Vestibular Rehabilitation for Peripheral Vestibular Hypofunction: An Evidence-based Clinical Practice Guideline

From the American Physical Therapy Association Neurology Section

Authors: Courtney D. Hall, P.T. Ph.D.[1,2]; Susan J. Herdman, P.T. Ph.D., FAPTA [3] Susan L. Whitney, P.T., ATC, Ph.D., FAPTA[4,5]; Stephen P. Cass, M.D., M.P.H.[6]; Richard A. Clendaniel, P.T., Ph.D.[7]; Terry D. Fife, M.D., FAAN, FANS[8,9] Joseph M. Furman, M.D., Ph.D.[10]; Thomas S. D. Getchius, B.A.[11]; Joel A. Goebel, M.D.[12]; Neil T. Shepard, Ph.D.[13] Sheelah N. Woodhouse, P.T., B.Sc.P.T.[14,15]

[1] Research Health Scientist, Auditory Vestibular Research Enhancement Award Program, Mountain Home VAMC, Mountain Home, TN

[2] Associate Professor, Department of Physical Therapy, East Tennessee State University

[3] Professor Emerita, Emory University School of Medicine, Atlanta, GA

[4] Professor, Department of Physical Therapy, University of Pittsburgh, Pittsburgh, PA

[5] Professor, Otolaryngology, Department of Medicine, University of Pittsburgh, Pittsburgh, PA

[6] Professor, Department of Otolaryngology, University of Colorado School of Medicine

[7] Assistant Professor, Department of Community and Family Medicine, Doctor of Physical Therapy Division, Duke University Medical Center

[8] Vice Chairman and Director, Balance Disorders and Vestibular Neurology, Barrow Neurological Institute

[9] Professor of Neurology, University of Arizona College of Medicine

[10] Professor, Department of Otolaryngology, University of Pittsburgh

[11] Director, Clinical Practice, American Academy of Neurology, Minneapolis, MN

[12] Professor and Vice Chairman, Director, Dizziness and Balance Center, Department of Otolaryngology- Head and Neck Surgery, Washington University School of Medicine, St. Louis, MO

[13] Professor and Chair, Audiology and Director, Dizziness and Balance Disorders Program, Mayo Clinical School of Medicine, Rochester, MN

[14] National Director of Vestibular Rehabilitation for LifeMark and Centric Health, Alberta, Canada

[15] President, Vestibular Disorders Association, vestibular.org

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ABSTRACT

Background: Uncompensated vestibular hypofunction results in postural instability, visual blurring with head movement, and subjective complaints of dizziness and/or imbalance. We sought to answer the question, "Is vestibular exercise effective at enhancing recovery of function in people with peripheral vestibular hypofunction?"

Methods: A systematic review of the literature was performed in five databases published after 1985 and five additional sources for relevant publications were searched. Article types included meta-analyses, systematic reviews, randomized controlled trials, cohort studies, case control series, and case series for human subjects, published in English. Seventy articles were identified as relevant to this clinical practice guideline.

Results/Discussion: Based on strong evidence and a preponderance of benefit over harm, clinicians should offer vestibular physical therapy to persons with unilateral and bilateral vestibular hypofunction with impairments and functional limitations related to the vestibular deficit. Based on strong evidence and a preponderance of harm over benefit, clinicians should not include voluntary saccadic or smooth-pursuit eye movements as a component of vestibular physical therapy or as an alternative for gaze stability exercises, which have strong evidence of effectiveness. Based on moderate evidence, clinicians may offer specific exercise techniques to target identified impairments or functional limitations. Based on moderate evidence and in consideration of patient preference, clinicians may provide supervised vestibular physical therapy. Based on expert opinion extrapolated from the evidence, clinicians may prescribe a minimum of three times per day for the performance of gaze stability exercises as one component of a home exercise program. Based on expert opinion extrapolated from the evidence (range of supervised visits: 2-38 weeks, mean = 10 weeks), clinicians may consider providing enough supervised vestibular physical therapy sessions for the patient to understand the goals of the program and how to manage and progress independently. As a general guide, persons without significant comorbidities that affect mobility and with acute or subacute unilateral vestibular hypofunction (UVH) may need 2-3 supervised sessions; persons with chronic UVH may need 4-6 weekly sessions;

persons with bilateral vestibular hypofunction may need a longer course of treatment (8-12 weekly sessions) than persons with UVH.

Disclaimer: These guidelines are intended to guide physical therapists and clinicians in optimizing rehabilitation outcomes for persons with vestibular hypofunction undergoing vestibular physical therapy.

LEVELS OF EVIDENCE AND GRADE OF RECOMMENDATIONS

This clinical practice guideline is intended to optimize rehabilitation outcomes for persons with vestibular hypofunction undergoing vestibular physical therapy. As such, the intention of the guideline is to provide guidance to vestibular physical therapists. The clinician should interpret the guidelines in the context of their specific clinical practice, patient situation and preference, as well as the potential for harm.

The methods of critical appraisal, assigning levels of evidence to the literature and assigning level of strength to the recommendations follow accepted international methodologies of evidence-based practice. The guideline is organized to present the definitions of the levels of evidence and grades for action statements (Tables 1 and 2), the summary of 10 action statements, followed by the description of each action statement with a standardized profile of information that meets the Institute of Medicine's criteria for transparent clinical practice guidelines. Recommendations for research are also made in the text.

Each research article was graded based on criteria from the Centre for Evidence-based Medicine criteria from 2009 to determine the level of evidence of intervention studies (Table 1). Levels 1 and 2 differentiate stronger from weaker studies by evaluating the research design and quality of study execution and reporting using key questions adapted from Fetters and Tilson.[1] The criteria for the grades of recommendation assigned to each action statement are provided in Table 2. The grade reflects the overall and highest levels of evidence available to support the action statement. Throughout the guideline, each action statement is preceded by a letter grade indicating the strength of the recommendation, followed by the statement and summary of the supporting evidence.

Table 1. Level of evidence

I	Evidence obtained from high-quality (≥ 50% critical appraisal score) diagnostic studies, prospective studies, or randomized controlled trials
II	Evidence obtained from lesser quality (< 50% critical appraisal score) diagnostic studies, prospective studies, or randomized controlled trials
III	Case-controlled studies or retrospective studies
IV	Case study or case series
V	Expert opinion

Table 2. Grades of Recommendations

GRADE	RECOMMENDATION	STRENGTH OF RECOMMENDATION
A	Strong evidence	A preponderance of Level I and/or Level II studies support the guidelines. This must include at least one Level I study.
B	Moderate evidence	A single high quality RCT or a preponderance of Level II evidence.
C	Weak evidence	A single Level II Study or a preponderance of Level III and IV studies.
D	Expert opinion	Best practice based on the clinical experience of the guideline development team and guided by the evidence, which may be conflicting. Where higher quality studies disagree with respect to their conclusions, it may be possible to come to agreement on certain aspects of intervention (e.g., variations in treatment/diagnostic test, population or setting that may account for conflict).

SUMMARY OF ACTION STATEMENTS*

Physical Therapy Intervention for Persons with Peripheral Vestibular Hypofunction

A. Action Statement 1: EFFECTIVENESS OF VESTIBULAR PHYSICAL THERAPY IN PERSONS WITH ACUTE AND SUBACUTE UNILATERAL VESTIBULAR HYPOFUNCTION (UVH). Clinicians should offer vestibular rehabilitation to patients with acute or subacute unilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong)

A. Action Statement 2: EFFECTIVENESS OF VESTIBULAR REHABILITATION IN PERSONS WITH CHRONIC UNILATERAL VESTIBULAR HYPOFUNCTION (UVH). Clinicians should offer vestibular rehabilitation to patients with chronic unilateral vestibular loss. Evidence quality: I; Recommendation Strength: Strong).

A. Action Statement 3: EFFECTIVENESS OF VESTIBULAR REHABILITATION IN PERSONS WITH BILATERAL VESTIBULAR HYPOFUNCTION (BVH). Clinicians should offer vestibular rehabilitation to patients with bilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong).

A. Action Statement 4: EFFECTIVENESS OF SACCADIC OR SMOOTH-PURSUIT EXERCISES IN PERSONS WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL OR BILATERAL). Clinicians should not offer saccadic or smooth-pursuit exercises to patients with unilateral or bilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong)

B. Action Statement 5: EFFECTIVENESS OF DIFFERENT TYPES OF EXERCISES IN PERSONS WITH ACUTE OR CHRONIC UVH. Based on moderate strength of evidence, clinicians may provide targeted exercise techniques to accomplish specific goals appropriate to address identified impairments and functional limitations (e.g., exercises related to gaze stability and visual motion sensitivity for improved stability of the visual world and decreased sensitivity to visual motion; head movements in a habituation format to decrease sensitivity to head movement provoked symptoms; activities related to body sway control for improved general stance and gait). (Evidence quality: II; Recommendation Strength: Moderate)

B. Action Statement 6. EFFECTIVENESS OF SUPERVISED VESTIBULAR PHYSICAL THERAPY. Clinicians may offer supervised vestibular physical therapy to patients with unilateral or bilateral peripheral vestibular hypofunction. (Evidence quality: I - III; Recommendation Strength: Moderate)

D. Action Statement 7. EVIDENCE FOR OPTIMAL EXERCISE DOSE OF TREATMENT IN PEOPLE WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL AND BILATERAL). Based on extrapolation from the evidence and expert opinion, physical therapists may prescribe a minimum of 3 times per day for a total of 20 minutes daily of gaze stability exercises to induce recovery of function. (Evidence Quality: V; Recommendation Strength: Expert opinion)

Physical Therapy Discharge Planning for Persons with Peripheral Vestibular Hypofunction

D. Action Statement 8: DECISION RULES FOR STOPPING VESTIBULAR PHYSICAL THERAPY IN PEOPLE WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL AND BILATERAL). Based on extrapolation from the evidence and expert opinion, physical therapists may use achievement of primary goals, resolution of symptoms, or plateau in progress as reasons for stopping therapy. (Evidence Quality: V; Recommendation Strength: Expert opinion)

C. Action Statement 9: FACTORS THAT MODIFY REHABILITATION OUTCOMES. Based on weak to strong evidence, physical therapists may evaluate factors that could modify rehabilitation outcomes. (Evidence quality: I-III; Recommendation Strength: Weak to Strong)

A. Action Statement 10: THE HARM/BENEFIT RATIO FOR VESTIBULAR PHYSICAL THERAPY IN TERMS OF QUALITY OF LIFE/ PSYCHOLOGICAL STRESS. Based on strong evidence and a preponderance of benefit over psychological harm, clinicians should offer vestibular physical therapy for persons with peripheral vestibular hypofunction. (Evidence quality: Level I-III; Recommendation Strength: Strong)

*These recommendations and clinical practice guidelines are based on the scientific literature published between 1985 and February 2015.

INTRODUCTION

Purpose of CPGs

The Neurology Section of the American Physical Therapy Association (APTA) supports the development of clinical practice guidelines (CPGs) to assist physical therapists (PTs) with the treatment of persons with peripheral vestibular hypofunction in order to optimize rehabilitation outcomes. Generally, the purpose of CPGs is the help PTs know who, what, how and when to treat. Specifically, the purpose of this CPG for peripheral vestibular hypofunction is to describe the evidence supporting vestibular physical therapy including interventions supported by current best evidence and discharge planning. Furthermore, this CPG identifies areas of research that are needed to improve the evidence base for physical therapy management of peripheral vestibular hypofunction.

This CPG seeks to answer the question of whether exercise is effective at enhancing recovery of function in people with peripheral vestibular hypofunction. The primary purpose of this CPG is to systematically assess the peer-reviewed literature and make recommendations based on the quality of the research for the treatment of peripheral vestibular hypofunction. A secondary purpose of this CPG is to provide recommendations to reduce unwarranted variation in care and to ensure that exercise interventions provided by physical therapists for vestibular hypofunction are consistent with current best practice. Currently, the type of exercises prescribed by therapists for patients with vestibular hypofunction varies widely and does not necessarily follow interventions supported by current best evidence. Finally, it is hoped that this CPG will serve to reduce unnecessary delays (> 1 year in some cases) in referring appropriate patients with vestibular hypofunction for vestibular physical therapy.[2]

Background and Need for a CPG on Vestibular Rehabilitation in Persons with Peripheral Vestibular Hypofunction

Uncompensated vestibular hypofunction results in postural instability, visual blurring with head movement, and subjective complaints of dizziness and/or imbalance. Based on data from the National Health and Nutrition Examination Survey (NHANES) for 2001-2004, it is estimated that 35.4% of adults in the U.S. have vestibular dysfunction requiring medical attention and the incidence increases with age.[3] Appropriate treatment is critical because dizziness is a major risk factor for falls: the incidence of falls is greater in individuals with vestibular hypofunction than in healthy individuals of the same age living in the community.[4] The direct and indirect medical costs of fall-related injuries are enormous.[5,6]

Data from the NHANES trial suggests that 35.4% of Americans 40 years of age or older (or 69 million people) have some type of vestibular dysfunction.[3] The precise incidence and prevalence of peripheral vestibular hypofunction is difficult to ascertain. The reported incidence of vestibular neuritis, a common etiology underlying vestibular hypofunction, is approximately 15 per 100,000 people.[7,8] Based on a meta-analysis of published studies, Kroenke et al. estimated that 9% of the approximately 7 million clinic visits (or 630,000 clinic visits) each year for dizziness are due to vestibular neuritis or labyrinthitis.[9] However, this figure does not include etiologies such as vestibular schwannoma or bilateral vestibular loss and, therefore, underestimates the number of people with peripheral vestibular hypofunction. Although vestibular dysfunction is less common in children, 20 - 70% of all children with sensorineural hearing loss also have vestibular loss.[10-12]

The NHANES trial also revealed that vestibular dysfunction escalates with increasing age such that nearly 85% of people age 80 years and older have vestibular dysfunction.[3] According to Dillon et al. the prevalence of balance (vestibular and sensory loss in feet) impairment in persons over the age of 70 years is 75%.[13] Additionally, people with vestibular disorders were reported to have an eight-fold increase in their risk of falling, which is of concern because of the morbidity and mortality associated with falls.[3,5] In the 2008 Balance and Dizziness Supplement to the US National Health Interview Survey, the prevalence of bilateral vestibular hypofunction (BVH) was reported to be 28 per 100,000 US adults (or 64,046 Americans).[14] Of the respondents with BVH, 44% had changed their driving habits, and approximately 55% reported reduced participation in social activities and difficulties with activities of daily living. Persons with BVH had a 31-fold increase in the odds of falling compared with all respondents. Additionally, 25% reported a recent fall-related injury. The Centers for Disease Control and Prevention report the cost of falls in 2000 exceeded $19 billion, and that cost is projected to skyrocket to almost $55 billion per year by the year 2020.[15] Cost-effective treatments that can reduce the risk for falling, therefore can reduce overall healthcare costs as well as the cost to personal independence and functional decline of patients with vestibular dysfunction.

Physical therapy interventions to address the signs, symptoms and functional limitations secondary to vestibular deficits (which will be referred to as vestibular physical therapy, VPT, in the rest of the manuscript) have been shown to decrease dizziness, improve postural stability thus reducing fall risk, and improve visual acuity during head movement in individuals with vestibular hypofunction.[16-23] A newly-revised Cochrane Database Systematic Review published in 2015 concluded that there is moderate to strong evidence in support of vestibular rehabilitation in the management of patients with UVH, specifically for reducing symptoms and improving function.[24] A recent systematic review concluded that there is moderate evidence to support the effectiveness of vestibular exercises in individuals with BVH for improving gaze and postural stability.[25]

At the time of submission, there are no clinical practice guidelines for the treatment of peripheral vestibular hypofunction. The 2015 Cochrane review of the treatment of vestibular hypofunction included etiologies such as benign paroxysmal positional vertigo (BPPV), for which there are already two CPGs from the American Academy of Neurology[26] and the American Academy of Otolaryngology - Head and Neck Surgery Foundation.[27] It was determined that a CPG to address appropriate vestibular exercise options for use with patients with unilateral and bilateral peripheral vestibular hypofunction was appropriate.

Statement of Intent

This guideline is intended for clinicians, family members, educators, researchers, policy makers and payers. It is not intended to be construed or to serve as a legal standard of care. As rehabilitation knowledge expands, clinical guidelines are promoted as syntheses of current research and provisional proposals of recommended actions under specific conditions. Standards of care are determined on the basis of all clinical data available for an individual patient/client and are subject to change as knowledge and technology advance, patterns of care evolve, and patient/family values are integrated. This CPG is a summary of practice recommendations that are supported with current published literature that has been reviewed by expert practitioners and other stakeholders. These parameters of practice should be considered guidelines only, not mandates. Adherence to them will not ensure a successful outcome in every patient, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate decision regarding a particular clinical procedure or treatment plan must be made using the clinical data presented by the patient/client/family, the diagnostic and treatment options available, the patient's values, expectations and preferences, and the clinician's scope of practice and expertise. However, we suggest that significant departures from accepted guidelines should be documented in patient records at the time the relevant clinical decisions are made.

METHODS

The vestibular guideline Workgroup (CDH, SJH, SLW) proposed the topic to the APTA and Neurology Section and was accepted to attend the APTA Workshop on Developing Clinical Practice Guidelines in July, 2012. The Workgroup submitted and received 3-year grant funding from APTA to support guideline development in October, 2012. The Workgroup solicited members to form an expert multidisciplinary (Audiology, ENT, Neurology, Patient Representative, Physical Therapy) Advisory Board who are actively involved in the management of patients with vestibular dysfunction. The first Advisory Board call took place in January, 2013 and four subsequent conference calls occurred over the following two years. The Advisory Board was intimately involved in development of the content and scope of the guideline with key questions to be answered, determination of articles for inclusion in the CPG, and writing/critical edits of the CPG.

Literature search

A systematic review of the literature was performed by the academic librarians from East Tennessee State University (Nakia Woodward, MSIS, AHIP; Richard Wallace, MSLS, EdD, AHIP), Emory University (Amy Allison, MLS, AHIP), and University of Pittsburgh (Linda Hartman, MLS, AHIP) in collaboration with the workgroup (Hall, Herdman, Whitney). The searches included the following databases: PubMed, CINAHL, EMBASE, Web of Science and Cochrane Library. The original PICO question was framed as, “Is exercise effective at enhancing recovery of function in people with peripheral vestibular hypofunction?”. The search query in PubMed, EMBASE and Web of Science combined terms from the concept sets of patient population (with peripheral vestibular hypofunction), intervention (exercise) and outcomes (based on ICF model) to retrieve all article records that include at least one term from each set below (Table 3). The search query for Cochrane Library included (vertigo OR vestibular) AND exercise.

Table 3. The search query combined terms from the following concept sets (patient population, intervention, outcome) to retrieve all articles that included at least one term from each set (i.e., Patient population AND Intervention AND outcome).

Patient population set
Peripheral vestibular (hypofunction OR loss) Vestibular system vestibular labyrinth Vestibular nervous system vestibular nerve vestibular nucleus vestibulocochlear nerve benign paroxysmal positional vertigo inner ear labyrinth disease vestibular disease Labyrinth Vestibule Vestibulum Auris Ear Vestibule Vestibular Apparatus Oval Window AND ear Saccule AND Utricle Acoustic Maculae Vestibular Aqueduct dizziness
Intervention set
Exercise Visual-vestibular interaction adaptation exercises substitution exercises habituation exercises
Outcome set
balance gait quality of life position falls

In addition, websites of agencies and organizations that produce guidelines and/or systematic reviews on clinical medicine were searched for relevant publications. These included: 1) Canada, Health Evidence; 2) UK, National Institute for Clinical Excellence; 3) US, Agency for Healthcare Research and Quality; 4) National Guidelines Clearinghouse; 5) ClinicalTrials.gov. The government agencies and websites produced only duplicates that were removed.

The study types included were: meta-analyses, systematic reviews, randomized controlled trials, cohort studies, case control studies and case series/studies. Inclusion criteria for articles included: human subjects, published in English, published after 1985. Exclusion criteria included: superior canal dehiscence, blindness, primary diagnosis of BPPV, migraine, central vestibular disorder, central nervous system pathology (PD, MS, stroke, cerebellar ataxia).

The initial systematic search was performed in March 2013 and 1540 potential articles were identified (Figure 1a). Identification of relevant studies involved a 3-step process: 1) a title/abstract review where obviously irrelevant articles were removed; 2) a full text article review using the inclusion/exclusion criteria; and 3) review article reference lists were searched for relevant, missed articles. After duplicates were removed (n = 778), 762 article titles and abstracts were each reviewed by two members of the workgroup (Hall, Herdman, Whitney) to exclude obviously irrelevant ones. In the case of disagreement, a third member reviewed the article title and abstract to arbitrate. On the basis of the title and abstract, 13 articles were excluded because of language (not English) and 567 were excluded because of irrelevance to the topic; thus, 182 full text articles were reviewed. In addition, review article reference lists were searched for relevant, missed articles by a graduate assistant and 13 additional articles were identified. Each full text article was examined by two reviewers from the Workgroup and Advisory Board using the inclusion/exclusion criteria. On the basis of the full text article, 121 articles were identified as relevant to the CPG.

A follow-up literature search following the same strategy was performed in February of 2015, and 573 articles were identified. After duplicates were removed (n = 2), 539 article titles and abstracts were each reviewed by two members of the Workgroup (Hall, Herdman, Whitney) to exclude obviously irrelevant ones. On the basis of the title and abstract, 16 articles were excluded because of language (not English) and 499 were excluded because of irrelevance to the topic; thus, 24 full text articles were reviewed. On the basis of the full text article, 14 articles were identified as relevant to the CPG.

Figure 1a. Flowchart of initial identification of relevant articles from 1985 through March 2013

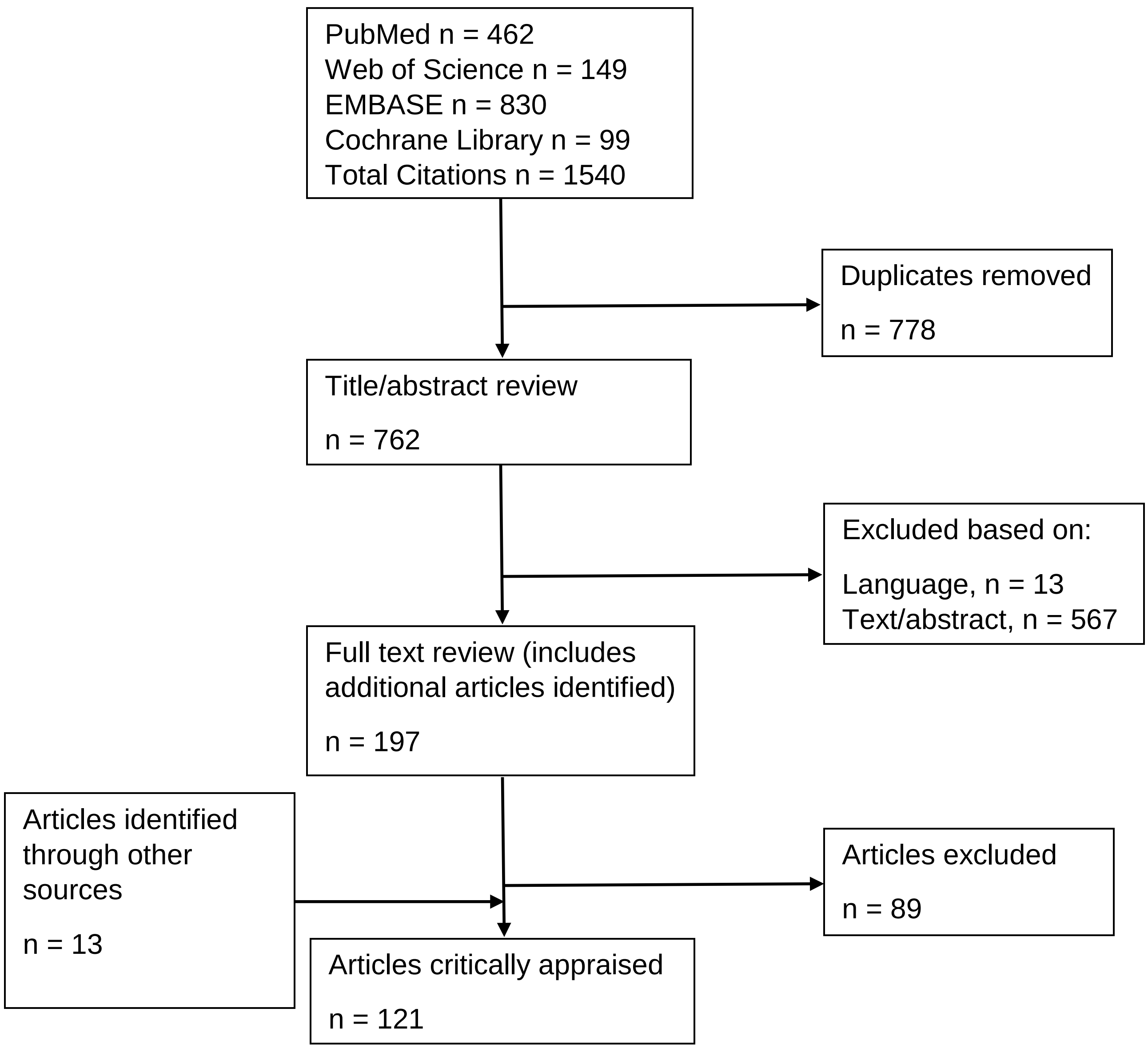
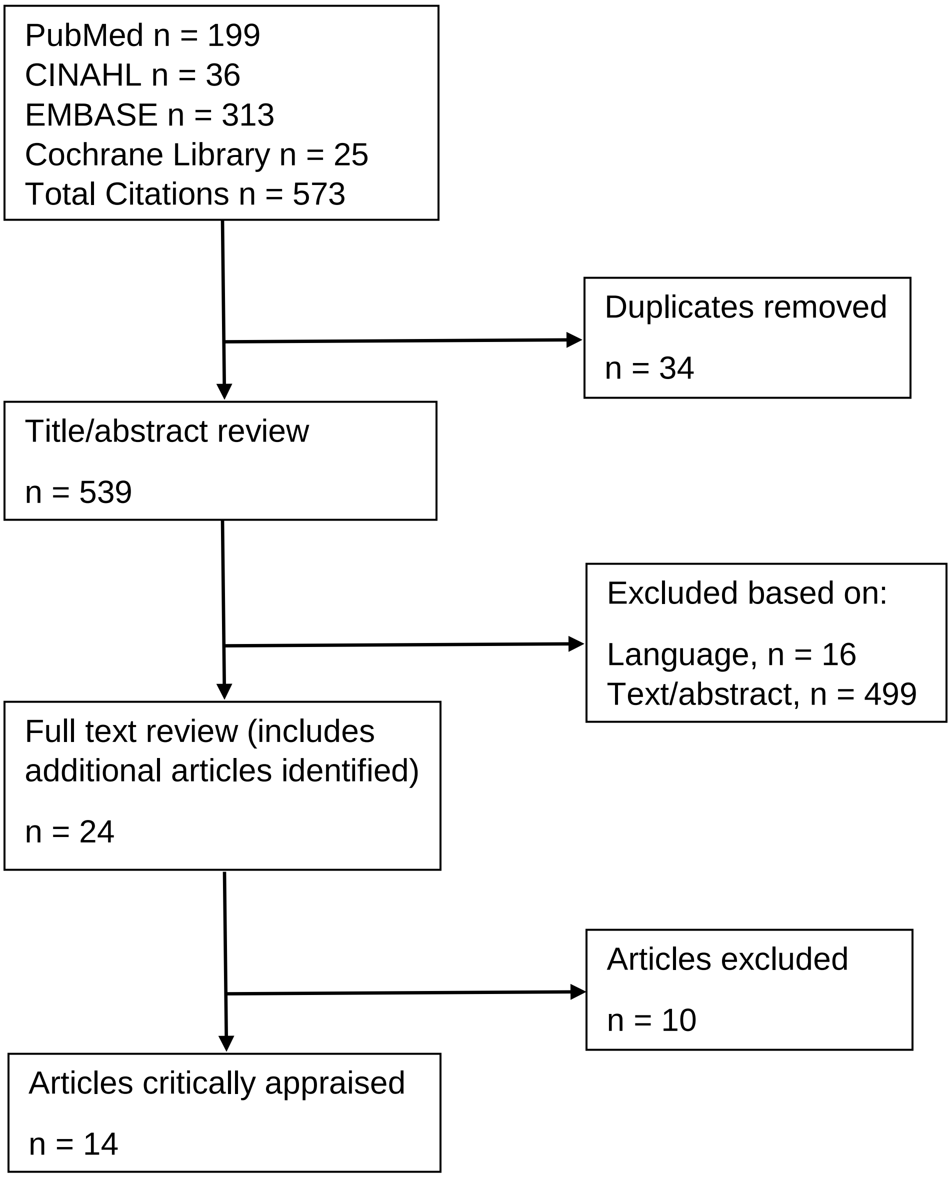


Figure 1b. Flowchart of identification of additional relevant articles through February 2015



Critical appraisals of articles

Volunteers were recruited from the Neurology Section and Vestibular Special Interest Group using an on-line "Call for Volunteers" to provide critical appraisals of the articles identified as being relevant to this CPG. Two, face-to-face training sessions (4 hours at the American Physical Therapy Association Combined Section Meeting, CSM, in 2013 and 2 hours at CSM in 2014) were provided by the Workgroup to this critical appraisal team. Critical appraisers performed two practice appraisals and were compared to scoring of the Workgroup. Critical appraisals and study characteristics extractions from each article were performed by two reviewers from Neurology Section or Vestibular SIG who had been identified as reliable and valid critical appraisers ($\geq$ 80% agreement with the Workgroup). The information was entered into an electronic data extraction form. Disagreement was resolved by consensus among the Workgroup.

Diagnostic considerations

The focus of this CPG is on the treatment of peripheral vestibular hypofunction; thus, studies where the patient group involved primarily central involvement (e.g., traumatic brain injury, concussion, multiple sclerosis, Parkinson's disease) were excluded. Studies in which the patient group involved primarily benign paroxysmal positional vertigo (BPPV) were excluded; whereas, studies that included individuals with BPPV in addition to peripheral vestibular hypofunction were included. Specific diagnoses such as Meniere's disease (for diagnostic criteria see Lopez-Escamez et al.[28]) or vestibular neuritis were included, but were not part of the search strategy.

Treatment approach

The primary approach to the management of patients with peripheral vestibular hypofunction is exercise-based. Whereas management of the patient in the acute stage following vestibular neuritis or labyrinthitis may include medications, such as vestibular suppressants or anti-emetics, the evidence does not support medication use for management of the chronic patient.[21] A surgical or ablative approach is limited to patients who have recurrent vertigo or fluctuating vestibular function and symptoms that cannot be controlled by other methods, such as lifestyle modifications or medication. The goal of the ablative approach is to convert a fluctuating deficit into a stable deficit to facilitate central vestibular compensation for unilateral vestibular hypofunction.[29]

The original vestibular exercises were developed by Cawthorne and Cooksey in the 1940s.[30] Cawthorne-Cooksey exercises are a general approach to vestibular rehabilitation and involve a standardized series of exercises that involve a progression of eye movements only, head movements with eyes open or closed, bending over, sit-stand, tossing a ball, and walking (Cooksey, 1946).

Current vestibular physical therapy is an exercise-based approach that typically includes a combination of four different exercise components to address the impairments and functional limitations identified during evaluation: 1) exercises to promote gaze stability (gaze stability exercises), 2) exercises to habituate symptoms (habituation exercises), 3) exercises to improve balance and gait (balance and gait training), and 4) walking for endurance.

<u>Gaze stability</u> exercises were developed based on the concepts of vestibulo-ocular reflex (VOR) adaptation and substitution (and are commonly referred to as adaptation exercises and substitution exercises). Adaptation refers to long-term change in the neuronal response to head movements with the goal of reducing symptoms and normalizing gaze and postural stability. Gaze stability exercises are based on the assumption that they promote vestibular adaptation and involve head movement while maintaining focus on a target, which may be stationary or moving. These exercises are referred to as VORx1 when the target remains stationary and may be performed at a near or far distance. These exercises are referred to as VORx2 when the target moves in the opposite direction of the head movement. Gaze stability exercises based on the principles of substitution were developed with the goal of promoting alternative strategies (e.g., use of cervical ocular reflex, smooth-pursuit eye movements, or central pre-programming of eye movements) to substitute for missing vestibular function. For example, during active eye-head exercise between targets, a large eye movement to a

target is made prior to the head moving to face the target, potentially facilitating use of preprogrammed eye movements.

Habituation as a treatment approach involves repeated exposure to the specific stimulus that provokes dizziness. Habituation exercises are chosen based on particular movements or situations (e.g., busy visual environments) that provoke symptoms. One approach is to have the individual perform several repetitions of 2 to 3 of the body or visual motions that caused mild to moderate symptoms on evaluation. This systematic repetition of provocative movements leads to a reduction in symptoms. More recent approaches involve the use of optokinetic (OK) stimuli or virtual reality environments as habituation exercises. Optokinetic stimuli involves the use of moving repeated patterns and virtual reality immerses patients in realistic, visually challenging environments and both are used to address visual motion sensitivity (also known as visual vertigo, space and motion discomfort, and visually induced dizziness). Both approaches use stimuli that can be graded in intensity through manipulation of stimulus parameters such as velocity, direction of stimulus motion, size/color of stimulus and instructions to participant. The stimulus may be provided via high-tech equipment, such as optokinetic discs, moving rooms or virtual reality, or lower tech equipment, such as busy screen savers on a computer or videos of busy visual environments.

Balance and gait training under challenging sensory and dynamic conditions are typically included as part of vestibular rehabilitation. These exercises are intended to facilitate use of visual and/or somatosensory cues to substitute for missing vestibular function. Balance exercises include balancing under conditions of altered visual (e.g., vision distracted or removed) and/or somatosensory input (e.g., foam or moving surfaces) and may involve changes in the base of support (e.g., Romberg, tandem, single leg stance) to increase the challenge. Weight shifting in stance is used to improve center of gravity control and balance recovery. Gait exercises involve dynamic conditions and may include walking with head turns or performing a secondary task while walking. Equipment is available that can augment balance and gait training such as gaming technology, optokinetic drums and virtual reality systems.

General conditioning, such as walking for endurance or aerobic exercise, is frequently an element of rehabilitation because people with peripheral vestibular dysfunction often limit physical activity to avoid symptom provocation. General conditioning exercise by itself has not been found to be beneficial in patients with vestibular hypofunction.[21,22]

Outcome Measures

A variety of outcome measures have been utilized to assess the impact of vestibular dysfunction; however, there is no consensus as to what aspects should be measured. An international group of investigators and healthcare providers developed a core set of measures to be used to assess patients with vertigo and dizziness to describe functioning.[31] The core set of measures include both subjective complaints and physical function and have been organized based on the International Classification of Functioning, Disability and Health (ICF) model (Tables 4a-c). The specific domains of the ICF include: 1) body function and structure (body level); 2) activity (individual level); 3) participation (societal level). In addition, the ICF model considers environmental contributions.

Recommendations for specific rehabilitation outcome measures to be used in the assessment of individuals with vestibular dysfunction have been made by the Vestibular Evidence Database to Guide Effectiveness (VEDGE) task force. They used a modified Delphi process to identify and select recommended measures. The VEDGE recommendations are available online at http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/vestibular-disorders. We provide a summary of recommended measures categorized according to the ICF model (Table 5).

Table 4a. International Classification of Functioning, Disability and Health (ICF) categories of the component Body Functions and Structures included in the Vertigo Comprehensive Core Set. The Comprehensive ICF Core Set is designed to serve as a basis for full assessment and documentation. Categories are denoted as follows: b for Body Functions, s for Body Structures, d for Activities and Participation. Categories marked with * were included in the Brief Core Set. The Brief ICF Core Set is a short list of categories and is the minimal standard for assessment and description of functioning and disability. (Adapted with permission: Grill E, Bronstein A, Furman J, Zee DS and Muller. International Classification of Functioning, Disability and Health (ICF) Core Set for patients with vertigo, dizziness and balance disorders. J Vestib Res. 2012;22:261-271.)

ICF Category: Body Functions	Description
Chapter: Mental functions	
b126	Temperament and personality functions
b130	Energy and drive functions
b134	Sleep functions
b140	Attention functions
b144	Memory functions
b152	Emotional functions*
b156	Perceptual functions*
b180	Experience of self and time functions
Chapter: Sensory functions and pain	
b210	Seeing functions*
b215	Functions of structures adjoining the eye*
b230	Hearing functions*
b235	Vestibular functions*
b240	Sensations associated with hearing and vestibular function*
b260	Proprioceptive function*
b265	Touch function
b280	Sensation of pain
Chapter: Functions of the cardiovascular, hematological, immunological and respiratory systems	
b410	Heart functions
b420	Blood pressure functions
b455	Exercise tolerance functions
b460	Sensations associated with cardiovascular and respiratory functions
Chapter: Neuromusculoskeletal and movement-related functions	
b710	Mobility of joint functions
b730	Muscle power functions
b735	Muscle tone functions
b760	Control of voluntary movement functions
b770	Gait pattern functions*

ICF Category: Body Structure	
Chapter: nervous system	
s110	Structure of brain*
s120	Spinal cord and related structures*
Chapter: The eye, ear and related structures	
s260	Structure of inner ear*
Chapter: Structures of the cardiovascular, immunological and respiratory systems	
s410	Structure of cardiovascular system*
Chapter: Structures related to movement	
s710	Structure of head and neck region
s750	Structure of lower extremity

* Brief Core Set

Table 4b. ICF Categories of the component Activities and Participation included in the Vertigo Comprehensive Core Set.

ICF Category: Activities and Participation	Description
Chapter: Learning and applying knowledge	
d110	Watching
d115	Listening
d160	Focusing attention
d166	Reading
Chapter: General tasks and demands	
d220	Undertaking multiple tasks
d230	Carrying out daily routine*
d240	Handling stress and other psychological demands
Chapter: Communication	
d350	Conversation
d360	Using communication devices and techniques
Chapter: Mobility	
d410	Changing basic body position*
d415	Maintaining a body position*
d420	Transferring oneself
d430	Lifting and carrying objects
d445	Hand and arm use
d450	Walking*
d455	Moving around*
d460	Moving around in different locations*
d465	Moving around using equipment
d469*	Walking and moving, other specified and unspecified*

d470	Using transportation
d475	Driving*
Chapter: Self-care	
d510	Washing oneself
d540	Dressing
Chapter: Domestic life	
d620	Acquisition of goods and services
d630	Preparing meals
d640	Doing housework*
d650	Caring for household objects
d660	Assisting others
Chapter: Interpersonal interactions and relationships	
d740	Formal relationships
d750	Informal social relationships
d760	Family relationships
d770	Intimate relationships
Chapter: Major life areas	
d825	Vocational training
d830	Higher education
(d840–d859) *Chapter: Work and employment*	
d845	Acquiring, keeping and terminating a job
d850	Remunerative employment
d855	Non-remunerative employment
Chapter: Community, social and civic life	
d910	Community life
d920	Recreation and leisure

* included in the Brief Core Set.

Table 4c. Categories of Environmental Factors that are included in the Vertigo Comprehensive Core Set.

ICF	Category description
Chapter: Products and technology	
e110	Products or substances for personal consumption*
e115	Products and technology for personal use in daily living
e120	Products and technology for personal indoor and outdoor mobility and transportation*
e125	Products and technology for communication
e150	Design, construction/ building products/ technology of buildings for public use
e155	Design, construction/ building products/ technology of buildings for private use
Chapter: Natural environment and human-made changes to environment	
e240	Light*
e250	Sound
e255	Vibration
Chapter: Support and relationships	
e310	Immediate family*
e315	Extended family
e320	Friends
e325	Acquaintances, peers, colleagues, neighbors and community members
e330	People in positions of authority
e340	Personal care providers and personal assistants
e355	Health professionals*
Chapter: Attitudes	
e410	Individual attitudes of immediate family members
e415	Individual attitudes of extended family members
e420	Individual attitudes of friends
e430	Individual attitudes of people in positions of authority
e440	Individual attitudes of personal care providers and personal assistants
e445	Individual attitudes of strangers
e450	Individual attitudes of health professionals
e460	Societal attitudes
Chapter: Services, systems and policies	
e515	Architecture and construction services, systems and policies
e540	Transportation services, systems and policies
e570	Social security services, systems and policies
e580	Health services, systems and policies*
e590	Labor and employment services, systems and policies

* included in the Brief Core Set.

Table 5. Summary of outcome measures recommended by the Vestibular Evidence Database to Guide Effectiveness (VEDGE) task force to assess symptoms, gaze and postural stability and participation for patients with vestibular hypofunction and organized based on the ICF model. Measures that were not recommended for use, diagnostic and positional testing are not included in this table. Details regarding recommendations are available online at http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/vestibular-disorders.

ICF level	Measure	What it measures
Body Structure/ Function	Dynamic visual acuity (DVA)	Visual acuity during fixed head movement velocity with decreasing optotype size.
	Gaze stabilization test (GST)	Visual acuity during increasing head movement velocity with fixed optotype size.
	Sharpened Romberg	Static stance with altered base of support (tandem).
	Sensory organization test (SOT)	Computerized assessment of postural control by measuring sway under conditions in which visual/somatosensory feedback is altered.
	SOT with head shake	Postural stability during head rotations compared to head still.
	Clinical test for sensory interaction and balance (CTSIB)/ modified CTSIB	Postural control under various sensory conditions.
	Visual analog scale (VAS)	Symptoms are quantified on a 10-cm line corresponding to intensity.
	Visual vertigo analog scale	Intensity of visual vertigo in 9 challenging situations of visual motions using VAS.
	Motion sensitivity quotient (MSQ)	Motion-provoked dizziness during a series of 16 quick changes to head or body positions.
	Vertigo symptoms scale (VSS)	Symptoms of balance disorder and somatic anxiety and autonomic arousal.
Activity/ Participation	Five time sit to stand	Functional lower extremity strength with published norms in older adults
	30-second chair stand	Functional lower extremity strength with published norms in older adults
	Functional reach/modified Functional reach	Stability of the maximum forward reaching distance while standing in a fixed position. The modified version

		is performed sitting.
	Gait velocity (10 m walk test)	Walking at preferred speed.
	Balance evaluation systems test (BESTest)	Six different balance control systems.
	Mini-BESTest	Shortened version of the BESTest
	Berg balance scale	14-item measure of static balance and fall risk during common activities.
	Dynamic gait index (DGI)	Postural stability during various walking tasks including change speed, turn head, walk over/ around obstacles, and climb stairs.
	Functional gait assessment (FGA)	Postural stability during various walking tasks including tandem, backwards and eyes closed.
	Four square step test	Ability to step over objects forward, sideways, and backwards.
	Unipedal stance test	Static stance on one leg
	Timed up and go (TUG)	Mobility and fall risk
	Modified TUG with dual-task conditions	Mobility under dual-task conditions and fall risk
	Activities-specific balance confidence scale (ABC)	Confidence in balance without falling or being unsteady across a continuum of activities.
	Disability Rating Scale	Level of disability based on descriptions of symptoms and limited activities.
	Dizziness Handicap Inventory (DHI)	Perceived handicap as a result of dizziness.
	UCLA Dizziness Questionnaire	Severity, frequency and fear of dizziness and its effect on quality of life and activities of daily living.
	Vertigo handicap questionnaire	Effects of vertigo on disability, handicap and psychological distress.
	Vestibular Activities and Participation	Effect of dizziness and/or balance problems on ability to perform activity and participation tasks.
	Vestibular Disorders Activities of Daily Living Scale	Independence in everyday activities of daily living.
	Vestibular Rehabilitation Benefit Questionnaire	Impact of symptoms on quality of life.

Diagnostic criteria for vestibular hypofunction

Diagnosis of peripheral vestibular hypofunction had to have been confirmed with vestibular function testing for a paper to be included in this CPG. Both caloric and rotational chair testing were used for diagnostic purposes. Unilateral vestibular hypofunction was determined by responses to bithermal air or water caloric irrigations with at least 25% or more reduced vestibular responses on one side.[32-34] Jongkees described the formula, which is typically used to calculate right-left asymmetry with caloric testing.[35] Although caloric asymmetry is abnormal in persons with unilateral loss, saccades and smooth pursuit eye movements are normal and therefore are not included in the diagnostic criteria.[33] Rotational chair data on gain, asymmetry and phase have been used to test the vestibulo-ocular system at higher frequencies up to 1.0 Hz and are used to diagnose bilateral vestibular hypofunction.[22]

A. Action Statement 1: EFFECTIVENESS OF VESTIBULAR PHYSICAL THERAPY IN PERSONS WITH ACUTE AND SUBACUTE UNILATERAL VESTIBULAR HYPOFUNCTION (UVH). Clinicians should offer vestibular rehabilitation to patients with acute or subacute unilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong)

Action Statement Profile

Aggregate evidence quality: Level I. Based on 5 Level I randomized controlled trials and 4 Level II randomized controlled trials.

Benefits: Improved outcomes in patients receiving Vestibular Physical Therapy (VPT) when compared to controls given either no exercise or given sham exercises

Risk, Harm, and Cost:

- Increased cost and time spent traveling associated with supervised VPT.
- Increase in symptom intensity at the onset of treatment.

Benefit-harm assessment:

- Preponderance of benefit

Value judgments:

- Early initiation of VPT ensures shorter episodes of care, higher levels of recovery of balance function, reduced symptom complaints, improved functional recovery to activities of daily living, reduced fall risk and improved quality of life.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role.

Exclusions:

- Individuals who have already compensated sufficiently to the vestibular loss and no longer experience symptoms or gait and balance impairments do not need formal vestibular physical therapy. For example, people who resume their customary sporting or physical activities may compensate quickly so that they do not need VPT and when evaluated by a physical therapist have normal test results.
- Possible exclusions also include active Meniere's disease or those with impairment of cognitive or general mobility function that precludes adequate learning and carry over or otherwise impedes meaningful application of therapy.

Supporting Evidence and Clinical Interpretation

Acute unilateral vestibular hypofunction (UVH) is the most common cause of acute spontaneous vertigo.[36,37] Acute UVH is most commonly due to vestibular neuritis but may also be due to trauma, surgical transection, ototoxic medication, Meniere's disease or other lesions of the vestibulocochlear nerve or labyrinth. The acute asymmetry results in imbalance in vestibular tone that manifests with vertigo, nausea and unsteadiness of gait as well as spontaneous nystagmus with the fast component beating away from the dysfunctional ear. While nystagmus and vertigo usually subside within hours to 14 days, imbalance and the sensation of dizziness, especially during head movement may persist for many months, or longer, resulting in a more chronic syndrome. Vestibular exercises have been used in recent years as a means of aiding patients to make a more speedy and thorough recovery. For purposes of this CPG, acute is defined as the first two weeks following onset of symptoms, subacute as after the first two weeks and up to three months following onset of symptoms and chronic as the presence of symptoms longer than three months.

Strong evidence indicates that vestibular physical therapy provides clear and substantial benefit to patients with acute or subacute UVH so, with the exception of extenuating circumstances, vestibular physical therapy should be offered to patients who are still experiencing symptoms (e.g., dizziness, dysequilibrium, motion sensitivity, oscillopsia) or imbalance due to UVH. Two Level I studies examined the effects of VPT solely with in the acute/sub-acute stage following resection of vestibular schwannoma. In the first study, patients scheduled for resection were randomly assigned to an exercise group (VPT group; n = 11) or control (n = 8).[18] Exercises were started 3 days after resection of the vestibular schwannomas and continued until the patients were discharged from the hospital (average = post-operative day 6). VPT consisted of gaze stabilization exercises for 1 minute each 5 times per day for total of 20 min per day. The control group performed vertical and horizontal smooth-pursuit eye movements against a featureless background on the same schedule. Patients in both groups walked at least once each day. The VPT group was older (mean age 59 versus 48 years in controls, $p < 0.04$) but otherwise both groups were similar. Both groups reported significantly more dizziness after surgery than before ($p < 0.05$) and more postural sway on post-op day 3 than pre-op ($p < 0.05$). By days 5/6, the exercise group reported less subjective disequilibrium compared to the control group. Some posturographic measures improved more in the exercise group compared to the control group on post-op day 6 and more patients in the exercise group were able to walk and turn their head without staggering than in the control group. This study has several limitations: 1) no allocation concealment, 2) a relatively small number of subjects and 3) it was assumed that patients developed acute UVH from surgery but this is not known. Some of the patients may have had a progressive loss of vestibular function over the years, with the growth of the tumor, and had adapted, and as such did not experience much of an acute loss post-operatively.

The second study examined the effectiveness of gaze stabilization exercises started after vestibular schwannoma surgery on reducing patients' perception of dizziness/imbalance.[16] In this Level I study, subjects were randomized into an exercise group who performed gaze stability and balance exercises (n = 30) or control group (n = 27). Patients were assigned to a group based on a sequentially randomized design (first part of study was control group; second part of the study was vestibular exercise group). Patients in the vestibular exercise group (VPT) performed gaze stabilization exercises starting on the third post-operative day. Each exercise was performed for one minute, four or five times each day. The exercises were initially performed while lying down or seated and were then performed while standing. The control group did not perform any exercises. Patients were reassessed for the first time at two-three weeks after surgery. The main finding was that there was less dizziness in the VPT group, based on the scores of the Dizziness Handicap Inventory (DHI), compared to the control group at 2-3 weeks, 6-7 weeks and at 10 -12 weeks post-operatively. Secondary findings showed no difference between groups in spontaneous nystagmus, subjective complaints of vertigo and VOR asymmetry when measured over the 12-week course of the study.

Mruzek et al. found that a course of vestibular exercises (VPT) following unilateral vestibular ablation in patients with vestibular schwannoma or Meniere's disease was beneficial in reducing symptom intensity and disability compared to a control group.[38] In this Level I study, they examined patients at post-operative day 5 and then 2, 5 and 7 weeks after surgery. Subjects were randomized into three groups: 1) VPT + social reinforcement, 2) VPT alone and 3) a control group who performed range of motion exercises + social reinforcement, all interventions lasted 8 weeks. Vestibular exercises were initiated on post-operative day 5 and consisted of habituation exercises, based on the results of the motion sensitivity test and Cawthorne-Cooksey exercises. The control group performed range of motion exercises. Social reinforcement consisted of periodic phone calls to urge compliance and encourage and praise the patients. They found that all patients improved in the motion sensitivity test, computerized dynamic posturography and DHI scores but the patients who performed the vestibular exercises had significantly less motion sensitivity (Groups 1 and 2) and had better (lower) scores on the physical subscale of the DHI (Group 1) at 8 weeks after surgery than the control group (Group 3).

Another study also started vestibular exercises in patients following vestibular schwannoma surgery 3-5 days post-operatively.[39] In this Level I study, patients were randomized (with allocation concealment) to 12-weeks of vestibular physical therapy (n = 16 young, n = 15 old defined as > 50 years old) or to a control group (n = 11 young, n = 11 old). There were no differences in tumor sizes or mean caloric paresis among all groups pre-operatively. Vestibular exercises included supervised walking, narrow based walking with head turning, treadmill and gaze stabilization exercises for a total of 4 sessions with a home exercise program (HEP) three times per day. The control group was told to walk, read and watch TV while in the hospital and then told to gradually increase their activity level once at home. There were no differences in balance measures between groups during the acute/subacute study period except for tandem gait, which was better in the vestibular physical therapy group. However, when only patients over 50 years old were considered, static balance, timed up and go and tandem gait were better in those that received VPT than in controls ($p < 0.05$). At 9 – 12 weeks, subjects > 50 years who received VPT were better on static balance, times up and go, tandem walk and the Dynamic Gait Index (DGI). This study found essentially no benefit in vestibular physical therapy compared to general instructions in those younger than 50 years old. This study's limitations include what seems like fairly minimal supervised VPT (only 4 supervised sessions over 12 weeks).

In the final Level 1 study comparisons were made between patients with acute unilateral vestibular hypofunction treated with a course of Nintendo® Wii Fit Balance Board balance exercises (n = 37) and a control group (n = 34).[40] They examined patients on the second day after admission for vestibular neuritis and then randomly assigned the patients to one of the two groups. The Wii exercise group performed a customized program of 5-6 exercises for a total of 45 minutes. The program consisted of 10 training sessions, partitioned in 2 daily units for 5 consecutive days. The control group performed only one session consisting of two exercises (the 'one-leg figure' and the vendor-specific training test to calculate the 'virtual fitness age') for a total time of 5 minutes. Patients were reassessed on day 5 of treatment and after 10 weeks. Outcome measure included performance on 16 different exercises performed by the Wii group during the 5 days of the study, sensory organization tests on a force platform, the DHI, Vertigo Symptom Scale (VSS) and a Tinetti questionnaire. There were no differences in age, gender or symptom duration between groups. Results showed that patients in the control group required a longer in-patient stay (average 2.4 ± 0.4 days) compared with patients following early rehabilitation with the Wii balance board. Additionally an absence of nystagmus was observed 2.1 ± 0.5 days earlier in the exercise group than in the control group. At both day 5 and 10 weeks after exercise, the exercise group showed significantly better results in the SOT, DHI, VSS, and Tinetti questionnaire than the control group. ($p < 0.05$). The authors concluded that the early use of a visual feedback system (Nintendo® Wii Balance Board) for balance training facilitated recovery of balance and symptoms in patients with acute unilateral vestibular hypofunction. Although this study received a Level I rating using our criteria, there are several flaws that impact this conclusion: 1) use of the exercises performed by the VPT group as an outcome measure; 2) although the authors conclude that VSS improved only in the exercise group, they provide no data to support this; 3) a level of significance of alpha < 0.05 was set, but no adjustment was made for multiple comparisons, so the potential for type I error is greater; 4) they do not account for all the subjects recruited for the study.

Several Level II studies also support the use of VPT in the treatment of patients with acute or sub-acute unilateral vestibular hypofunction. Strupp et. al. conducted a randomized controlled trial in which patients were randomized to VPT (n = 19) or a control group (n = 20).[41] The control group was given no particular exercises; however, both groups were encouraged to engage in regular daily activities, such as walking to the bathroom and sitting up for meals. The VPT group performed gaze stabilization exercises as well as static and dynamic balance exercises, which included head movement. The primary outcome was postural stability with eyes closed on foam as measured by sway path velocity. In general, both groups improved in postural stability across time; however, at the assessment 30 days after symptom onset the VPT group was significantly more stable compared to the control group ($p < 0.001$). They found no differences between groups in the recovery of signs and symptoms related to the tonic vestibular system (e.g., ocular torsion and subjective visual vertical). This study shows that vestibular physical therapy administered early after onset of unilateral vestibular hypofunction results in improvement in sway and balance by day 30 after onset but that, as expected, problems that affect the tonic vestibular system recover with or without vestibular physical therapy.

A second level II study studied 87 patients with at least one vertigo spell within 5 days of study enrollment, and 2 abnormal tests (among Romberg, Fukuda Stepping Test, head shaking nystagmus or spontaneous nystagmus).[42] They excluded those with vestibular symptoms in the prior 6 months or those with benign paroxysmal positional vertigo (BPPV). Patients were randomized and blinded to their group: VPT group (n = 45) were given supervised gaze stability exercises, consisting of VORx1 viewing and VORx2 viewing, performed with horizontal and vertical head movements for 1 minute three times per day for 21 days. The control group (n = 42) did gaze fixation without head movement while blinking their eyes, again three times per day for 21 days. The exercise group showed significant improvement in Romberg, Fukuda's stepping test, spontaneous nystagmus and post head-shaking induced nystagmus compared to the control group by 10 days. Most patients improved in the timeframe of 3-10 days compared to controls but by about 3 weeks the differences between controls and treatment groups began to diminish.

A Level II study by Marioni et al. enrolled 30 patients starting 2 weeks after acute UVH (no mention of allocation concealment): 15 patients were randomized to 5 weeks of posturography-assisted VPT + HEP while the other 15 served as controls did no particular exercises.[43] UVH was defined by 50% reduced vestibular responses on one side done approximately 2 weeks prior to administering exercises consisting of 30-min sessions once per week for 5 weeks and HEP done three times per day. They found that the VPT and HEP group improved in eyes open foam ($p = 0.02$) and eyes closed foam ($p = 0.00004$) after VPT compared to before whereas the controls only improved with eyes closed foam ($p = 0.03$). At 6 weeks center of gravity sway velocity with eyes open foam ($p = 0.03$) and eye closed foam ($p = 0.000001$) was better in treated than untreated subjects. This study demonstrates improvement in posturography measures such as center of gravity sway velocity when VPT is administered starting 2 weeks after a significant UVH.

A Level II study by Teggi et al. examined the effect of vestibular physical therapy on patients hospitalized with acute vestibular neuritis.[44] Patients were randomly assigned to either the vestibular physical therapy group or a control group. The vestibular physical therapy group (n = 20) underwent a total of 10 sessions of rehabilitation consisting of balance exercises on a force platform using both visual feedback and an optokinetic stimulus. They also performed gaze stability exercises and a sub-set of Cawthorne-Cooksey exercises. The control group was told only to ‘perform their daily activities’. Outcome measures included the sway path analysis of stance with eyes open and eyes closed, DGI, DHI and a visual analogue scale for anxiety, at baseline and after 25 days. There was a statistically significant difference in the dizziness handicap questionnaire total scores ($p < 0.002$), and in the anxiety visual analog scale (VAS) scores ($p < 0.001$) between the two groups; there was no significant difference between groups in the DGI score.

Three Level III studies introduced a new concept of rehabilitation for patients scheduled for vestibular ablation, either for vestibular schwannoma or Meniere’s disease.[45-47] These studies advocate for treating the patients with a combination of intratympanic gentamicin to induce further loss of vestibular function and vestibular exercises to induce vestibular compensation prior to surgery. They report that patients undergoing this “pre-hab” had faster recovery of symptoms and balance after surgery. Further research is needed however to determine if there is a significant difference in the rate and level of recovery with pre-hab compared to post-operative rehabilitation.

R. Research Recommendation 1. Researchers should examine the concept of a critical period for optimal vestibular compensation through studies that examine early versus delayed intervention. Researchers should identify factors that predict which patients will recover without the benefit of vestibular physical therapy and which patients will need vestibular physical therapy to optimize outcomes.

A. Action Statement 2: EFFECTIVENESS OF VESTIBULAR REHABILITATION IN PERSONS WITH CHRONIC UNILATERAL VESTIBULAR HYPOFUNCTION (UVH). Clinicians should offer vestibular rehabilitation to patients with chronic unilateral vestibular loss. Evidence quality: I; Recommendation Strength: Strong).

Action Statement Profile

Aggregate evidence quality: Level I. Based on 3 Level I and 1 Level II randomized controlled trials.

Benefits:

- Improved outcomes in patients receiving vestibular physical therapy when compared to controls given either no exercise or given sham exercises

Risk, Harm, and Cost:

- Increased cost and time spent traveling associated with supervised vestibular physical therapy

Benefit-harm assessment:

- Preponderance of benefit

Value judgments:

- Importance of optimizing and accelerating recovery of balance function and decreasing distress, improving functional recovery to activities of daily living and reducing fall risk.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role.

Exclusions:

- Individuals who have already compensated sufficiently to the vestibular loss and no longer experience symptoms or gait and balance impairments do not need formal vestibular physical therapy.

- Possible exclusions include active Meniere's disease or those with impairment of cognitive or general mobility function that precludes adequate learning and carry over or otherwise impedes meaningful application of therapy.

Supporting Evidence and Clinical Interpretation

Strong evidence indicates that vestibular physical therapy provides clear and substantial benefit to patients with chronic UVH so, with the exception of extenuating circumstances, vestibular physical therapy should be offered to patients who are still experiencing symptoms (e.g., dizziness, dysequilibrium, motion sensitivity, oscillopsia) or imbalance due to UVH. A Level I RCT studied 21 patients with chronic UVH (based on caloric testing) of 2 weeks to 3 years duration who also had impairment of dynamic visual acuity (DVA) along with VAS for "seeing clearly during head movement" as a measure of oscillopsia.[19] Patients were randomized to vestibular (n = 13) versus placebo exercises (n = 8). Patients were taken through supervised adaptation exercises and eye-head exercises to improve gaze stability whereas placebo exercises were saccadic eye movements with head stationary. Exercises were done 4-5 times daily for 20-30 min plus 20 minute of gait exercises daily for 4 weeks with compliance monitored and program adjusted as indicated for individuals and patients seen weekly for 4 weeks. The vestibular exercise group showed improvement in DVA ($p < 0.001$) and 12/13 improved DVA to normal; whereas, no change in DVA was seen in the control group and no control subject achieved normal DVA. Thus, vestibular exercises facilitate recovery of gaze stability as measured by DVA. There was no indication of failure to improve based on age and improvement was seen even if exercises were administered 12 months after symptom onset. The improvement in DVA did not correlate with improvement in oscillopsia VAS.

In a Level I RCT Loader et al. studied 24 patients with chronic unilateral vestibular hypofunction who were randomly assigned to either a treatment group (n = 12, exposure to optokinetic stimuli while standing) or a control group (n = 12, no treatment).[48] The outcome measure consisted of measures of postural stability in stance (sensory organization test). The treatment group was required to read stochastically presented texts while standing. Patients attended 10 treatment sessions over a three week period with each session being approximately 30 minutes in duration. The control group simply had their balance tested before and after a three week period. Neither group performed a home exercise program. There were no differences between groups prior to the initiation of treatment but after the 3-week intervention period, the treatment group had significantly better postural stability on SOT. Two limitations of the study are that there is a difference in how the two groups were treated (the control group having much more limited contact with the therapists) and that the treatment group practiced standing balance, closely related to the outcome measure, while the control group did not.

In another Level I RCT study, Giray examined 41 patients with chronic vestibular dysfunction treated with VPT for 4 weeks (n=20) versus a no-treatment control group (n=21). Interestingly the ratio of male: female was 11:2.[49] They specifically excluded patients with BPPV and Meniere's disease or any orthopedic or neurological co-morbid condition that would confound recovery. All participants had chronic uncompensated UVH based on caloric testing. No mention was made of allocation concealment in the randomization process. Patients were seen in the clinic twice per week for 4 weeks for 30-45 minutes and monitored for compliance. Between supervised sessions, patients did twice daily home exercise program for a total of 30-40 min per day. The home exercise program included a combination of adaptation (VORx1 and VORx2 in pitch and yaw planes for 1 minute each for 3 times per day), substitution, habituation and balance exercises. The VPT group made improvements from pre to post treatment in all measures, including disequilibrium based on visual analog scale ($p < 0.003$), DHI ($p < 0.001$), Berg Balance Scale ($p<.013$) and modified Clinical Test for Sensory Interaction and Balance (CTSIB) ($p<.004$); whereas, the control group did not change in any of the measures. Furthermore, there were significant differences ($p < 0.05$) in change scores of all measures for the VPT group compared to the control group.

Enticott et al reported, in their 2005 Level II study, that all subjects on average significantly improved pre- to post-therapy for DHI and Activities-specific Confidence Scale (ABC; $p < 0.05$).[16] Nine subjects had vestibular migraine. Three subjects had BPPV which initially had not resolved, but had resolved by end of study. However, the experimental group (vestibular exercises) improved to a greater extent than Control group (strength and endurance exercises) on DHI and ABC ($p < 0.05$). All subjects on average significantly improved pre- to post-therapy for tandem walk, step test, tandem stance, and single-leg stance test ($p < 0.05$). The experimental group improved to greater extent than Control on tandem walk, step tests, and posturography on foam and eyes closed condition ($p < 0.05$).

Finally, although not a traditional randomized controlled trial, Shepard and Telian provide support specifically for the use of habituation exercises.[50] In this Level III study of patients with chronic vestibular deficits, Shepard and Telian compared the efficacy of customized vestibular exercise programs to a more generic exercise program using a delayed treatment paradigm. Subjects first were assessed to establish a baseline and re-assessed at one month before initiating any exercises. This delayed treatment model served as a control for spontaneous recovery. Subjects who had not shown spontaneous recovery were then stratified by age and by pre-treatment disability. After three months of therapy, only the vestibular rehabilitation group showed a significant reduction in dizziness during routine daily activities. The vestibular rehabilitation group also showed a significant improvement on both static and dynamic posturography, a reduction in motion sensitivity and a decrease in asymmetry of vestibular function. The generic exercise group improved only in their performance of static balance tests.

Several other treatment modalities have been explored as possible interventions for patients with unilateral vestibular hypofunction. In a Level III study Verdecchia et al. present the results from a cohort of 69 patients with chronic unilateral vestibular hypofunction.[51] All patients performed a vestibular physical therapy program of gaze stability, balance and gait exercises to which the complementary use of video game equipment (Wii®) was added. Outcome measures included the perception of handicap, fall risk, and gaze stability (clinical DVA). As a group, patients improved significantly in all measures ($p<.0001$). Aquatic physiotherapy may also be beneficial for people with chronic unilateral vestibular hypofunction.[52] In this study, patients performed 10 sessions of aquatic physiotherapy consisting of eye, head and body movements that stimulate the vestibular system and other systems involved in body balance that frequently generate dizziness in UVH patients. As a group, patients had lower Brazilian

DHI total scores, lower intensity of dizziness and better postural stability following aquatic physiotherapy. They found no association between age, time since symptom onset and use of anti-vertigo medication and rehabilitation outcomes.

A. Action Statement 3: EFFECTIVENESS OF VESTIBULAR REHABILITATION IN PERSONS WITH BILATERAL VESTIBULAR HYPOFUNCTION (BVH). Clinicians should offer vestibular rehabilitation to patients with bilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong).

Action Statement Profile

Aggregate evidence quality: Level I. Based on 4 Level I randomized controlled trials.

Benefits:

- Improved function and decreased symptoms in patients receiving VR when compared to controls given sham exercises.

Risk, Harm, and Cost:

- Risk: Increased symptom intensity and imbalance when performing the exercises. Harm: none reported. Cost: Increased cost and time spent traveling associated with supervised VR.

Benefit-harm assessment:

- Preponderance of benefit

Value judgments:

- Benefit of gaze stability and balance exercises in patients with bilateral vestibular hypofunction has been demonstrated in Level I studies. However, the number of subjects in these studies was small (with the exception of one study) and the outcome measures utilized were variable.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role.

Exclusions:

- Possible exclusions include impairment of cognitive or general mobility function that precludes adequate learning and carry over or otherwise impedes meaningful application of therapy.

Supporting Evidence and Clinical Interpretation

Strong evidence indicates that vestibular physical therapy provides clear and substantial benefit to patients with BVH so with the exception of extenuating circumstances vestibular physical therapy should be offered to patients who are still experiencing symptoms (e.g., dizziness, dysequilibrium, oscillopsia) or imbalance due to BVH. Four Level I, randomized controlled trials assessed the effectiveness of vestibular exercises in individuals with bilateral vestibular hypofunction. Herdman et al. examined the influence of gaze stability exercises (a combination of adaptation and substitution exercises) as compared to a vestibular-neutral placebo treatment (saccadic eye movements without head movement against a plain background) on dynamic visual acuity (DVA) in 13 patients with BVH.[20] All participants were seen weekly in the clinic by a physical therapist and were instructed to perform the home exercise program of eye exercises (either gaze stability or saccadic eye movements) 4-5 times per day for a total of 20-40 minutes. All participants performed balance and gait exercises as part of a home exercise program for 20 minutes per day. As a group, the individuals performing the gaze stability exercises demonstrated an improvement in their DVA as compared to the placebo group.

In a Level I study by Krebs et al. eight individuals with bilateral vestibular hypofunction who performed an exercise program consisting of gaze stability exercises (both adaptation and substitution exercises) and balance and gait activities, demonstrated increased gait speed and increased stability, as compared to those who performed a placebo exercise program consisting of isometric exercises.[22] The vestibular exercises involved a staged progression of gaze stability and balance and gait exercises; e.g., Phase I - VOR x1 with slow head movement; Phase II - VOR x 1 with fast head movement; Phase III - VOR x 2 with fast head movement. Participants were seen for weekly outpatient physical therapy visits and were instructed to perform the home exercise program 1-2 times per day for 8 weeks. Both groups demonstrated improvements in DHI scores; however, there were no differences between the experimental and control group in improvement in perceived disability.

There is one additional Level I randomized controlled trial that included a significant proportion of individuals with BVH (53 out of 86) who completed 12 weeks of vestibular physical therapy.[53] Based on improved gait biomechanics (preferred gait speed, decreased double support time, and decreased vertical center of mass excursion), Krebs and colleagues determined that patients with vestibular hypofunction benefitted from vestibular physical therapy as compared to a placebo control group. As described above vestibular physical therapy included a staged progression of gaze stability and balance and gait retraining exercises.[22] Participants were seen for 6 weeks of supervised visits and were instructed to perform a home exercise program at least once per day and 5 days per week for an additional 6 weeks. Patients with unilateral and bilateral vestibular hypofunction benefitted equally from vestibular physical therapy. Although the UVH group had more stable and faster gait characteristics at baseline than the BVH group, both groups' gait characteristics improved significantly with rehabilitation.[53]

Rine et al.[54] used a similar intervention approach as that described by Krebs and colleagues[22] but modified for children's motor abilities, attention span and motivational factors. The investigators reported a significant improvement in motor development scores and a trend towards improvement in posturography sensory organization test scores in the treatment group as compared to the placebo group. Together these Level I studies provide strong support for the use of vestibular physical therapy in patients with bilateral vestibular hypofunction to improve gaze and postural stability.[54]

There are five, Level III and IV studies that have examined change with vestibular physical therapy using a variety of outcomes.[55-59] Patten et al. (Level III) found that individuals with BVH improved in coordinated head-trunk control following vestibular physical therapy although no change in preferred gait speed was noted.[55] Gillespie and Minor (Level III) using retrospective chart review identified 35 patients with confirmed BVH based on clinical test, caloric and rotary chair testing.[56] The majority of patients (32 out of 35) underwent vestibular physical therapy that included gaze stability exercises (VORx1 and eye-head movement between targets) as well as gait and balance exercises. Patients were instructed to perform gaze stability exercises at least three times per day. Outcome measures included dynamic visual acuity, static balance in Romberg, and gait speed as well as subjective measures of symptoms. Half of the patients improved with vestibular physical therapy. Improvement was defined as normalization of at least two of the three measures. The group that did not improve had more comorbidities (2.5) than the group that did improve (1.7) and having four or more comorbidities was associated with poorer outcomes. Taken together these studies demonstrate improvements in measures of gaze stability, static postural stability, gait, and symptoms. However, it is apparent from these studies that not all individuals improved, individuals did not improve on all measures, and there was a great deal of variability in outcome measures.

R. Research Recommendation 2. With the advent of new diagnostic tools, it is possible to assess the functioning of each component of the vestibular apparatus. Researchers should examine rehabilitation outcomes in persons with damage to semicircular canal versus otolith components of the vestibular apparatus. Further, researchers should examine the impact of the magnitude and range of hypofunction relative to functional recovery.

A. Action Statement 4: EFFECTIVENESS OF SACCADIC OR SMOOTH-PURSUIT EXERCISES IN PERSONS WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL OR BILATERAL). Clinicians should not offer saccadic or smooth-pursuit exercises to patients with unilateral or bilateral vestibular hypofunction. (Evidence quality: I; Recommendation Strength: Strong)

Action Statement Profile

Aggregate evidence quality: Level I. Based on 3 Level I randomized controlled trial.

Benefits:

- Poorer outcomes in patients performing only saccadic or smooth-pursuit eye movements without head movement for gaze stability when compared to vestibular physical therapy.

Risk, Harm, and Cost:

- Delay in patient receiving an effective exercise program.
- Increased cost and time spent traveling associated with ineffective supervised exercises

Benefit-harm assessment:

- Preponderance of harm

Value judgments:

- Importance of prescribing an effective exercise program rather than exercises that will not improve symptom complaint or balance while walking.

Role of patient preferences:

- It is doubtful that patients would chose to perform an ineffective exercise.

Exclusions:

- None.

Supporting Evidence and Clinical Interpretation

Three Level I studies have used either saccadic or smooth-pursuit eye movements as control (placebo) exercises.[18-20] Note: the saccadic eye movements used in all three of these studies are voluntary saccades of the type used when reading; these should not be confused with compensatory saccadic eye movements seen after a head impulse (high acceleration of head in yaw through a small amplitude) in some patients with vestibular hypofunction. In one study, patients scheduled for resection of vestibular schwannoma were randomly assigned to either an exercise group (vestibular physical therapy, VPT; n = 11) or a control group (n = 8).[18] Exercises were started 3 days after resection of the vestibular schwannomas and continued until the patients were discharged from the hospital (average = post-operative day 6). The control group performed vertical and horizontal smooth-pursuit eye movements against a featureless background. Patients in both groups walked at least once each day. The VPT group was older (mean age 59 versus 48 in controls, p<.04) but both groups were similar in other respects. Both groups reported significantly more dizziness after surgery than before (p < 0.05) and more postural sway on post-op day 3 than pre-op (p < 0.05). By post-op days 5-6, patients in the control group reported greater subjective disequilibrium than the VPT group who performed gaze stabilization exercises. Additionally none of the control group were able to walk and turn their head without loss of balance while 50% of the exercise group were able to walk and turn their head without losing their balance.

Herdman et al. in a Level I study in patients with chronic unilateral vestibular hypofunction used saccadic eye movements as the exercise for the control group.[19] Patients were randomized to VPT (n = 13) versus placebo exercises (n = 8). The VPT group was taken through supervised adaptation and substitution exercises to improve gaze stability; whereas, the control group performed saccadic eye movements with head stationary. Exercises were done 4-5 times daily for 20-30 minutes plus 20 minutes of gait and balance exercises for 4 weeks with compliance monitored and progressed as indicated. There was no change in DVA in the control group and no control subject achieved normal DVA. In contrast, the vestibular treatment group showed improvement in DVA (p<.001) and 12/13 improved DVA to normal. Thus, saccadic eye movement exercises did not facilitate recovery of gaze stability as measured by DVA nor did they result in a decrease of oscillopsia. The same experimental design was used to examine the effect of exercises in patients with bilateral vestibular hypofunction.[20] As a group, the individuals performing the control saccadic eye movement exercises showed no improvement in DVA while those performing gaze stability exercises improved significantly.

B. Action Statement 5: EFFECTIVENESS OF DIFFERENT TYPES OF EXERCISES IN PERSONS WITH ACUTE OR CHRONIC UVH. Based on moderate strength of evidence, clinicians may provide targeted exercise techniques to accomplish specific goals appropriate to address identified impairments and functional limitations (e.g., exercises related to gaze stability and visual motion sensitivity for improved stability of the visual world and decreased sensitivity to visual motion; head movements in a habituation format to decrease sensitivity to head movement provoked symptoms; activities related to body sway control for improved general stance and gait). (Evidence quality: II; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate evidence quality: Level II. Based on one Level 1 and two Level II randomized controlled trials examining whether one traditional vestibular exercise is more beneficial than another. Additionally, two Level II studies compared a traditional vestibular exercise with a novel exercise.

Benefits:

- Unknown

Risk, Harm, and Cost:

- Increased cost and time spent traveling associated with supervised VRT

Benefit-harm assessment:

- Unknown; there is a potential for patients to perform an exercise that will not address their primary problems.

Value judgments:

- Importance of identifying the most appropriate exercise approach to optimize and accelerate recovery of balance function and decreasing distress, improving functional recovery to activities of daily living and reducing fall risk.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role.

Exclusions:

- Possible exclusions include active Meniere's disease or those with impairment of cognitive or general mobility function that precludes adequate learning and carry over or otherwise impedes meaningful application of therapy.

Supporting Evidence and Clinical Interpretation

Few studies have examined whether any one traditional vestibular exercise is more beneficial than another. A few studies have compared a traditional vestibular exercise (e.g., Cawthorne-Cooksey exercises) with a novel exercise (e.g., moving platform practice). Of 14 randomized clinical trials initially thought to compare the traditional vestibular exercise approaches (gaze stabilization, adaptation, habituation, substitution, Cawthorne-Cooksey) only three actually compared these exercise approaches relevant to the issue of vestibular rehabilitation for vestibular hypofunction. Two other randomized trials examined the concept that particular exercises should be used to accomplish specific goals.

In a Level I randomized trial, Pavlou et al compared patients performing a customized exercise program (n = 20; balance, gait, Cawthorne-Cooksey, gaze stability) with patients performing exercises in an optokinetic environment (n = 20).[60] Outcome measures included the Sensory Organization Test (SOT), the Berg Balance Scale and several symptom complaint measures including the Vertigo Symptom Scale, Situational Characteristics Questionnaire, and Hospital Anxiety and Depression Scale. Both groups improved significantly in the SOT and symptom scores; however, the optokinetic stimulus group improved more in the symptom measures. Although the optokinetic stimulus group appears to have improved more in the SOT score, the customized exercise group had higher (better) scores to begin with and therefore there may have been a ceiling effect for that group.

In a Level II study, Clendaniel et al. studied seven patients with chronic uncompensated UVH based on caloric testing or clinical examination.[61] Patients were randomized (no mention of allocation concealment) to habituation exercises (n = 4) designed to reduce patient sensitivity to head movement or gaze stabilization exercises (n = 3) designed to improve visual acuity during head movement. Both patient groups also performed balance and gait exercises and were provided a home exercise program. Both groups were to perform the exercises three times daily over a six-week period. Exercise compliance averaged 69.7% (range 34-90%). In this preliminary study, both exercise interventions resulted in improved self-reported ability to perform daily activities, decreased sensitivity to movement and better visual acuity during head movements. However, because of the small number of subjects in the study and the fact that some patients had normal values on the outcome measures at baseline, further research is strongly recommended.

In another Level II study, Szturm et al. examined postural stability (SOT) and vestibular asymmetry (rotary chair and optokinetic testing) in patients with chronic uncompensated UVH.[62] Patients were randomly assigned to perform either vestibular physical therapy (VPT consisting of gaze stability and balance exercises performed in the clinic and as a home program) or control exercises (Cawthorne-Cooksey exercises performed only as an unsupervised home program). The VPT group showed improvement in both postural stability and vestibular symmetry while those performing the Cawthorne-Cooksey exercises did not. The study, however, has several limitations. First, not all patients appear to have UVH based on the investigators criteria (approximately 25% in each group did not appear to have UVH). Second, the investigators examined VOR gain asymmetry by rotational testing, which is insensitive to UVH. Finally, because one group was supervised and the other group was not, the differences in outcome may be attributed to a supervision effect rather than to the type of exercise.

Two studies provide support for using particular exercises for specific problems. One, a Level I study by McGibbon et al. randomly assigned 53 patients with vestibular hypofunction and documented gait and balance impairments to either a group-based vestibular exercise intervention, or a group-based Tai Chi exercise intervention.[63] Fifteen subjects dropped out of the study and another 12 were unable to perform the step up/ step down test; thus, the final sample size was 26 and 8 subjects had unilateral and 5 subjects had bilateral vestibular hypofunction in each treatment group. Subjects met once a week for ten weeks in small groups for 70 minutes of exercise each week. The study demonstrated that balance exercises (Tai Chi) selectively improved whole body stability during a step-up and step down test while vestibular exercises (adaptation and eye-head exercises) selectively improved gaze stability. The role of severity of vestibular hypofunction (unilateral versus bilateral) is unclear.

In a Level II study, Jauregui-Renaud et al. compared the effectiveness of Cawthorne-Cooksey exercises, Cawthorne-Cooksey exercises plus training in breathing rhythm and Cawthorne-Cooksey exercises plus proprioceptive exercises on disability (DHI) and static balance in patients with chronic vestibular hypofunction.[64] Although all three groups showed improvement in DHI scores and in static balance, the group performing Cawthorne-Cooksey exercises plus breathing training were more likely to have a meaningful clinical improvement in DHI scores and the patients performing Cawthorne-Cooksey plus proprioceptive exercises had decreased sway during static balance tests. Although not conclusive, the results from these two studies support the concept of exercise specificity in the treatment of patients with vestibular hypofunction.

Pavlou et al. examined the effect of different virtual reality experiences on outcome in patients with unilateral peripheral vestibular hypofunction.[65] Patients were randomly allocated to a virtual reality regime incorporating exposure to a static (Group S) or dynamic (Group D) virtual reality environment. Participants practiced vestibular exercises, twice weekly for four weeks, inside a virtual crowded square environment. Both groups also received a vestibular exercise home program to practice on days not attending clinic. A third group (D1) completed both the static and dynamic virtual reality training. Outcome measures included the DGI and questionnaires concerning symptom triggers and psychological state. Those groups who performed exercises within the dynamic virtual reality environment (D and D1) had significantly better visual vertigo scores than those who performed exercises inside the static virtual reality environment

(S). In contrast, depression scores increased only in Group S. DGI did not differ across groups; however, many subjects were already within the normal range prior to the initiation of the intervention. The investigators concluded that use of dynamic virtual reality environments should be considered as a useful adjunct to vestibular exercises for patients with chronic vestibular disorders and visual vertigo symptoms.

Based on the few randomized trials, clinicians may offer targeted exercise techniques to accomplish specific goals for improvement in exercise programs (activities related to body sway control for improved general stance and gait; exercises related to gaze stability and visual motion sensitivity for improved stability of the visual world and decreased sensitivity to visual motion; head movements in a habituation format to decrease sensitivity to head movement provoked symptoms).

R. Research Recommendation 3. There is sufficient evidence that vestibular exercises compared to no or placebo exercises is effective; thus, future research efforts should be directed to comparative effectiveness research. Researchers should directly compare different types of vestibular exercise in large clinical trials to determine optimal exercise approaches.

B. Action Statement 6. EFFECTIVENESS OF SUPERVISED VESTIBULAR PHYSICAL THERAPY. Clinicians may offer supervised vestibular physical therapy in patients with unilateral or bilateral peripheral vestibular hypofunction. (Evidence quality: I - III; Recommendation Strength: Moderate)

Action Statement Profile

Aggregate evidence quality: Level II. Based on numerous Level I, II and III studies.

Benefits: Possibly better compliance with a supervised exercise program.

Risk, Harm, and Cost:

- There is an increased cost and time spent traveling associated with supervised VRT.
- Without feedback from the supervising physical therapist, the patient may under or over-comply with the exercise prescription resulting in either lack of progress/improvement or increased symptoms potentially leading to stopping therapy.

Benefit-harm assessment:

- Preponderance of benefit for supervision.
- Evidence suggests that patients drop out at higher rates when unsupervised.

Value judgments:

- Supervised vestibular physical therapy appears to promote compliance and continued performance of vestibular exercises, which may lead to improved outcomes.
- Persons with impairment of cognition or moderate-severe mobility dysfunction may need supervision in order to benefit from vestibular physical therapy.
- People who are fearful of falling may not do well in an unsupervised exercise program.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role.

Exclusions:

- Patients who live at a distance may not be able to participate in supervised vestibular physical therapy.

Supporting Evidence and Clinical Interpretation

Several studies (Levels I[62] and II[21,44,66-68]) demonstrate that patients may respond better to customized, supervised rehabilitation than to generic exercises or solely a home program. The reason for these differences may be that supervised vestibular physical therapy promotes compliance and continued performance of vestibular exercises, which may lead to improved outcomes.

Two studies examined the effect of supervision during the acute stages of vestibular dysfunction with different outcomes. Kammerlind in a Level I study compared a supervised versus a home training group of vestibular exercises that included gaze stability and balance and gait exercises.[69] All patients received oral and written instructions for the vestibular exercises in the hospital and were instructed to exercise 15 minutes per day. The supervised group received three additional supervised physical therapy sessions in the hospital. Once discharged home, the supervised group received 10 additional supervised visits. At 1-week, 10-weeks and 6-months post-discharge, both groups improved in measures of balance and symptoms of vertigo, but were not different from each other. A Level I study in post-surgical acute patients compared patients who started exercises in the hospital to a control group who did no exercise.[39] In patients under 50 years of age, outcomes were equally good whether or not exercises were performed. The average age of Kammerlind's participants was 52 years and so the study outcomes may reflect the age of patients versus the role of supervision.[69]

Teggi in a Level II study compared a supervised exercise program with usual activity for patients hospitalized for an acute episode of vertigo.[44] Participants were randomly assigned to attend 10 therapy session (n=20) within 10 days of baseline assessment or were instructed to perform daily activities (n=20). Twenty- five days later, the group that underwent a supervised exercise program had better outcomes on all measures (DGI, computerized CTSIB, DHI, and a visual analog scale for anxiety) with the greatest change noted in the DGI. The results of this study are confounded by differences in exercises (vestibular exercises versus daily activities) and may explain the difference in outcomes compared to Kammerlind.[44,69]

Kao et al. in a Level II study compared supervised and home based (unsupervised) vestibular rehabilitation.[66] Both groups performed seated and standing eye movements and VORx1 as well as walking with head turns. The supervised group received an initial evaluation and individualized treatment plan followed by three, 30-minutes sessions per week with a physical therapist. The home group received an individualized treatment plan based on an initial evaluation and were not seen again by the physical therapist until outcomes were assessed at 2 months. The subjects self-selected their treatment group with 28 choosing supervised rehabilitation and 13 choosing home based or unsupervised rehabilitation. Both groups improved, but there were greater improvements in the supervised group compared to the home group for the DGI (86% versus 14%) and DHI (74% versus 26%). There are several limitations of this study that limit generalizability including small sample size, no randomization, and assessors that were not blinded to group.

Optokinetic training for visual vertigo was utilized in a Level I study.[70] Sixty patients were randomized into three groups: a supervised training group that utilized a full field environmental rotator, a supervised training group provided with a DVD, and an unsupervised training using a DVD. All subjects also received a customized program of gaze and postural stability exercises to perform at home. The outcome measures were visual vertigo symptoms, SOT and Functional Gait Assessment (FGA). SOT and FGA improved significantly for the supervised groups (full field and DVD groups) and anxiety scores improved for the supervised DVD group. The study has a major limitation related to the high dropout rate of 55% in the unsupervised group compared with 10% in the supervised groups. Pavlou et al concluded that supervision promotes greater compliance and improvements in postural stability and psychological state.[70] Yardley et al. in a Level I study reported “fair” self-reported adherence to an exercise booklet for persons with vestibular disorders.[71] In a subsequent study, she reported that additional advice or encouragement might improve compliance in a home based program.

Monitoring of the exercise program may have value as demonstrated by Shepard et al. in a Level III study.[72] The investigators reported that nausea, emesis and vertigo provoked by exercises could be managed by stopping the exercise session and resumption of exercises at the next session. In most cases, they found this approach to successfully allow continued participation. In those cases where this was not successful, they suggested that anti-emetic or vestibular suppressant medication may be required. Recommendations for use of anti-emetic drugs should be carefully considered due to concerns about slowing central compensation. For example, Strupp et al. limited anti-emetic use to a maximum of three days due to concerns for slowed vestibular compensation.[41]

Failure to return to the clinic[65,70,73], failure to comply with the exercise program[66,73] and illness have been noted as reasons for why people do not complete a program of vestibular exercises. In Pavlou's work, those with an unsupervised exercise program had higher dropout rates.[65,70] It is unknown why the dropout rate was higher in the unsupervised group.

R. Research Recommendation 4. Researchers should include measures of compliance in order to understand the impact of supervision. Researchers need to incorporate intent-to-treat research designs in order to understand dropout rates related to supervision.

D. Action Statement 7. EVIDENCE FOR OPTIMAL EXERCISE DOSE OF TREATMENT IN PEOPLE WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL AND BILATERAL). Based on extrapolation from the evidence and expert opinion, physical therapists may prescribe a minimum of 3 times per day for a total of 20 minutes daily of gaze stability exercises to induce recovery of function. (Evidence Quality: V; Recommendation Strength: Expert opinion)

Action Statement Profile

Aggregate evidence quality: Level V based on lack of direct evidence on exercise dose. Best practice based on the clinical experience of the guideline development team and guided by the evidence.

Benefit:

- Improved outcomes with appropriate exercise dose

Risk, Harm and Cost:

- Risk of provoking temporary dizziness during and after performance of exercises.
- Risk of increased nausea and possible emesis when exercises are performed during most acute stage.
- Some physicians may want to delay exercises during the early post-operative stage in some patients because of risk of bleeding or CSF leak.
- Increased cost and time spent traveling associated with supervised vestibular physical therapy.

Benefit-harm assessment:

- Preponderance of benefit over harm

Value judgments:

- Benefit of gaze stability exercises in patients with unilateral vestibular hypofunction has been demonstrated in numerous Level l and Level II studies; however, the frequency and intensity of the exercises is based on extrapolation from research studies rather than based on direct evidence.

Role of patient preferences:

- minimal

Exclusions:

- Patients at risk for bleeding or CSF leak.

Supporting Evidence and Clinical Interpretation

There are few studies to date that have examined in what ways, if any, exercise dose (frequency and intensity) affects outcomes in patients with unilateral or bilateral vestibular hypofunction. Two studies examined the influence of exercise intensity on outcomes.[74,75] Cohen et al. compared two groups of patients, one performing exercises with rapid head movements (i.e., approximately 1-2 Hz) and the other group performing exercises with slow head movements (approximately 0.04 Hz), 5 times per day for a total of 4 weeks. They reported both groups improved equally in vertigo intensity, vertigo frequency and on a functional repetitive head movement task suggesting that the dose intensity (frequency of head movement) was not a factor in recovery. There are some limitations to the study that confound the interpretation of the data however. First, it is not clear that the groups were equivalent at baseline on the timed repetitive head movement task and second, the data suggest that the time to perform the repetitive head movement task did not improve until four months after initiation of exercises.

Although far from ideal, some information on exercise dose can be found by comparing the findings from multiple studies.

Acute and sub-acute post-operative patients: Two Level I and one Level II studies have examined the effect of gaze stabilization exercises on recovery of patients during the early post-operative period after vestibular schwannoma resection.[16,18,42] Patients performed gaze stabilization exercises 3 to 5 times daily for a total of 12-20 minutes a day and reported improvement in subjective complaints of imbalance[18,42], DHI[16] and stability while walking with voluntary head movements.[18] These results suggest that as little as 12 minutes of gaze stabilization exercises a day over 3 exercise periods may be sufficient to induce recovery in patients during the acute and sub-acute stage after vestibular schwannoma resection.

Chronic unilateral vestibular hypofunction: Four studies (two Level I and two Level II), each examining the effect of vestibular rehabilitation on outcomes in patients with chronic unilateral vestibular hypofunction included sufficient details on the type, frequency and duration of exercise to provide some guideline as to exercise dose in these patients.[19,20,66] In these studies, patients performed the gaze stability exercises 3-5 times per day for a total of 20-40 minutes each day.[19,20,66,76] Patients performing these exercises improved compared to a control group. The data suggest that a minimum of performing the exercises 3 times per day for a total of 20 minutes daily may be sufficient to induce recovery.

R. Research Recommendation 5. Researchers should examine impact of frequency, intensity, time and type of exercises rehabilitation outcomes. Researchers should determine difficulty of exercises and how to progress patients in a systematic manner.

D. Action Statement 8: DECISION RULES FOR STOPPING VESTIBULAR PHYSICAL THERAPY IN PEOPLE WITH PERIPHERAL VESTIBULAR HYPOFUNCTION (UNILATERAL AND BILATERAL). Based on extrapolation from the evidence and expert opinion, physical therapists may use achievement of primary goals, resolution of symptoms, or plateau in progress as reasons for stopping therapy. (Evidence Quality: V; Recommendation Strength: Expert opinion)

Action Statement Profile

Aggregate evidence quality: Level V. Based on extrapolation from methodology and results in 69 studies, it may be advisable to consider the following in the decision to stop treatment:

1. Goals are met, a plateau has been reached, or patient is no longer symptomatic
2. Non-compliance / patient choice
3. Deterioration of clinical status or a prolonged increase in symptoms
4. Fluctuating/unstable vestibular conditions (e.g., Meniere's) and co-morbid musculoskeletal, neurologic, cardiac, visual, cognitive, psychological or disability-related conditions affecting ability to participate
5. Overall length of treatment

Benefits:

- More efficient management of treatment duration, avoiding cessation of treatment before optimal recovery is achieved or continuing treatment for unreasonably protracted periods.

Risk, Harm, and Cost:

- Prematurely stopping treatment before maximum gains are achieved.

- Protracted treatment is costly to the payer, the patient and the physical therapist who are not seeing documented improvement, and to other patients who are waiting to receive treatment.

Benefit-harm assessment:

- Preponderance of benefit over harm

Value judgments:

- No concrete stopping rules have been explored in the research; however, numerous level I through IV studies provide comments and findings that can assist in the decision-making process.

Role of patient preferences:

- It is the patient's decision whether or not to participate in vestibular physical therapy and when to stop vestibular physical therapy.

Patient exclusions:

- Patients with impaired cognition or moderate to severe mobility dysfunction may need a greater number of treatment sessions, so using the treatment duration based on research (which typically excludes these patients) may not be appropriate.
- Patients with moderate to severe motion sensitivity may also benefit from a greater number of treatment sessions.
- In a Level II study, patients taking vestibular suppressant medication required additional treatment sessions (11 versus 9 weeks before plateau; Shepard, 1993).

Supporting Evidence and Clinical Interpretation

There are no studies that have specifically examined decision rules for stopping vestibular physical therapy in those with unilateral or bilateral peripheral vestibular hypofunction. An investigator's *a priori* decision relative to the research design determines the length of the intervention; thus, the duration of treatment is protocoldriven and not based on patient outcomes. Furthermore, the length of the study intervention may affect a patient's willingness to participate in the study. Thus, we cannot extrapolate from research studies to create clinical stopping rules based on current research design.

Implicit reasons for stopping therapy in a clinic setting include ideally, the patient no longer being symptomatic, goals being met or a plateau being reached[2,77]; for example, Hall's level III study (2004) reported discharge from treatment when 75% of goals were met.[17] Multiple studies cited non-compliance as a reason to discontinue treatment. Only a few studies provided specific criteria, such as missing at least 3 treatment sessions or 30% of therapy sessions.[41,68,78] Some reasons that patients report noncompliance with vestibular therapy include the following: unrelated health issues, finding the exercises too provoking, family or work conflicts, litigation, travel or time inconvenience, loss of interest or motivation and feeling better.

Deterioration of clinical status was cited as a reason for 9 of 37 patients showing an increase DHI score in a level II study by Perez and seems an obvious reason to pause or stop treatment; however, if worsening of subjective complaints is a factor in the consideration to stop treatment, the following studies may provide some guidance.[79] A level IV study found that nausea, body shift, dizziness, and stress were increased during first two weeks of intervention, but subsided by week two.[80] Szturm's RCT level I study found that the adverse effects of moderate to strong dizziness, nausea, and disorientation during exercises subsided within 2-5 weeks.[62] Thus, worsening symptoms during the one or two weeks of the VPT program should not necessarily be considered as a reason for stopping therapy. However, more persistent worsening symptoms should be carefully considered as reason to discontinue therapy.

Numerous factors were identified by researchers to exclude patients from studies or to drop subjects from study participation. These factors may also provide guidance for stopping or deferring therapy if a patient is not showing progress. Factors include: 1) progressive, fluctuating, or unstable vestibular conditions (i.e., vestibular schwannoma, episodes of spontaneous vertigo, unrepaired perilymphatic fistula and active Meniere's disease); 2) musculoskeletal conditions affecting the ability to stand or perform exercises; 3) CNS or other neurologic diseases or conditions (e.g., head injury) affecting balance, motor control, muscle strength or somatosensation; 4) significant cardiac problems; 5) severe visual disorders or blindness; 6) cognitive impairment affecting comprehension; 7) severe migraine; 8) psychological conditions. In Shepard's level II study in 1993, those with head injury showed a substantially less reduction in symptoms than the rest of the subjects and comprised a significantly higher percentage of those showing no change or worsening.[67]

Pre-treatment disability could also be considered when deciding whether or not to discontinue therapy in a patient, as patients with high disability scores may be more resistant to change and may be less likely to improve based on one level II study[67] and three level III studies.[59,72,81]

Based on expert opinion extrapolated from the evidence, clinicians may consider providing enough supervised vestibular physical therapy sessions for the patient to understand the goals of the program and how to manage and progress independently. Sixty-one of the prospective studies reported that treatment duration for vestibular rehabilitation ranged from 5 days to 16 weeks (average = 6.7 weeks). However, the researchers did not provide justification for the length of treatment time chosen for their studies. In 20 retrospective studies that reflect clinical practice (based on chart review) treatment duration for vestibular rehabilitation ranged from 2 weeks to 38 weeks (average = 10.0 weeks); however, some patients with BVH may need a longer course of treatment than individuals with UVH. As a general guide, persons without significant comorbidities that affect mobility and with acute or subacute unilateral vestibular hypofunction (UVH) may only need 2-3 sessions; persons with chronic UVH may need 4-6 weekly sessions; persons with bilateral vestibular hypofunction may need a longer course of treatment (8-12 weekly sessions) than persons with UVH.

Finally, based on expert opinion, the advisory panel recommends that before stopping therapy for patients who remain symptomatic or have not met their goals, consultation with another vestibular physical therapist colleague would be advisable.

R. Research Recommendation 6. Researchers should determine optimal duration of vestibular physical therapy for favorable outcomes and the factors that impact functional recovery.

C. Action Statement 9: FACTORS THAT MODIFY REHABILITATION OUTCOMES. Based on weak to strong evidence, physical therapists may evaluate factors that could modify rehabilitation outcomes. (Evidence quality: I-III; Recommendation Strength: Weak to Strong)

Action Statement Profile

Aggregate evidence quality: Age: Level I. Based on four Level I randomized controlled trials and two Level II quasi experimental studies. Gender: Level III. Based on one Level II and two Level III studies. Time from onset: Level III. Based on one Level I randomized controlled trial and three Level III studies, one with contradictory results to the others. Comorbidities: Level III. Based on one Level I randomized controlled trial, two Level II and one Level III study.

Benefits:

- Older patients obtain similar benefits from vestibular physical therapy.

Risk, Harm, and Cost:

- Peripheral neuropathy may increase risk of falling and negatively impact rehabilitation outcomes.

Benefit-harm assessment:

- Vestibular physical therapy has been shown to improve outcomes regardless of time from onset; however, the potential harm (decreased quality of life, falls) to initiating rehabilitation later warrants initiating rehabilitation as soon as possible.

Value judgments:

- Little evidence is available to make decisions about how to consider factors that may affect outcomes.

Role of patient preferences:

- Cost and availability of patient time and transportation may play a role, especially with older patients who may have transportation issues.

Exclusions:

- none

Supporting Evidence and Clinical Interpretation

Several non-disease-related modifying factors—including age, gender, time from onset of symptoms to start of rehabilitation, and comorbidities—have been evaluated for their impact on vestibular rehabilitation outcomes.

- **Age**: Increased age does not affect potential for improvement with vestibular physical therapy. Clinicians should offer vestibular rehabilitation to older adults with the expectation of good outcomes. (Evidence quality: I; Recommendation Strength: Strong).
- **Gender**: Gender may not impact rehabilitation outcomes and clinicians may offer vestibular rehabilitation to males and females with expectation of similar outcomes. (Evidence quality: III; Recommendation Strength: Weak).
- **Time from onset (acute)**: Earlier intervention improves rehabilitation outcomes; thus, vestibular rehabilitation may be started as soon as possible following acute onset of vertigo (Evidence quality: II; Recommendation Strength: Moderate).
- **Time from onset (chronic)**: Vestibular exercises have been shown to improve outcomes regardless of time from onset; however, the potential for harm related to decreased quality of life or falls suggests that therapists may initiate rehabilitation as soon as possible. (Evidence quality: I-III; Recommendation Strength: Moderate).

- **Comorbidities**: Anxiety, migraine, and peripheral neuropathy may negatively impact rehabilitation outcomes. (Evidence quality: III; Recommendation Strength: Weak).

Supporting Evidence and Clinical Interpretation

Several non-disease-related modifying factors have been evaluated in various studies. These factors include age, gender, time from onset of symptoms until starting vestibular rehabilitation, and comorbidities. A single study addressed the effect of medication use. The level of evidence for these studies ranged from level I to level III.

Eleven studies evaluated the effect of age and none demonstrated a significant effect of age on the efficacy of vestibular rehabilitation. Six studies evaluated the influence of age on vestibular physical therapy in patients with unilateral vestibular hypofunction; of these, three studies had an evidence level of I,[19,39,82] one study had an evidence level of II,[68] and two studies had an evidence level of III.[2,17] Four studies evaluated the influence of age on vestibular rehabilitation in patients with various diagnoses including both peripheral and central vestibular deficits; of these one study had an evidence level of II,[66] and three studies had an evidence level of III.[81,83,84] One Level I study evaluated the influence of age on vestibular rehabilitation in patients with bilateral peripheral vestibular deficits.[20]

Three studies evaluated the effect of gender and none demonstrated a significant effect of gender on the efficacy of vestibular rehabilitation. Two of these – one Level II[68] and one Level III[2] – evaluated the influence of gender on vestibular rehabilitation in patients with unilateral vestibular hypofunction. One Level III study evaluated the influence of gender on vestibular rehabilitation in patients with various diagnosis including both peripheral and central vestibular deficits.[66]

Two Level I studies examined the effects of vestibular exercises solely in the acute stage following resection of vestibular schwannoma.[18,26] Both studies provide evidence that early intervention is beneficial. Herdman started vestibular physical therapy 3 days post-surgery and continued until discharge from the hospital.[18] Participants randomized to receive gaze stability exercises were less symptomatic and had better postural stability at discharge than the placebo group. Enticott compared a cohort of patients who were randomized to VPT (gaze stability exercises) versus a control group starting post-op day 3.[16] The VPT group had lower perceived disability (based on DHI) over the course of 12 weeks.

Six studies of patients with chronic vestibular hypofunction evaluated the effect of time from onset of symptoms until starting vestibular rehabilitation. Four studies evaluated patients with unilateral vestibular hypofunction with conflicting results. One Level III study indicated that earlier intervention produced better results.[85] The other three studies, one of which had level I evidence[19] and two with level III evidence,[2,17] showed no effect of duration of symptoms prior to initiation of vestibular rehabilitation therapy. A Level III study of patients with various diagnosis including both peripheral and central vestibular deficits also found no effect of time from onset of symptoms until starting vestibular rehabilitation.[81] One Level I study determined that time from onset of symptoms did not affect the outcomes of the vestibular physical therapy in individuals with bilateral vestibular hypofunction.[20] In each of these studies, participants improved with vestibular physical therapy; thus, these studies demonstrate that vestibular physical therapy improves outcomes regardless of time from onset.

Four studies evaluated the effect of comorbidities on response to vestibular rehabilitation. Two studies evaluated the influence of anxiety. In a study of patients with unilateral peripheral vestibular deficits, anxiety was found to result in decreased balance confidence based on level III evidence.[2] In a study of patients with various diagnoses, higher anxiety was associated with poorer scores on the DGI based on level II evidence.[44] In persons with psychological conditions (anxiety/depression), addressing psychological needs as an adjunct to physical therapy may increase the success of the intervention based on evidence from level I, II and III studies.[44,71,86,87]

A single study reported a negative effect of peripheral neuropathy on vestibular rehabilitation in patients with peripheral vestibular disorders based on level II evidence. Arnada examined a mixed population of individuals with UVH or BVH and diabetes with or without peripheral neuropathy.[88] They found that individuals with peripheral neuropathy had no improvement on measures of standing balance with eyes open and closed on a firm surface, and eyes open on a compliant surface; individuals without peripheral neuropathy demonstrated significant improvements in these test conditions. These findings suggest that peripheral neuropathy may have a negative impact on recovery of function.

Two studies (one Level I[89]13 and one Level III[90]) investigated the impact of migraine on rehabilitation outcomes and found that individuals with vestibular dysfunction and migraine had poorer outcomes in terms of quality of life as measured by DHI. Another Level I study reported that patients with migraine improved in symptoms of visual vertigo more than patients without migraine.[70] These study findings are in contrast to Vitkovic and Wrisley and may reflect the use of an optokinetic stimulus.[89,90]

A single study, based on level III evidence, reported that patients with various disorders who were using centrally active medications such as vestibular suppressants, antidepressants, tranquilizers, and anticonvulsants, required a longer duration of therapy to achieve the same benefit as compared with patients who were not using medications.[72]

R. Research Recommendation 7. Researchers should perform longitudinal studies. Researchers should examine time from onset and to see if they affect short- and long-term outcomes.

A. Action Statement 10: THE HARM/BENEFIT RATIO FOR VESTIBULAR PHYSICAL THERAPY IN TERMS OF QUALITY OF LIFE/ PSYCHOLOGICAL STRESS. Based on strong evidence and a preponderance of benefit over psychological harm, clinicians should offer vestibular physical therapy to persons with peripheral vestibular hypofunction. (Evidence quality: Level I-III; Recommendation Strength: Strong)

Action Statement Profile

Aggregate evidence quality: Level I-III based on randomized trials and descriptive studies. No targeted randomized trials are available to directly answer the question of the harm/benefit ratio of vestibular rehabilitation for persons with vestibular hypofunction; however, quality of life measures have been used as primary outcome measures in a number of studies.

Benefits:

- There are improved quality of life and psychological outcomes of persons undergoing vestibular physical therapy when compared to controls who receive sham or no exercise interventions.

Risk, Harm and Cost:

- Neck pain, motion sickness, and nausea have been reported as side effects of rehabilitation and these can affect quality of life.
- Dizziness as a side effect of the exercises could increase psychological distress in some patients.

Benefit-harm assessment:

- Preponderance of benefit, although not all patients improve with vestibular physical therapy.

Value judgments:

- There is sufficient evidence of improved quality of life and reduced psychological distress with vestibular physical therapy.

Role of patient preferences:

- Cost and availability of patient time, location of the vestibular physical therapy clinic, and transportation may play a role.

Exclusions: None.

Supporting Evidence and Clinical Interpretation

Loss of vestibular function can result in postural instability, visual blurring with head movement, and subjective complaints of dizziness and/or imbalance. Although vestibular physical therapy was not provided, Sun et al. recently reported via a quality of life survey that persons with bilateral vestibular loss had impaired quality of life plus loss of work days as a result of their dizziness.[91]

Quality of life has been reported to improve post vestibular physical therapy for persons with unilateral vestibular dysfunction (Level I: Johansson, 2001[92]; Rossi-Isquierdo, 2011[93]; Winkler, 2011[94]; Level II: Clendaniel, 2010[61]; Badaracco, 2007[95]; Enticott, 2005[16]; Gottshall, 2005[96]; Mantello, 2008[97]; Meli, 2006[98]; Morozetti, 2011[99]; Murray, 2001[86]; Perez, 2006[79]; Schubert, 2008[76]; Tee, 2010[100]; Teggi, 2008[44]; Topuz, 2004[68]; Level III: Cowand,1998[101]; Patatas, 2009[83]; Level IV: Bittar, 2002[102]) and bilateral loss (level I: Krebs, 1993[22]; level III: Brown, 2001[54]; Gillespie & Minor, 1999[55]) based on improvements in the DHI. Although the DHI was designed to measure the handicapping effects of dizziness, it has also been used as a measure of quality of life to record improvements over time. Others have utilized the Activities-specific Balance Confidence scale to note beneficial changes over time in patients balance (level I: Enticott, 2005[16]; level II: Gottshall, 2005[96]; Badaracco, 2007[95]; Meli, 2006[98]; level III: Brown, 2001[57]). The improvements in the DHI and the ABC suggest that persons are less dizzy and have improved perception of balance after a course of vestibular physical therapy.

Harm/benefit ratios were not specifically noted in any of the literature reviewed related to quality of life and psychological distress. Occasional mentions were made about negative side effects of the vestibular physical therapy program and that not all patients improve. Herdman et al recently reported in a Level III study that anxiety and depression were associated with lower balance confidence scores, a quality of life measure in persons with unilateral hypofunction.[2] This suggests that co-existing anxiety and depression might potentially diminish potential beneficial effects of an exercise program. Cohen in a Level II study reported nausea as a side effect of the exercise program, which could affect quality of life.[74] Although nausea if a common side effect of exercise, it has not been routinely reported in the literature as being “harmful” or resulting in drop outs from a vestibular physical therapy exercise program.

Telian et al. in a Level II study reported that a majority of patients (82% of the patients, n=65) indicated that they had improved; whereas, 12% reported feeling worse. Almost half of their subjects had central vestibular disorders.[81] Of the 12% who were worse after VRT, it is not reported whether these people had central or peripheral vestibular diagnoses. Bittar in a Level IV study also reported that 14% of their subjects were not any better after rehabilitation,[103] which is similar to the Telian et al. report.[81] Therefore, there is the possibility that people will undergo the exercise program and not change their quality of life.

Meli et al. (Level III) studied 42 people prospectively and followed up at 6 months to determine if they had improved after a course of vestibular rehabilitation.[98] The Medical Outcomes Study 36 item-short form (SF-36) improved in their subjects, except bodily pain and vitality. Younger subjects reported worse SF-36 scores, suggesting that dizziness may have more effect on their lives with work and possibly a busier schedule than the older adults studied.

Return to work is an important measure of the benefit of any exercise program; however, virtually no researchers have incorporated a measure of return to work. Chen et al. in a Level IV trial reported that in 3 out of 3 of their subjects they were able to return to work and drive.[80] All had chronic symptoms prior to starting the Wiimote gaze stabilization exercise program. Improvements in driving have been noted in others with chronic unilateral hypofunction after an exercise program.[104] In one Level II study[49] and five Level III studies,[67] patient’s perceived disability has been reported to positively change after rehabilitation. This disability scale includes ability to work as a portion of the instrument, yet no studies specifically report how frequently people are able to return to work effectively after vestibular physical therapy (level II: Giray, 2009[49]; Shepard, 1993[67]; level III: Shepard, 1990[72]; Telian, 1990[81]; Telian, 1991[59]).

In two randomized trials (Level II), Pavlou et al. reported that the autonomic/somatic anxiety scores decreased (improved anxiety) with vestibular physical therapy.[65,70] Pavlou et al also reported positive changes on the Hospital Anxiety and Depression- A and B Scale plus the Speilberger State Trait Anxiety Inventory, suggesting that after rehabilitation their subjects were less anxious.[65,70] A visual analog scale for anxiety improved when compared to control subjects at 25 days post hospitalization for acute vertigo (Level II).[44] The exercise group participated in 10 sessions that included dynamic posturography training and gaze stabilization exercises. There is emerging evidence that psychological distress and anxiety are decreased with exercise in persons with vestibular hypofunction.

R. Research Recommendation 8. Researchers should examine the concept of return to work. Areas for study include job requirements that may be difficult for patients with vestibular hypofunction, job modification or assistive technology to allow return to work, criteria for return to work or disability assignment, indicators for return to safe driving.

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