

# Assessment and Management of Dizziness and Visual Disturbances Following Concussion/Mild Traumatic Brain Injury: Guidance for the Primary Care Manager

## References and Acknowledgements:

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### Expert Working Group:

#### Dizziness:

Stephanie Beauregard, PT, MPT  
CDR Selena Bobula,  
PT, DPT, NCS  
Carlos Esquivel, MD, FACS  
Michael Hoffer, MD, FACS  
LTC Carrie Hoppes, PT, DPT, PhD,  
NCS  
Paula Kodosky, PT, DPT  
LCDR Michael Krok, PT, DPT  
Karen Lambert, PT, DPT, NCS  
Tara Lapointe, Au.D., ABA, CCC-A,  
FAAA  
Meghan Melinchak, ATC, LAT,  
AIB-VR/CON  
Marcy Pape, PT, DPT, CBIS, CCVT  
Karen Skop, PT, DPT

### End User Group:

Capt Tyler Bates, DO, USAF  
Michelle A. Lindsay, ANP-BC  
MAJ Blaise Pascale, MD, MPH  
Maj Matthew Puderbaugh, DO,  
USAF, MN ANG, MC, FS  
LCDR Rebecca C Rausa, PA-C,  
MSC, USN  
CDR Adam Susmarski, DO, MC,  
USN

### Core Working Group:

Amanda Gano, MPH, MS, PA-C  
Joanne Gold, PharmD, BCGP  
Stacey Harcum, MPH, MS,  
OTR/L  
Karen Lambert, PT, DPT, NCS  
Rachael Lardieri, MS, OTR/L  
Donald Marion, MD, MSc  
Gary McKinney, DHSc, CBIS  
Michael D. Pattison, OD, MS,  
FAAO  
Keith Stuessi, MD

### Vision:

Mark Ettenhoffer, PhD  
Geeta Girdher, OD, FAAO  
Jill Gutierrez, OD, FAAO  
Lt Col Justin Holbrook, OD, FAAO  
Roya Lackey, MSOT, OTR/L, CBIS  
Marina LeBlanc, OTR/L  
Imelda Llanos, MS Visual  
Disabilities, OTR/L  
Rita Mallia, OD, MPA  
Michael Pattison, OD, MS, FAAO  
Mitchell Scheiman, OD, PhD

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## References:

1. Honaker JA, Tomasek R, Bean K, Logan B. Impact of visual disorders on vestibular and balance rehabilitation therapy outcomes in soldiers with blast injury. *Int Tinnitus J.* 2012;17(2):124-133.
2. Hoffer ME, Balaban C, Gottshall K, Balough BJ, Maddox MR, Penta JR. Blast exposure: vestibular consequences and associated characteristics. *Otol Neurotol.* Feb 2010;31(2):232-236.
3. Valovich McLeod TC, Hale TD. Vestibular and balance issues following sport-related concussion. *Brain injury.* 2015;29(2):175-184.
4. Wasserman EB, Kerr ZY, Zuckerman SL, Covassin T. Epidemiology of Sports-Related Concussions in National Collegiate Athletic Association Athletes From 2009-2010 to 2013-2014: Symptom Prevalence, Symptom Resolution Time, and Return-to-Play Time. *The American journal of sports medicine.* Jan 2016;44(1):226-233.
5. Herdman SJ, Clendaniel RA. *Vestibular Rehabilitation* 4th ed: F.A. Davis Company 2014.
6. Akin FW, Murnane OD, Hall CD, Riska KM. Vestibular consequences of mild traumatic brain injury and blast exposure: a review. *Brain injury.* 2017;31(9):1188-1194.
7. Aligene K, Lin E. Vestibular and balance treatment of the concussed athlete. *NeuroRehabilitation.* 2013;32(3):543-553.
8. Reynolds ME, Barker FM, 2nd, Merezhinskaya N, Oh GT, Stahlman S. Incidence and temporal presentation of visual dysfunction following diagnosis of traumatic brain injury, active component, U.S. Armed Forces, 2006-2017. *MSMR.* Sep 2019;26(9):13-24.
9. Hunt AW, Mah K, Reed N, Engel L, Keightley M. Oculomotor-Based Vision Assessment in Mild Traumatic Brain Injury: A Systematic Review. *J Head Trauma Rehabil.* Jul-Aug 2016;31(4):252-261.
10. Merezhinskaya N, Mallia RK, Park D, Bryden DW, Mathur K, Barker FM, 2nd. Visual Deficits and Dysfunctions Associated with Traumatic Brain Injury: A Systematic Review and Meta-analysis. *Optom Vis Sci.* Aug 2019;96(8):542-555.
11. Ettenhofer ML, Barry DM. Saccadic Impairment Associated With Remote History of Mild Traumatic Brain Injury. *J Neuropsychiatry Clin Neurosci.* Summer 2016;28(3):223-231.
12. Ettenhofer ML, Hershaw JN, Engle JR, Hungerford LD. Saccadic impairment in chronic traumatic brain injury: examining the influence of cognitive load and injury severity. *Brain injury.* 2018;32(13-14):1740-1748.
13. Capo-Aponte JE, Jorgensen-Wagers KL, Sosa JA, et al. Visual Dysfunctions at Different Stages after Blast and Non-blast Mild Traumatic Brain Injury. *Optom Vis Sci.* Jan 2017;94(1):7-15.
14. Capo-Aponte JE, Urosevich TG, Temme LA, Tarbett AK, Sanghera NK. Visual dysfunctions and symptoms during the subacute stage of blast-induced mild traumatic brain injury. *Mil Med.* Jul 2012;177(7):804-813.
15. Wetzel PA, Lindblad AS, Raizada H, et al. Eye Tracking Results in Postconcussive Syndrome Versus Normative Participants. *Invest Ophthalmol Vis Sci.* Aug 1 2018;59(10):4011-4019.
16. Meehan A, Searing E, Weaver LK, Lewandowski A. Baseline vestibular and auditory findings in a trial of post-concussive syndrome. *Undersea & hyperbaric medicine : journal of the Undersea and Hyperbaric Medical Society, Inc.* Aug-Sept 2016;43(5):567-584.
17. Goodrich GL, Flyg HM, Kirby JE, Chang CY, Martinsen GL. Mechanisms of TBI and visual consequences in military and veteran populations. *Optom Vis Sci.* Feb 2013;90(2):105-112.
18. Magone MT, Kwon E, Shin SY. Chronic visual dysfunction after blast-induced mild traumatic brain injury. *J Rehabil Res Dev.* 2014;51(1):71-80.
19. King JE, Pape MM, Kodosky PN. Vestibular Test Patterns in the NICoE Intensive Outpatient Program Patient Population. *Mil Med.* Mar 1 2018;183(suppl\_1):237-244.
20. Mucha A, Collins MW, Elbin RJ, et al. A Brief Vestibular/Ocular Motor Screening (VOMS) assessment to evaluate concussions: preliminary findings. *The American journal of sports medicine.* Oct 2014;42(10):2479-2486.
21. Kontos AP, Deitrick JM, Collins MW, Mucha A. Review of Vestibular and Oculomotor Screening and Concussion Rehabilitation. *Journal of athletic training.* Mar 2017;52(3):256-261.
22. Goodrich GL, Martinsen GL, Flyg HM, et al. Development of a mild traumatic brain injury-specific vision screening protocol: a Delphi study. *J Rehabil Res Dev.* 2013;50(6):757-768.
23. Newman-Toker DE, Edlow JA. TiTrATE: A Novel, Evidence-Based Approach to Diagnosing Acute Dizziness and Vertigo. *Neurol Clin.* Aug 2015;33(3):577-599, viii.

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24. Ritenour AE, Wickley A, Ritenour JS, et al. Tympanic membrane perforation and hearing loss from blast overpressure in Operation Enduring Freedom and Operation Iraqi Freedom wounded. *J Trauma*. Feb 2008;64(2 Suppl):S174-178; discussion S178.
25. Claes J, Germonpre P, Van Rompaey V, Bourmanne E. Ear, nose and throat and non-acoustic barotrauma. *B-ENT*. 2016;Suppl 26(1):203-218.
26. Shah A, Ayala M, Capra G, Fox D, Hoffer M. Otologic assessment of blast and nonblast injury in returning Middle East-deployed service members. *Laryngoscope*. Jan 2014;124(1):272-277.
27. Quatman-Yates CC, Hunter-Giordano A, Shimamura KK, et al. Physical Therapy Evaluation and Treatment After Concussion/Mild Traumatic Brain Injury. *J Orthop Sports Phys Ther*. Apr 2020;50(4):CPG1-CPG73.
28. Ouchterlony D, Masanic C, Michalak A, Topolovec-Vranic J, Rutka JA. Treating Benign Paroxysmal Positional Vertigo in the Patient With Traumatic Brain Injury: Effectiveness of the Canalith Repositioning Procedure. *The Journal of neuroscience nursing : journal of the American Association of Neuroscience Nurses*. Apr 2016;48(2):90-99; quiz E91.
29. Pisani V, Mazzone S, Di Mauro R, Giacomini PG, Di Girolamo S. A survey of the nature of trauma of post-traumatic benign paroxysmal positional vertigo. *Int J Audiol*. May 2015;54(5):329-333.
30. Dix MR, Hallpike CS. The pathology, symptomatology and diagnosis of certain common disorders of the vestibular system. *Ann Otol Rhinol Laryngol*. 1952;61:987-1016.
31. Bhattacharya N, Gubbels SP, Schwartz SR, et al. Clinical Practice Guideline: Benign Paroxysmal Positional Vertigo (Update). *Otolaryngol Head Neck Surg*. Mar 2017;156(3\_suppl):S1-S47.
32. Epley JM. The canalith repositioning procedure: for treatment of benign paroxysmal positional vertigo. *Otolaryngol Head Neck Surg*. Sep 1992;107(3):399-404.
33. Aron M, Lea J, Nakku D, Westerberg BD. Symptom Resolution Rates of Posttraumatic versus Nontraumatic Benign Paroxysmal Positional Vertigo: A Systematic Review. *Otolaryngol Head Neck Surg*. Nov 2015;153(5):721-730.
34. Department of Veterans Affairs & Department of Defense (2021). VA/DoD Clinical Practice Guideline for the Management and Rehabilitation of Post-Acute Mild Traumatic Brain Injury. Retrieved from: <https://www.healthquality.va.gov/guidelines/Rehab/mtbi/VADoDmTBICPGFinal508.pdf>.
35. Ellis MJ, Leddy JJ, Willer B. Physiological, vestibulo-ocular and cervicogenic post-concussion disorders: an evidence-based classification system with directions for treatment. *Brain injury*. 2015;29(2):238-248.
36. Reiley AS, Vickory FM, Funderburg SE, Cesario RA, Clendaniel RA. How to diagnose cervicogenic dizziness. *Arch Physiother*. 2017;7(12):12.
37. Ernst A, Basta D, Seidl RO, Todt I, Scherer H, Clarke A. Management of posttraumatic vertigo. *Otolaryngol Head Neck Surg*. Apr 2005;132(4):554-558.
38. Friedman JM. Post-traumatic vertigo. *Med Health R I*. Oct 2004;87(10):296-300.
39. Cockerham GC, Lemke S, Glynn-Milley C, Zumhagen L, Cockerham KP. Visual performance and the ocular surface in traumatic brain injury. *Ocul Surf*. Jan 2013;11(1):25-34.
40. Lee CJ, Felix ER, Levitt RC, et al. Traumatic brain injury, dry eye and comorbid pain diagnoses in US veterans. *Br J Ophthalmol*. May 2018;102(5):667-673.
41. Fife TD, Kalra D. Persistent vertigo and dizziness after mild traumatic brain injury. *Annals of the New York Academy of Sciences*. Apr 2015;1343:97-105.
42. Denby E, Murphy D, Busutil W, Sakel M, Wilkinson D. Neuropsychiatric Outcomes in UK Military Veterans With Mild Traumatic Brain Injury and Vestibular Dysfunction. *J Head Trauma Rehabil*. Jan/Feb 2020;35(1):57-65.
43. Callahan ML, Binder LM, O'Neil ME, et al. Sensory sensitivity in operation enduring freedom/operation Iraqi freedom veterans with and without blast exposure and mild traumatic brain injury. *Appl Neuropsychol Adult*. Mar-Apr 2018;25(2):126-136.
44. Goodrich GL, Martinsen GL, Flyg HM, Kirby J, Garvert DW, Tyler CW. Visual function, traumatic brain injury, and posttraumatic stress disorder. *J Rehabil Res Dev*. 2014;51(4):547-558.
45. Wares JR, Hoke KW, Walker W, et al. Characterizing effects of mild traumatic brain injury and posttraumatic stress disorder on balance impairments in blast-exposed servicemembers and Veterans using computerized posturography. *J Rehabil Res Dev*. 2015;52(5):591-603.
46. Esterov D, Greenwald BD. Autonomic Dysfunction after Mild Traumatic Brain Injury. *Brain Sci*. Aug 11 2017;7(8):100.

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47. Pertab JL, Merkle TL, Cramond AJ, Cramond K, Paxton H, Wu T. Concussion and the autonomic nervous system: An introduction to the field and the results of a systematic review *NeuroRehabilitation*. 2018;42(4):397-427.
48. Chan TLH, Hale TD, Steenerson KK. Vestibular Lab Testing: Interpreting the Results in the Headache Patient with Dizziness. *Curr Neurol Neurosci Rep*. May 19 2020;20(6):16.
49. Formeister EJ, Rizk HG, Kohn MA, Sharon JD. The Epidemiology of Vestibular Migraine: A Population-based Survey Study. *Otol Neurotol*. Sep 2018;39(8):1037-1044.
50. Cianfrone G, Pentangelo D, Cianfrone F, et al. Pharmacological drugs inducing ototoxicity, vestibular symptoms and tinnitus: a reasoned and updated guide. *Eur Rev Med Pharmacol Sci*. Jun 2011;15(6):601-636.
51. Clinical Resource, Drug-Induced Adverse Eye Effects. *Pharmacist's Letter/Prescriber's Letter*. 2020.
52. Carvalho AF, Sharma MS, Brunoni AR, Vieta E, Fava GA. The Safety, Tolerability and Risks Associated with the Use of Newer Generation Antidepressant Drugs: A Critical Review of the Literature. *Psychother Psychosom*. 2016;85(5):270-288.
53. Milazzo V, Stefano CD, Servo SD, Crudo V, Fulcheri C. Drugs and Orthostatic Hypotension: Evidence from Literature. *J of Hypertension* 2012;1(2):104.
54. Rivasi G, Rafanelli M, Mossello E, Brignole M, Ungar A. Drug-Related Orthostatic Hypotension: Beyond Anti-Hypertensive Medications. *Drugs Aging*. Oct 2020;37(10):725-738.