Guidelines for Concussion / Mild Traumatic Brain Injury & Persistent Symptoms

Second Edition

For adults (18+ years of age)







Module 10: Persistent Vestibular (Balance / Dizziness) & Vision Dysfunction

Ontario Neurotrauma Foundation
Fondation ontarienne de neurotraumatologie

MODULE 10: PERSISTENT VESTIBULAR (BALANCE/DIZZINESS) & VISION DYSFUNCTION

Ontario Neurotrauma Foundation
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Please note, the project team independently managed the development and production of the guideline and, thus, editorial independence is retained.

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The recommendations and resources found within the *Guidelines for Concussion/Mild Traumatic Brain Injury & Persistent Symptoms* are intended to inform and instruct care providers and other stakeholders who deliver services to adults who have sustained or are suspected of having sustained a concussion/mTBI. These guidelines are not intended for use with patients or clients under the age of 18 years. These guidelines are not intended for use by people who have sustained or are suspected of having sustained a concussion/mTBI for any self-diagnosis or treatment. Patients may wish to bring their healthcare and other providers' attention to these guidelines.

The recommendations provided in these guidelines are informed by best available evidence at the time of publication, and relevant evidence published after these guidelines could influence the recommendations made within. Clinicians should also consider their own clinical judgement, patient preferences and contextual factors such as resource availability in clinical decision-making processes.

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Unique Features & Symbols in the Current Guideline

Hyperlinks

To improve ease of use, the current guideline has embedded hyperlinks to improve navigation between sections, appendices, and so on. For example, by clicking any heading in the table of contents above, you will be taken directly to that particular section in the current PDF document. Also, anytime there is mention of a particular table, figure, appendix or section, you can simply click on it to go directly to that item.

Symbols

The following symbol has been placed to the left of each guideline recommendation that should be prioritized for implementation. This was determined by expert consensus members during the endorsement/prioritization process, where experts were allowed to provide 20 prioritization votes (see Methodology in the Complete Version). Guideline recommendations with a summed prioritization score greater than 20 are key clinical practice guidelines recommendations for implementation.

The following symbol has been placed to the left of one key guideline recommendation in each of the sections that did not include a recommendation with a prioritization score greater than 20 (determined by expert consensus members during the endorsement/prioritization process).

At the bottom of each page in the current document, there is a hyperlinked footer that can be used to return to the table of contents as desired. Also, clicking “Return to Last Page” will take you back to the previously viewed page. (Note: When scrolling through the pages, the “Return to Last Page” button will only return to the last page that was scrolled through).

10 Persistent Vestibular (Balance/ Dizziness) & Vision Dysfunction

Special contributors: Angela Peddle (vision), Jennifer Shea (vestibular)

Vestibular (Balance/Dizziness) Dysfunction

Persistent vertigo, dizziness, imbalance, and vision changes are common complaints post mTBI and are often associated with vestibular system impairments.[1,2] Vestibular deficits can be peripheral in origin, affecting the inner ear, or central, affecting central nervous system integration and output to maintain balance and posture. The peripheral vestibular organs also affect eye movement through the vestibulo-occular reflex (VOR). Thus, vestibular dysfunction presents as balance impairments and VOR abnormalities.

The most common cause of post-traumatic peripheral vestibular dysfunction is benign paroxysmal positional vertigo (BPPV).[3] Patients experience episodes of vertigo, nystagmus, and nausea with sudden changes in position, often including rolling over in bed or looking up. These attacks usually last less than 30 seconds, but can be quite disabling and occur multiple times per day. BPPV is most commonly caused by dislodged otoconia in the posterior semicircular canal (SCC).

Assessment of vestibular function is important following mTBI to identify vestibular deficits, which may benefit from evidence-based interventions. Evaluation should minimally include a balance screen, the Dix-Hallpike manoeuvre and VOR screening. Balance testing should reference normal values to document impairment (see Figure 10.1).[4,5]

Table 10.1 Important Components to Include in the Neurological Exam

Vision	• Acuity • Tracking • Saccades • Nystagmus • Vergence
Auditory	• Hearing screen • Otoscopic exam
Sensory	• Sharp • Light tough • Proprioception • Vibration
Motor	• Power • Coordination
Vestibular	• Dynamic activity • Positional testing
Functional Activities	Sitting and standing • Romberg with eyes open/closed • Single leg stance Balance Transfers • Supine ↔ sit • Sit ↔ stand Gait • Walking • Tandem walking • Turning

When the history suggests BPPV, posterior SCC involvement can be diagnosed by the Dix-Hallpike manoeuvre (see Appendix 10.1 for more information and Appendix B for links to video demonstrations). VOR abnormalities will often present as nystagmus in one or more directions of gaze. When assessment suggests vestibular dysfunction, vestibular interventions can be considered. Although, historically, medications have been used to suppress vestibular symptoms, including nausea, current evidence does not support this approach. A Cochrane review by Hillier and Hollohan (2007) identifies vestibular rehabilitation (VR) as an effective intervention for unilateral peripheral vestibular dysfunction.[1] Weaker evidence also suggests VR may be helpful for central vestibular dysfunction.[6] VR is typically provided by a specialized physiotherapist and involves various movement-based regimens to bring on vestibular symptoms and desensitize the vestibular system, coordinate eye and head movements, and improve functional balance and mobility. However, for the specific treatment of BPPV, Hillier and Hollohan (2007) conclude that canalith or particle repositioning manoeuvres are more effective than VR techniques.[1]

Figure 10.1 Clinical Assessment of Balance

Instructions

The 10 Second Balance Screen:

Age 49 and Under: Ask the subject to stand on one leg, arms free to move. He or she can choose which leg to stand on and are allowed to alternate between legs in between trials. Patients perform the tests with eyes closed. A subject who requests help to assume a testing position is allowed to use the investigator's arm to steady him- or herself prior to starting the timed trials. No instructions are given regarding the subject's knee position. Timing starts when the subject assumes the proper position and indicates that he or she is ready to begin the test. Timing stops when the subject disengages from the starting position or reaches the 30-second time limit. The best of three trials is taken for the result.

Age 69 and Under: Ask the subject to stand with one foot just in front of the other with arms free to move (Tandem Romberg). He or she can choose which leg to be in front and can change position in between trials. Patients perform the tests with eyes closed. A subject who requests help to assume a testing position is allowed to use the investigator's arm to steady him- or herself prior to starting the timed trials. Timing starts when the subject assumes the proper position and indicates that he or she is ready to begin the test. Timing stops when the subject disengages from the starting position or reaches the 30-second time limit. The best of three trials is taken for the result.

Age 70 and Older: Ask the subject to stand on one leg, arms free to move. He or she can choose which leg to stand on and is allowed to alternate between legs in between trials. Patients perform the tests with eyes open. A subject who requests help to assume a testing position is allowed to use the investigator's arm to steady him- or herself prior to starting the timed trials. No instructions are given regarding the subject's knee position or visual fixation. Timing starts when the subject assumes the proper position and indicates that he or she is ready to begin the test. Timing stops when the subject disengages from the starting position or reaches the 30-second time limit. The best of three trials is taken for the result.

Any test score of 10 seconds or less suggests balance impairment.

Normative Data

Decade	Mean	SD	Median	Perc 05	Interquartile range	Perc 95	Valid N	% 30 s	% 10 s
One leg standing (eyes open)									
3	30.00	.00	30.00	30.00	30.00 - 30.00	30.00	N = 74	100	100
4	30.00	.00	30.00	30.00	30.00 - 30.00	30.00	N = 43	100	100
5	29.64	2.06	30.00	25.91	30.00 - 30.00	30.00	N = 32	97	100
6	30.00	.00	30.00	30.00	30.00 - 30.00	30.00	N = 30	100	100
7	27.74	5.25	30.00	11.59	30.00 - 30.00	30.00	N = 56	80	95
8	21.43	10.08	26.33	2.05	13.04 - 30.00	30.00	N = 56	48	86
One leg standing (eyes closed)									
3	27.52	6.45	30.00	9.45	30.00 - 30.00	30.00	N = 74	86	96
4	27.48	6.48	30.00	8.46	30.00 - 30.00	30.00	N = 43	86	95
5	21.77	9.09	24.75	3.94	10.90 - 30.00	30.00	N = 31	45	90
6	19.92	9.81	20.90	3.78	10.55 - 30.00	30.00	N = 29	38	79
7	8.93	7.54	5.66	1.61	3.32 - 12.13	28.33	N = 56	4	34
8	4.87	3.46	3.93	1.18	2.87 - 6.03	11.78	N = 56	0	5
Tandem Romberg (eyes closed)									
3	29.94	.43	30.00	30.00	30.00 - 30.00	30.00	N = 58	98	100
4	30.00	.00	30.00	30.00	30.00 - 30.00	30.00	N = 42	100	100
5	28.82	4.66	30.00	11.46	30.00 - 30.00	30.00	N = 32	94	97
6	28.03	4.87	30.00	13.57	29.70 - 30.00	30.00	N = 28	82	100
7	17.96	10.33	16.50	4.18	7.66 - 30.00	30.00	N = 56	36	64
8	13.20	9.50	11.26	2.27	4.68 - 18.74	30.00	N = 56	16	54

Cut-Off

It is recommended that a 10-second time limit per decade is used to delineate poor performance.

Content based on Vereek, Wuyts, Truijen & Van de Heyning (2008) with normative data tables taken from the paper.

RECOMMENDATIONS FOR PERSISTENT VESTIBULAR (BALANCE/DIZZINESS) DYSFUNCTION

		GRADE
10.1	Evaluation should include a thorough neurologic examination that emphasizes vision, vestibular, balance and coordination, and hearing. See Table 10.1 for specific exam details. [a]	C
10.2	If symptoms of benign positional vertigo are present, the Dix-Hallpike manoeuvre (see Appendix 10.1) should be used for assessment.	A
10.3	A canalith repositioning manoeuvre (Appendix 10.1) should be used to treat benign positional vertigo if the Dix-Hallpike manoeuvre is positive.	A
10.4	For persons with functional balance impairments and screening positive on a balance measure, consideration for further balance assessment and treatment by a qualified health care professional may be warranted pending clinical course.	C
10.5	Vestibular rehabilitation therapy is recommended for unilateral peripheral vestibular dysfunction.	A

a. Adapted from the *VA/DoD Management of Concussion/Mild Traumatic Brain Injury Clinical Practice Guideline (VA/DoD, 2009).*

RECOMMENDATIONS FOR PERSISTENT VESTIBULAR (BALANCE/DIZZINESS) DYSFUNCTION (CONTINUED)		
		GRADE
10.6	When the patient identifies a problem with hearing the following steps should be followed: 1. Perform an otologic examination. 2. Review medications for ototoxicity. 3. Refer to audiology for hearing assessment if no other apparent cause is found. [a]	C
10.7	When the patient identifies a problem with nausea the following steps should be followed: 1. Define triggers and patterns of nausea and conduct appropriate investigations as required. 2. Assess medication list for agents that may cause or worsen GI symptoms. 3. Perform oropharyngeal examination. 4. Assess vision and vestibular/balance systems. [a]	C

Vision Dysfunction

Patients presenting with vision disorders post-TBI may display anomalies of visual acuity, accommodation, version movements, vergence movements, photosensitivity, visual field integrity and ocular health–collectively termed post-trauma vision syndrome (PTVS; Table 10.2).[7-9] Practitioners should take a detailed history of any persistent vision symptoms and perform examinations to detect potentially unrecognized visual deficits or take note of the specific type of visual disorder the patient is experiencing.[8,10] Mild TBI patients with advanced ocular health changes and complex strabismic anomalies should be referred to a neuro-ophthalmologist.[11-13] Otherwise, patients who experience changes in accommodation, version or vergence movements, photosensitivity, and visual field integrity are amenable to rehabilitative techniques rendered by qualified optometrists.[8,10,11] See Table 10.3.

There is some current evidence that optometric vision rehabilitation can be an important modality in the rehabilitation of these patients in certain situations.[7,8,10,14] It should therefore be offered as a possible option for the treatment and management of persistent vision disorders. Treatment may include rehabilitative interventions such as vision therapy, reading spectacles, prism spectacles, and/or tinted spectacles.[8,12,14]

Table 10.2 Post-Trauma Vision Syndrome (PTVS) Definitions

Accommodation: The ability to clearly focus the lens of the eye for clear near vision. This ability is gradually lost with increased age (45 yrs +) as a result of loss of elasticity of the lens and its surrounding muscles.
Version Movements: The movement of both eyes in the same direction – easily tested by following a near target in an "H" pattern about 40 cm from the patient.
Vergence Movements: Convergence and divergence eye movements, which enable accurate depth perception. Supra- and infra-vergence relate to the vertical fusional movements of the eyes.

Table 10.3 Common Visual Symptoms and Associated Visual Deficits

Symptom	Possible Visual Deficit
Blurry vision	Accommodative dysfunction
Reading comprehension or efficiency problems	Version eye movement deficits or visual perceptual processing deficits
Diplopia	Vergence eye movement deficits
Eyestrain/headaches	Accommodative or vergence dysfunction
Sensitivity to light/glare	Abnormal light-dark adaptation, photosensitivity
Dizziness	Impaired vestibular-ocular reflex and motion perception
Spatial deficits	Impaired visual field or visual processing deficits

a. Adapted from the *VA/DoD Management of Concussion/Mild Traumatic Brain Injury Clinical Practice Guideline (VA/DoD, 2009).*

RECOMMENDATIONS FOR PERSISTENT VISION DYSFUNCTION		
		GRADE
10.8	Take an appropriate case history, including questions on visual blur, scanning/reading ability, light sensitivity, diplopia, eyestrain, motion sensitivity, and spatial deficits (indicating loss of visual field integrity). See Table 10.2 for a detailed description of symptoms and their related vision dysfunction.	**C**
10.9	Perform tests of visual acuity, extra-ocular motility, vergence, visual fields, pupils, and fundoscopy. See Appendix 10.2 for an explanation of screening techniques.	**C**
10.10	Other functional vision changes should be given consideration for referral to a qualified optometrist specializing in neuro-optometric rehabilitation for vision therapy.	**B**

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References

1 Hillier SL, Hollohan V. Vestibular Rehabilitation for unilateral peripheral vestibular dysfunction. Cochrane Database of Systematic Reviews Library. 2007; Issue 4, Art. No.: CD005397. DOI:10.1002/14651858.CD005397.pub2.

2 Maskell F, Chiarelli P, Isles R. Dizziness after traumatic brain injury: overview and measurement in the clinical setting. *Brain Injury*. 2006; 20:293-305.

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6 Hansson EE, Mansson NO & Hakansson A. Effects of specific rehabilitation for dizziness among patients in primary health care. A randomized controlled trial. *Clinical Rehabilitation*. 2004;18:558-565.

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8 Fox RS. The rehabilitation of vergence and accomodative dysfunctions in traumatic brain injury. *Brain Injury Professional*. 2005;2(3):12-15.

9 Ciuffreda KJ, Rutner, D, Kapoor N, Suchoff IB, Craig S, Han ME. Vision therapy for oculomotor dysfunctions in acquired brain injury: A retrospective analysis. *Optometry*. 2008;79:18-22.

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Appendix 10.1

Dix-Hallpike Manoeuvre and Particle Repositioning Manoeuvre (PRM)*

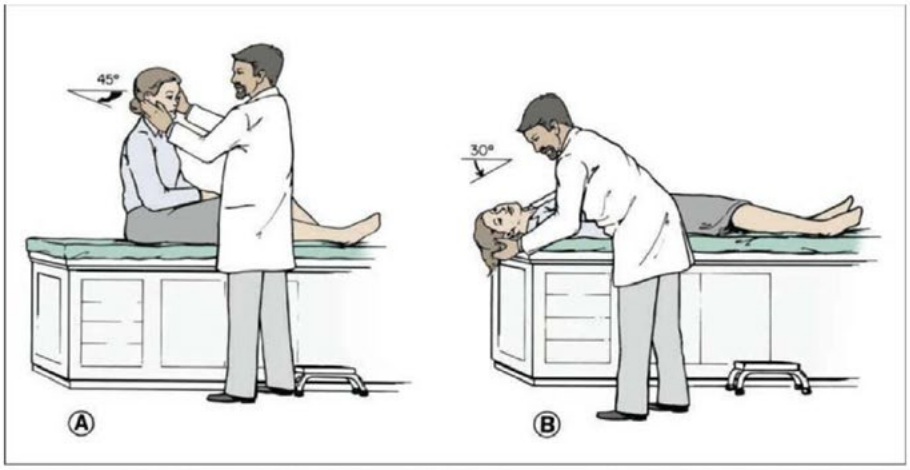

Fig. 6: Dix–Hallpike manoeuvre (right ear). The patient is seated and positioned so that the patient's head will extend over the top edge of the table when supine. The head is turned 45° toward the ear being tested (position A). The patient is quickly lowered into the supine position with the head extending about 30° below the horizontal (position B). The patient's head is held in this position and the examiner observes the patient's eyes for nystagmus. In this case with the right side being tested, the physician should expect to see a fast-phase counter-clockwise nystagmus. To complete the manoeuvre, the patient is returned to the seated position (position A) and the eyes are observed for reversal nystagmus, in this case a fast-phase clockwise nystagmus.

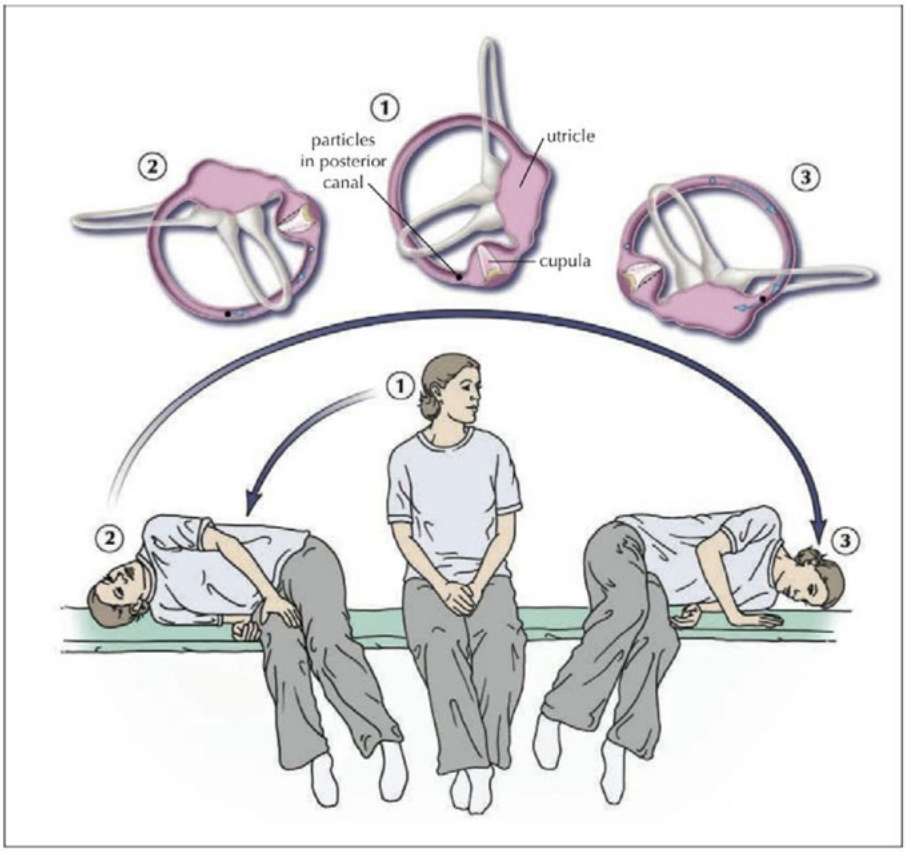

Fig. 7: Liberatory manoeuvre of Semont (right ear). The top panel shows the effect of the manoeuvre on the labyrinth as viewed from the front and the induced movement of the canaliths (from blue to black) This manoeuvre relies on inertia, so that the transition from position 2 to 3 must be made very quickly.

* Taken from Parnes LS, Agrawal SK, Atlas J. Diagnosis and management of benign paroxysmal positional vertigo (BPPV). *Canadian Medical Association Journal*. 2003;169:681-693. For links to video demonstrations of the above manoeuvres, please see Appendix B.

Appendix 10.2

Screening Techniques for Vision Dysfunction

Visual Acuity	Visual acuity should be performed at both distance and near with each eye, with their current prescription (if applicable).
Extra-ocular Motility	The “Broad H” Test is designed to assess the action of all 6 extraocular muscles around each eye. Have the patient follow a penlight as it is moved into the patient’s right and left field, as well as upwards and downwards in both right and left gaze, making a large “H” pattern out to at least 30-40 degrees (shoulder width as a rule of thumb). The movements should be full and smooth, without diplopia or eyestrain.
Vergence	The ability for the eyes to converge as a team should also be assessed via the Near Point of Convergence test. As a penlight is slowly brought inward towards the patient’s nose, the patient is asked to report when the light “breaks into two” (diplopia). The normal point of convergence is approximately 8cm or less from the nose. If one eye turns outwards, or the patient report diplopia is greater than 8 cm, further investigation is warranted.
Pupils	Pupils should be equal, round and reactive to light without afferent pupillary defect.
Fundoscopy	The internal retinal examination should reveal healthy, distinct optic nerves, maculae and retinal tissue.

Appendix A

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* The recommendations in this document are those of the Ontario Neurotrauma Foundation, identified by the guideline development team and expert consensus group members, and do not necessarily represent agreement of or endorsement by the Centers for Disease Control and Prevention.

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Appendix B

Other Links/References for Resources to Consider

Section 10: Persistent Vision & Vestibular (Balance/Dizziness) Dysfunction

Balance Error Scoring System (BESS)
A portable and objective method of assessing static postural stability. More specifically, the BESS can be used to assess the effects of traumatic brain injury on static postural stability. The BESS utilizes a combination of stances (feet in a narrow stance, preferably touching; single leg stance; and tandem stance) and footing surfaces (bare feet on the floor or a medium density foam surface).

Guskiewicz KM. Postural stability assessment following concussion: one piece of the puzzle. C*linical Journal of Sports Medicine.* 2001;11:182–189.

Links for Dix-Hallpike & Repositioning Manoeuvre Video Demonstrations
http://www.youtube.com/watch?v=kEM9p4EX1jk
http://www.youtube.com/watch?v=1-hsUU7MDqc
http://www.youtube.com/watch?v=RQV-oz0baFM