonance imaging; PT = physical therapy

Conclusion

This clinical recommendation is based on a review of the literature and consensus of expert opinion. It is intended to provide procedural recommendations for the eye care provider regarding assessment, management, rehabilitation and referral for patients with medical eye care conditions and visual dysfunctions 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.

References

1. Dougherty, A. L., MacGregor, A. J., Han, P. P., Heltemes, K. J., & Galarneau, M. R. (2011). Visual dysfunction following blast-related traumatic brain injury from the battlefield. *Brain Injury, 25*(1), 8-13.
2. Stelmack, J. A., Frith, T., Van Koeveing, D., Rinne, S., & Stelmack, T. R. (2009). Visual function in patients followed Veterans Affairs Polytrauma Network site: An electronic medical record review. *Optometry, 80*(8), 419-424.
3. Barnett, B. P., & Singman, E. L. (2015). Vision concerns after mild traumatic brain injury. *Current Treatment Options in Neurology, 17*(2), 1-14.
4. Magone, M. T., Kwon, E., & Shin, S. Y. (2014). Chronic visual dysfunction after blast-induced mild traumatic brain injury. *Journal of Rehabilitation Research and Development, 51*(1), 71-80.
5. Defense Medical Surveillance System and the Theater Medical Data Store (DMSS-TMDS). (2014). Prepared by the Armed Forces Health Surveillance Center. <http://dvbic.dcoe.mil/dod-worldwide-numbers-tbi>.
6. Luu, S., Lee, A. W., Daly, A., & Chen, C. S. (2010). Visual field defects after stroke—a practical guide for GPs. *Australian Family Physician, 39*(6), 499-503.
7. Warren, M. (2009). Pilot study on activities of daily living limitations in adults with hemianopsia. *American Journal of Occupational Therapy, 63*(5), 626-633.
8. Goodrich G., Martinsen, G. (2013). Development of a mild traumatic brain injury-specific vision screening protocol: a Delphi study. *Journal of Rehabilitation Research & Development, 50*(6), 757-768.
9. Cockerham, G. C., Goodrich, G. L., Weichel, E. D., Orcutt, J. C., Rizzo, J. F., Bower, K. S., et al. (2009). Eye and visual function in traumatic brain injury. *Journal of Rehabilitation Research and Development, 46*(6), 811-818.
10. Kapoor, N., & Ciuffreda K. J. (2011). Vision problems. In J. M. Silver, T. W. MacAllister, & S. C. Yudofsky (Eds.), *Textbook of traumatic brain injury* (pp. 363-373). (2nd ed.). Arlington, VA: American Psychiatric Publishing.
11. Brahm, K. D., Wilgenburg, H. M., Kirby, J., Ingalla, S., Chang, C.Y., & Goodrich, G. L. (2009). Visual impairment and dysfunction in combat-injured servicemembers with traumatic brain injury. *Optometry and Vision Science, 86*(7), 817-825.

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