

Vestibular Rehabilitation for Peripheral Vestibular Hypofunction:

Updated Clinical Practice Guideline from the Academy of Neurologic Physical Therapy of the American Physical Therapy Association

Table 1. Levels of evidence for studies

I	Evidence obtained from high-quality ($\geq 50\%$ critical appraisal score AND $>80\%$ follow-up, blinding, & appropriate randomization) randomized controlled trials
II	Evidence obtained from high-quality cohort ($> 80\%$ follow-up) study or lesser quality ($< 50\%$ critical appraisal score OR the study does not meet requirements for high quality) randomized controlled trials
III	Evidence obtained from case-control study, lower-quality cohort study or retrospective studies
IV	Evidence obtained from case series
V	Expert opinion

Table 2. Definition of Grades of Recommendations*

GRADE	RECOMMENDATION	STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of Level I and/or Level II studies support the recommendation. This must include at least one Level I study directly on the topic that supports the recommendation. Recommendation obligation: “should” or “should not”.
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of Level II studies support the recommendation. Recommendation obligation: “may” or “may not”.
C	Weak evidence	A single Level II study or a preponderance of Level III and IV studies support the recommendation. Recommendation obligation: “may” or “may not”.
D	Expert opinion	Best practice based on the clinical experience of the guideline development team and guided by the evidence, which may be conflicting. Recommendation obligation: “may consider”.

* Each Action Statement is preceded by a **bolded** letter grade (A – D) indicating the strength of the recommendation.

Table 3. List of abbreviations

Abbreviation	Definition
ABC	Activities-Specific Balance Confidence Scale
ADL	Activities of Daily Living
APTA	American Physical Therapy Association
BBS	Berg Balance Scale
BEST	Balance Evaluation Systems Test
BVH	Bilateral Vestibular Hypofunction, including partial and complete loss of function
CDP	Computerized Dynamic Posturography
COG	Center of Gravity
CON	Control group
COP	Center of Pressure
CPG	Clinical Practice Guideline
DGI	Dynamic Gait Index
DHI	Dizziness Handicap Inventory
DRS	Disability Rating Scale
DVA	Dynamic Visual Acuity
EXP	Experimental Group
FGA	Functional Gait Assessment
FRT	Functional Reach Test
FSST	Four-Square Step Test
FTSST	Five Times Sit to Stand Test
GDS	Geriatric Depression Scale
GSE	Gaze Stabilization Exercises
GST	Gaze Stabilization Test
GDG	Guideline Development Group
10 MWT	10 Meter Walk Test
HADS	Hospital Anxiety and Depression Scale
HEP	Home Exercise Program
HMD	Head-Mounted Display or Device
LOE	Levels of Evidence
LOS	Limits of Stability
MCI	Mild Cognitive Impairment
mCTSIB	modified Clinical Test of Sensory Interaction on Balance
mini BEST	mini Balance Evaluation Systems Test
MST	Motion Sensitivity Test
OFI	Oscillopsia Functional Impact Scale
OSQ	Oscillopsia Severity Questionnaire
OKN	Optokinetic nystagmus
OKS	Optokinetic Stimulus

PANAS	Positives Affect Negative Affect Scale
POMA	Performance-Oriented Mobility Assessment
POS	Perceived Outcomes Scale
PPPD	Persistent Postural- Perceptual Dizziness
PSFS	Patient Specific Functional Scale
PRO	Patient-Reported Outcomes
QoL	Quality of Life
RCT	Randomized Controlled/Clinical Trial
SLS	Single Leg Stance
SOT	Sensory Organization Test
TUG	Timed Up and Go
TUG Dual Task	TUG with cognitive and motor dual tasks
UCLADQ	UCLA Dizziness Questionnaire
UVH	Unilateral Vestibular Hypofunction, including partial and complete loss of function
VADL	Vestibular Disorders Activities of Daily Living Scale
VAP	Vestibular Activities and Participation Scale
VAS	Visual Analog Scale
VHQ	Vertigo Handicap Questionnaire
VOR	Vestibulo-ocular reflex
VORx1	VOR times 1 viewing paradigm exercise
VORx2	VOR times 2 viewing paradigm exercise
VR	Virtual Reality
VRBQ	Vestibular Rehabilitation Benefits Questionnaire
VPT	Vestibular Physical Therapy
VSS	Vertigo Symptom Scale
VVAS	Visual Vertigo Analog Scale
vHIT	Video Head Impulse Test

Table 4. Definition of Common Terms

Term and Abbreviation	Definition
Unilateral vestibular hypofunction (UVH)	Partial or complete loss of one of the peripheral vestibular sensory organs and/or vestibular nerves
Bilateral vestibular hypofunction (BVH)	Partial or complete loss of both peripheral vestibular sensory organs and/or vestibular nerves
Acute	First 2 weeks following the onset of symptoms
Subacute	After the first 2 weeks and up to 3 months following the onset of symptoms
Chronic	The presence of symptoms longer than 3 months
Cervical Ocular Reflex (COR)	Mechanism to maintain stable vision using proprioceptive input from the neck and may be seen in the early period of recovery after onset of BVH
Vestibulo-ocular Reflex (VOR)	Mechanism to maintain stable vision during head movement. Two components: angular VOR, mediated by the semi-circular canals, compensates for head/body rotation; linear VOR, mediated by the otoliths, compensates for translation motion.
Head Impulse Test (HIT)	Test of VOR function using high acceleration, small amplitude head rotation in the plane of the semicircular canals being tested.
Gaze Stabilization Exercises (GSE)	Exercises designed to promote gaze stability and developed based on the concepts of VOR adaptation and substitution
VOR Adaptation Exercises	Exercises developed to induce long-term changes in the neuronal response to head movements with the goal of reducing symptoms and normalizing gaze and postural stability during head movement. Examples of adaptation exercises include VORx1 and VORx2.
VOR Substitution Exercises	Exercises developed to promote alternative strategies (e.g., central pre-programming of eye movements including saccades) to substitute for impaired vestibular function to enable gaze stability. Examples of substitution exercises include eye-head movements between targets and remembered target exercises.
VSR Substitution exercises	Exercises developed to promote alternative strategies (e.g. increased reliance on visual and somatosensory cues) to substitute for impaired or lost vestibular function to improve postural and gait stability.
Habituation Exercises	Exercises or movements that systematically expose the individual to a provocative stimulus that over time with repeated exposure leads to a reduction in symptoms

<p>Balance Exercises</p> <p>Low Technology</p>	<p>Static (quiet stance) or dynamic exercises to optimize functioning of the systems underlying postural control. These exercises may include center of gravity control training, anticipatory and reactive balance control training, multisensory training, and gait training. Progression of exercises may involve altering visual (e.g., visual cues altered (reduced, absent or moving) and/or somatosensory input (e.g., firm, uneven or moving surfaces), and/or base of support (e.g., Romberg, tandem, single leg stance), and/or head movements, and/or a cognitive task to increase the balance challenge. Examples of dynamic activities include weight-shifting, walking with head turns and performing a secondary task (e.g., arm movements) while standing or walking as appropriate based on the individual's capabilities.</p>
<p>High Technology</p>	<p>Virtual Reality (VR): computer-generated simulation of real or imagined environments within which individuals interact using their own movements, such as Wii Fit Balance Board, Biodex, Cave Automatic Virtual Environments, and head mounted displays.</p> <p>Optokinetic stimuli (OKS): the use of repetitive moving visual patterns provided by optokinetic discs, moving rooms or lower tech equipment, such as busy screen savers on a computer or videos of busy visual environments.</p>
<p>Augmented Sensory Feedback</p>	<p>Sensory information delivered via an alternate sensory channel to replace or augment a deficient sense.</p> <p>Vibrotactile feedback: tactile cues provided to an individual when they are leaning/tilting away from vertical more than a predetermined amount.</p> <p>Haptic cues: transmission of information through the sense of touch, such as information provided by a cane.</p> <p>Platform oscillations: horizontal sinusoidal movement combined with oscillations</p>
<p>Compensation</p>	<p>Compensation for a vestibular disorder is a gradual process that is most likely of central origin. The process may involve adaptation of residual VOR gain, substitution of alternative strategies, habituation of symptoms and regaining postural control</p>
<p>Vertigo</p>	<p>Specific term meaning an illusion of self-motion or of motion of the surrounding environment; typically, a spinning sensation of the body but can also be non-spinning</p>

Dizziness	Generic term for light-headedness, swimming sensation, giddiness, imbalance or disturbed spatial orientation
Disequilibrium	The perception of being off-balance or unsteady
Oscillopsia	The perception of visual motion or blurring of a stationary object during head movement. Often described as “bouncing” of objects especially when moving the head quickly or during self-motion.
Presbyvestibulopathy	Age-related chronic vestibular syndrome characterized by unsteadiness, gait disturbance, and/or recurrent falls in the presence of mild bilateral vestibular deficits.
Persistent Postural-Perceptual Dizziness (PPPD)	Persistent dizziness, unsteadiness, or non-spinning vertigo (e.g., distorted sensation of swaying of self or environment) lasting three months or longer. Typically, the disorder follows occurrences of acute or episodic vestibular or balance-related problems, but may follow non-vestibular insults (e.g., psychological distress).

Table 5. Summary of outcome measures to assess individuals with vestibular hypofunction organized based on the ICF model*

Measure	What it measures
ICF Level: Body Structure/ Function	
Dynamic Visual Acuity, instrumented	Computerized assessment of visual acuity during head movement relative to static visual acuity without head movement (Herdman, 1998; Li, 2014). ^{5,6}
Dynamic Visual Acuity, non-instrumented (clinical)	Clinical assessment of visual acuity during head movement relative to static visual acuity without head movement using an eye exam chart (Longridge, 1984; Herdman, 2010). ^{7,8}
Gaze Stabilization Test, instrumented	Computerized assessment of visual acuity that identifies the most rapid head rotation velocity at which an optotype of fixed size can be identified (Ward, 2010). ⁹
Head Impulse Test, instrumented (video HIT)	VOR gain and presence of overt and covert saccades with a head impulse (Weber, 2009). ¹⁰
Head Shake nystagmus test	Clinical assessment of the VOR whereby the persons head is passively moved in the yaw plane to determine if the person exhibits nystagmus when the head shaking has stopped (Kamei, 1988). ¹¹
Romberg	Assesses static standing balance with feet together (Thyssen, 1982; Ekdahl, 1989). ^{12,13}
Sharpened Romberg	Assesses static standing balance with feet in tandem position (heel touching toe) (Thyssen, 1982; Ekdahl, 1989). ^{12,13}
Sensory Organization Test	Computerized assessment of postural control by measuring sway under conditions in which visual/somatosensory feedback are altered. (Nashner, 1982; DiFabio, 1995). ^{14,15}
Sensory Organization Test with Head Shake	Postural stability during head rotations compared to head still (Honaker, 2016). ¹⁶
Subject visual vertical- bucket and instrumented	Test of perceived verticality that can be done with the “bucket test” as a low tech alternative and with a light bar for instrumented testing (Zwergal et al, 2009). ¹⁷
(Modified) Clinical Test of Sensory Interaction on Balance	Postural control under various sensory conditions, including eyes open and closed plus firm and foam surfaces (Shumway-Cook, 1986; Anacker, 1992; Cohen, 1993). ¹⁸⁻²⁰
Visual Analog Scale	Symptoms of dizziness, disequilibrium, and vertigo are quantified on a 10-cm line corresponding to (Hall & Herdman, 2006; Toupet, 2011). ^{21,22}
Visual Vertigo Analog Scale	Intensity of visual vertigo in nine challenging situations of visual motions using a visual analog scale (Dannenbaum, 2011). ²³

Motion Sensitivity Test	Motion-provoked dizziness during a series of 16 quick changes to head or body positions (Shepard, 1990). ²⁴
Vertigo Symptoms Scale	Symptoms of balance, somatic anxiety, and autonomic arousal problems (Yardley, 1992). ²⁵
ICF Level: Activity/ Participation	
Five Times Sit to Stand	A measure of lower extremity strength with published norms in older adults and individuals with vestibular disorders (Guralnik, 1995; Whitney, 2005; Meretta, 2006). ²⁶⁻²⁸
30-second Chair Stand	A measure of lower extremity strength with published norms in older adults (Rikli & Jones, 2001). ²⁹
Functional Reach	A measure of the maximum forward reaching distance while standing in a fixed position (Duncan, 1992; Mann, 1996). ^{30,31}
Gait Velocity (10 m Walk Test)	Walking at preferred speed (Bohannon, 1997; Perera, 2006; Studenski, 2011). ³²⁻³⁴
Balance Evaluation Systems Test (BESTest)	Assessment of six domains contributing to postural control (Horak, 2009). ³⁵
Mini BESTest	Abbreviated 14-item version of the BESTest to assess dynamic balance and validated in individuals with balance disorders (Franchignoni, 2010; Godi, 2013). ^{36,37}
Berg Balance Scale	14-item measure of static balance and fall risk during common activities (Berg, 1992; Whitney, 2003). ^{38,39}
Dynamic Gait Index	Postural stability during various walking tasks including change speed, turn head, walk over/ around obstacles, and climb stairs (Shumway-Cook, 1997; Whitney, 2000). ^{40,41}
Functional Gait Assessment	Postural stability during various walking tasks including tandem, backwards and eyes closed (Wrisley, 2004). ⁴²
Four Square Step Test	Ability to step over objects forward, sideways, and backwards (Whitney, 2007). ⁴³
Single Leg or Unipedal Stance Test	Ability to maintain stance on one leg (Bohannon, 1984). ⁴⁴
Timed Up and Go	Mobility and fall risk (Podsiadlo, 1991; Whitney, 2004). ^{45,46}
Timed Up and Go Dual Task	Mobility under dual-task conditions (cognitive and motor) and fall risk (Shumway-Cook, 2000; Caixeta, 2012). ^{47,48}

* Details regarding recommendations from the Vestibular Evidence Database to Guide Effectiveness task force are available online at <http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/vestibular-disorders> (Accessed 8-31-2020).

Table 6. Patient-reported outcome measures for individuals with vestibular hypofunction

Patient-reported outcomes	
Measure	What it measures
Activities-Specific Balance Confidence Scale	Confidence in balance without falling or being unsteady across a continuum of activities (Powell, 1995; Myers, 1996). ^{49,50}
Balance Exercise Difficulty Scale	Self-report rating of the perceived intensity of balance exercises (Alsubaie, 2019). ⁵¹
Disability Rating Scale	Level of disability based on descriptions of symptoms and limited activities (Shepard 1990). ²⁴
Dizziness Handicap Inventory	Perceived handicap as a result of dizziness (Jacobson & Newman, 1990). ⁵²
Hospital Anxiety and Depression Scale (HADS)	A 14-item scale to identify anxiety and depression among ill patients (The hospital anxiety and depression scale (Zigmond & Snaith, 1983; Hermann, 1997). ^{53,54}
Oscillopsia Functional Impact scale (OFI)	Impact of oscillopsia on daily activities (Anson, 2018). ⁵⁵
Oscillopsia Severity Questionnaire (OSQ)	Severity of oscillopsia during various activities (Guinand, 2012). ⁵⁶
Positive Affect Negative Affect	Validated and reliable tool for assessing depression and anxiety in individuals with dizziness (Hazlett, 1996). ⁵⁷
UCLA Dizziness Questionnaire	Severity, frequency and fear of dizziness and its effect on quality of life and activities of daily living (Honrubia, 1996). ⁵⁸
Vertigo Handicap Questionnaire	Effects of vertigo on disability, handicap and psychological distress (Duracinsky, 2007). ⁵⁹
Vestibular Activities and Participation	Effect of dizziness and/or balance problems on ability to perform activity and participation tasks according the ICF WHO document (Alghwiri, 2012). ⁶⁰
Vestibular Disorders Activities of Daily Living Scale	Independence in everyday activities of daily living (Cohen & Kimball, 2000). ⁶¹
Vestibular Rehabilitation Benefit Questionnaire	Impact of symptoms on quality of life (Morris, 2008, 2009). ^{62,63}

Table 7. Vestibular exercises and dose for chronic unilateral vestibular hypofunction

1 st Author/ Year/ LOE	Intervention	Type of Exercises	Clinic Dosage (visits/week, min/session)	HEP Dosage (days/week, min/day)	# of weeks	Outcome
LOW TECHNOLOGY (TRADITIONAL) BALANCE EXERCISES						
Giray 2009 ⁷³ ; II	EXP: Low Tech VPT CON: No treatment	EXP: Standing/walking altering visual, vestibular and somatosensory inputs. GSE	EXP:2x/week, 30-45 min CON: No treatment	EXP: 2x/day, 30-40 min/day Balance portion: 18- 28 min/day	4	EXP: BBS, mCTSIB improved (<i>P</i> <.05)
Herdman 2012 ¹⁹⁷ ; III	EXP: Low Tech VPT CON: none	GSE, balance, gait, endurance (walking)	1x/week, 60-70 min	Total: 60-70 min/day GSE: 3-5x/day Balance: 2x/day Walking: 10-20 min/day	5	Gait speed, DGI improved (<i>P</i> <0.001); 75-88% with UVH improved significantly in outcome measures
Meldrum 2015 ¹¹³ ; I	EXP: Wii Fit virtual reality balance (non- immersive) CON: Low Tech VPT	EXP: Wii Fit + rocker board (SLS, weight shift), GSE, endurance (walking) CON: Balance with foam pad, GSE, endurance (walking)	EXP: 1x/week, 30-40 min CON: 1x/week, 30-40 min	Balance:5x/week, 15 min/day GSE: 7x/week; 20- 35 min/day, Walking:5x/week 10- 30 min/day,	6	Both groups improved in gait speed and SOT. No differences between group at 8 weeks and 6 months

Ricci 2016 ¹³⁵ ; I	"Multi-Modal" Cawthorne-Cooksey (EXP) Conventional Cawthorne-Cooksey (CON)	EXP: Cawthorne Cooksey with unstable surfaces and altered foot positions, with eye or head movements, walking with ankle weights including slopes	EXP: 2x/week, 50 min CON: 2x/week, 50 min	EXP/CON: 1x/day, 24-38 min/day	8	EXP/CON: Improved DGI and decreased subjects with fall risk: maintained at 3 months
Smolka 2020 ¹¹⁷ ; II	EXP: VPT CON: Cawthorne-Cooksey HEP	EXP: endurance, balance with/without visual feedback, gait exercises, gaze stabilization exercises CON: Cawthorne-Cooksey	EXP: 1x/week, 90 min	CON: 2x/day, 30 min/day	6	EXP: DGI and BBS improved (P <0.05); EXP and CON: Improved TUG (P <0.05)
HIGH TECHNOLOGY BALANCE EXERCISES						
VIRTUAL REALITY						
Meldrum 2015 ¹¹³ ; I	EXP: Wii Fit virtual reality balance (non-immersive VR) CON: Low Tech VPT	EXP: Wii Fit + rocker board (SLS, weight shift), GSE, endurance (walking) CON: Balance with foam pad, GSE, endurance (walking)	EXP: 1x/week, 30-40 min CON: 1x/week, 30-40 min	Balance: 15 min/day 5x/week GSE: 20-35 min/day, 5x/week Walking: 10-30 min/day, 5x/week	6	Both groups improved in gait speed and SOT. No differences between group at 8 weeks and 6 months
Rosiak 2018 ¹⁸⁶ ; III	EXP: Virtual reality (non-immersive VR) CON: Posturography	EXP: Virtual reality games; upper body movements while maintaining COP CON: static posturography with visual feedback	10 sessions over 10 days, 25-30 min/session	Both groups: Cawthorne-Cooksey, 3x/day	2	Both groups improved postural stability; no difference between groups at 1-month post intervention

Micarelli 2017 ¹⁶⁵ ; II	EXP: Low Tech VPT plus immersive VR CON: Low Tech VPT	Static/dynamic balance/gait exercises altering visual, somatosensory and visual inputs, Herdman (2003) GSE protocol	2x/week, 30-45 min	EXP: HMD virtual reality 20 min/day EXP/CON: 2x/day, total 30-40 min/day	4	EXP: ABC, DHI, vHIT gain and some posturography measures improved
Viziano 2019 ¹⁷⁰ ; I	EXP: Low Tech VPT plus immersive VR CON: Low Tech VPT	Static/dynamic balance/gait exercises altering visual, somatosensory and visual inputs, Herdman 2003 GSE protocol	2x/week, 30-45 min	EXP: HMD VR 20 min/day EXP/CON: 2x/day, total 30-40 min/day	4	EXP: ABC, DHI, vHIT gain and some posturography measures improved and maintained for 12 months
Micarelli 2019 ¹⁸⁷ ; II	EXP: Low Tech VPT plus HMD immersive VR CON: Low Tech VPT	Static/dynamic balance/gait exercises altering visual, somatosensory and visual inputs, Herdman 2003 GSE protocol	2x/week, 30-45 min	EXP: HMD VR 20 min/day EXP/CON: 2x/day, total 30-40 minutes/day	4	EXP Groups (with and without MCI): improved in VOR gain, DGI and static posturography measures compared to controls
OPTOKINETIC STIMULUS						
Loader 2007 ¹⁷² ; I	EXP: OKS (standing) CON: No treatment	EXP: Standing, reading randomly projected moving texts	EXP: 3x/week, 30 min CON: no treatment	None	3	EXP: SOT SOT-4, SOT-6, and Composite score improved; EXP significantly better on SOT-

						1, SOT-6, SOT composite than EXP
Pavlou 2004 ¹⁹¹ ; I	EXP: Low Tech VPT plus OKS CON: VPT	EXP: OKS exposure while sitting, standing, walking, tandem walking CON: Customized VPT	EXP: 2x/week, 60 min CON: 2x/week, 60 min	EXP: OKS 26 min/day CON: 12 to 30 min/day	8	Composite SOT improved in both groups with greater improvements in EXP group
Rossi-Izquierdo 2011 ¹⁹⁹ ; I	EXP: OKS CON: CDP	EXP: Standing with OKS planetarium, varied stimulation planes CON: Ten CDP exercises: weight shifting, changing visual surround, moving platform	EXP: 5x/week, 5 to 15 min/day CON: 5x/week, 15-20 min	None	1	EXP: Visual preference SOT scores improved; CON: Vestibular and somatosensory preference SOT scores improved
AUGMENTED SENSORY FEEDBACK						
Bao 2017 ¹⁶⁶ ; II	EXP: Balance exercises plus trunk vibrotactile CON: Balance exercises	6 reps of each training task each for 30 seconds. Stand on firm/foam EO/EC, with/without head movement, walk with head turns, Tandem gait, VORx1	3x/week, 18 min/day	None	6	Mini-BESTest, SOT, Gait Speed, DGI, FGA did not significantly improve in either group

Basta 2017 ¹³² ; II	EXP: Balance exercises plus trunk vibrotactile and medication CON: Balance exercises plus trunk vibrotactile no medication	5 reps of each training task, 20 seconds each; EO/EC Stance on firm/foam, SLS, marching, Tandem gait, walk with head turns	5x/week, 10 min/day (10 sessions total)	None	2	EXP/CON: Significant improvement in SOT, DHI
Coehlo 2020 ¹⁸⁹ ; I	EXP1: Balance + Anchors (haptic support); EXP2: Balance, no Anchors CON: No treatment	EXP1/2: Standing altering foot position, weight shifting; walking: obstacles, tandem, with eye movements CON: no treatment	EXP1: 2x/week, 40 min EXP2: 2x/week, 40 min	No HEP	6	EXP1, EXP2 (with/without anchors): Mini-BESTest, gait speed improved. Only anchor group maintained findings at 3 months
Nardone 2010 ²⁰¹ ; I	EXP: Horizontal perturbation CON: Cawthorne-Cooksey; Cross-over design	EXP: Balance on oscillating platform, EO/EC, two frequencies, two orientations (A/P, M/L) CON: Cawthorne- Cooksey	EXP: 5 days, 2 x/day, 24 min/session CON: 5 days, 2x/day, 30 min each	None	2	EXP/CON: POMA scores improved after initial intervention. EXP/CON: decreased body sway after both interventions

Winkler 2011 ²⁰⁰ ; I	EXP1: Perturbation tilts EXP2: Perturbation tilts + HEP CON: HEP	EXP1: 10 perturbation tilts, 30 secs each (5 EO/5 EC). EXP2: 10 perturbation tilts, 30 secs each (5 EO/5 EC). GSE, Balance CON HEP: GSE, balance exercises	EXP1, EXP2: 3x/week, 5 min/day (20-25 min contact time/session) CON: 1x/week, 45 min	EXP 1: no HEP EXP2: 3x/day, 15-21 min/day CON: 3x/day, 15-21 min/day	3	EXP1, EXP2: DHI, DGI, Patient Specific Functional Scale and gait improved; CON: DHI improved
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ABC: Activities-specific Balance Confidence scale; A/P: anterior-posterior; BBS: Berg Balance Scale; BESTest: Balance Evaluation Systems Test; CDP: computerized dynamic posturography; CON: control group; DGI: Dynamic Gait Index; DHI: Dizziness Handicap Inventory; EC: eyes closed; EO: eyes open; EXP(1,2): experimental group (1, 2); FGA: Functional Gait Assessment; GSE: gaze stabilization exercises; HEP: home exercise program; HMD: head-mounted device; LOE: level of evidence; MCI: mild cognitive impairment; mCTSIB: modified Clinical Test of Sensory Interaction on Balance; M/L: medial-lateral; OKS: optokinetic stimulation; POMA: Performance Oriented Mobility Assessment; SLS: Single Leg Stance test; SOT: Sensory Organization Test; TUG: Timed Up and Go test; UVH: unilateral vestibular hypofunction; vHIT: video head impulse test; VOR: vestibulo-ocular reflex; VPT: vestibular physical therapy; VR: virtual reality