Vestibular Rehabilitation for Unilateral Peripheral Vestibular Dysfunction

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<LEAP> highlights the findings and application of Cochrane reviews and other evidence pertinent to the practice of physical therapy. The Cochrane Library is a respected source of reliable evidence related to health care. Cochrane systematic reviews explore the evidence for and against the effectiveness and appropriateness of interventions—medications, surgery, education, nutrition, exercise—and the evidence for and against the use of diagnostic tests for specific conditions. Cochrane reviews are designed to facilitate the decisions of clinicians, patients, and others in health care by providing a careful review and interpretation of research studies published in the scientific literature.[1] Each article in this PTJ series summarizes a Cochrane review or other scientific evidence on a single topic and presents clinical scenarios based on real patients or programs to illustrate how the results of the review can be used to directly inform clinical decisions. This article focuses on an adult patient with unilateral peripheral vestibular hypofunction. Could a physical therapist–guided vestibular rehabilitation program decrease his symptoms and improve his function?

Find the <LEAP> case archive at http://ptjournal.apta.org/cgi/collection/leap.

Dizziness is a common patient complaint in primary care practice and results in more than 6 million physician visits per year in the United States alone.[2] From 2001 through 2004, 35.4% of US adults aged 40 years and older had vestibular dysfunction, the majority being diagnosed with unilateral peripheral vestibular dysfunction (UPVD).[3,4] Symptoms of UPVD include dizziness, visual disturbance, imbalance, and functional deficits. The diagnosis of UPVD is made by a detailed history; a thorough clinical examination, including oculomotor and vestibular ocular reflex (VOR) testing; and laboratory testing, such as electronystagmography and caloric testing.

Potential causes of UPVD include vestibular neuritis, vestibular labyrinthitis, Ménière disease, perilymphatic fistula, acoustic neuroma, and benign paroxysmal positional vertigo (BPPV).[5] With the exception of BPPV, those diagnoses result in vestibular hypofunction (decreased vestibular function). Benign paroxysmal positional vertigo, the most common cause of vestibular dizziness,[6,7] results when dislodged otoconia crystals are present in a semicircular canal. With changes in head position, those displaced otoconia cause abnormal vestibular output, resulting in vertigo and imbalance. Canalith repositioning maneuvers are the standard treatment for a patient diagnosed with BPPV.[8,9]

Treatment for vestibular hypofunction consists of vestibular rehabilitation and medical management, which may include vestibular suppressant medications or surgery. Rehabilitation for vestibular hypofunction combines exercises and patient education to manage the signs and symptoms of UPVD.[5,10] It includes exercises to facilitate habituation and adaptation and to promote motor and sensory substitution strategies.

Habituation exercises decrease dizziness and nausea through repetition of symptom-provoking head movements.[11] Adaptation exercises consist of repeated head movements while focusing on a target.[12,13] They improve gaze stability through adaptation of the VOR[12,13] and development of compensatory saccadic eye movements.[14] These saccadic eye movements provide motor substitution for an impaired VOR. Sensory substitution exercises promote the use of nonvestibular sensory systems to assist with postural control.[15] Detailed descriptions of specific habituation, adaptation, and substitution exercises are available elsewhere.[10,16]

To determine the effectiveness of vestibular rehabilitation, Hillier and McDonnell conducted a systematic review of the literature published in the *Cochrane Database of Systematic Reviews* in 2011.[5] This review is an update of a previously performed review first published in *The Cochrane Library* in 2007.[17] It included 27 randomized controlled studies utilizing vestibular rehabilitation to treat community-dwelling participants with symptoms of UPVD. *Vestibular rehabilitation* was defined as predominantly exercise and movement based and did not include passive repositioning maneuvers. The trials compared ves-

tibular rehabilitation with a control treatment, with other non–vestibular rehabilitation treatment, or with a different form of vestibular rehabilitation. A large variety of outcome measures were utilized. The Appendix summarizes the findings of this review.

Take-Home Message

The evidence presented in the systematic review by Hillier and McDonnell[5] supports movement- and exercise-based vestibular rehabilitation as an effective treatment for UPVD. Vestibular rehabilitation positively affects dizziness, gait, activities of daily living, gaze stability, and balance. The systematic review also showed that repositioning maneuvers for the treatment of BPPV were superior to movement-based vestibular rehabilitation in the short term. Canalith repositioning maneuvers plus vestibular rehabilitation was more effective in the long term in improving patient mobility as measured by the Dynamic Gait Index (DGI) for patients diagnosed with BPPV.

Case #13: Applying Evidence to a Patient With UPVD

Can a vestibular rehabilitation program help this patient?

Mr Luther is a 60-year-old bank teller who awoke in the night with constant vertigo (room-spinning dizziness), nausea, vomiting, and imbalance. He was transported to the emergency department, where he complained of blurry vision with quick head movements, but had no change in hearing. His past medical history was unremarkable, and his family history was noncontributory. Mr Luther reported having had a flu-like illness 2 weeks prior to the onset of vertigo.

The computed tomography scan and magnetic resonance image of the head were negative, and the blood work results were within normal limits. Because the neurological examination was negative for central signs, cerebrovascular accident, multiple sclerosis, and brain tumor were ruled out quickly. The differential diagnosis at the time of this work-up was for vestibular neuritis, vestibular labyrinthitis, or migraine. The patient was given a vestibular suppressant medication and sent home with instructions to follow up with his primary care physician in the next week.

Mr Luther saw his primary care physician 5 days after the initial episode of vertigo. He still complained of imbalance, dizziness, blurry vision during rapid head movements and unstable gait. Using a computer at work, walking on uneven surfaces, and driving increased his symptoms. His primary care physician referred him to an otorhinolaryngologist for further evaluation. The videonystagmography results were normal, but caloric testing showed a 35% weakness in the right ear. Positional testing for BPPV with visual fixation removed by infrared goggles was negative. The patient was diagnosed with a right UPVD secondary to vestibular neuritis. The physician advised him to discontinue his vestibular suppressant and referred him to a physical therapist for vestibular rehabilitation.

The physical therapist evaluated Mr Luther 10 days after the initial onset of his symptoms. A review of systems showed no musculoskeletal or central nervous system impairments. All position testing for BPPV was negative. Oculomotor testing revealed a left-beating spontaneous vestibular nystagmus with light fixation removed by Frenzel lenses. Clinical gaze stability testing revealed an impaired VOR at slow and fast head speeds and a positive right head thrust test in the horizontal plane.[20] During the clinical dynamic visual acuity (DVA) test,[21] Mr Luther had a visual acuity of 20/20 with his head still, but with passive head rotation at a frequency of 2 Hz, his visual acuity decreased to 20/200. Although the limitations of the clinical DVA test have been well documented,[22] the computerized DVA test was not available in the clinic.

Mr Luther scored 16/24 on the DGI,[23] indicating that he was at increased risk for falls.[24] His computerized dynamic posturography[25] results were abnormal compared with age-matched data and demonstrated an impaired ability to maintain balance when visual and somatosensory cues were altered.

His Dizziness Handicap Inventory (DHI) score of 36% indicated a moderate perception of handicap due to dizziness.[19] The patient exhibited imbalance during gait assessment, stepping outside a 30.48-cm-wide (12-in-wide) path 5 times over a 6.1-m-long (20-ft-long) walkway. Mr Luther's reported functional problems were supported by a score of 4 on the Vestibular Disorders Activities of Daily Living Scale (VD-ADL).[26,27] At the start of his evaluation, Mr Luther rated his dizziness as 4/10 using a visual analog scale.[28] His self-rated dizziness increased to 8/10 during the evaluation. Outcome measures were selected based on primary and secondary outcomes described in the Cochrane review.

How did the physical therapist apply the results of the Cochrane review to Mr Luther?

Using the PICO (Population, Intervention, Comparison, Outcome) format, the physical therapist asked the question: Could a 60-year-old man diagnosed with UPVD benefit from a physical therapist–directed vestibular rehabilitation program? The therapist identified that the information contained in the systematic review would be useful in developing an

evidence-based vestibular rehabilitation program for Mr Luther.

In the studies reviewed by Hillier and McDonnell,[5] participants were community-dwelling adults with a diagnosis of UPVD. The ages of the participants varied, but most were aged 65 years or older. Mr Luther's community-dwelling status, age, and diagnosis fit the inclusion criteria for a majority of the studies. Although a study of BPPV by von Brevern et al[7] showed a higher incidence in women than in men, no studies have examined the potential relationship between sex and incidence of unilateral vestibular hypofunction. Treatment interventions and outcome measures utilized in the studies varied widely. Trials compared vestibular rehabilitation with a control treatment, with other non–vestibular rehabilitation treatment, or with a different form of vestibular rehabilitation. Based on the results of the systematic review, Hillier and McDonnell concluded there is moderate to strong evidence that vestibular rehabilitation is a safe and effective treatment for UPVD. There is moderate evidence supporting vestibular rehabilitation for symptom reduction and improvement in function. There is insufficient evidence to determine whether 1 type of vestibular rehabilitation is more effective than another. It appears that even the most basic approach of providing education, encouraging movement, and prescribing home exercise may be effective in treating people with UPVD.

Using the evidence in the systematic review, the physical therapist developed an individualized vestibular rehabilitation program for Mr Luther. It consisted of 7 one-hour treatment sessions scheduled once per week. The goal of each supervised therapy session was to progress Mr Luther's individualized home exercise program and ensure proper exercise technique. The program included progressive gaze stabilization exercises and static and dynamic balance exercises. Gaze stability exercises included horizontal and vertical head movements performed while the patient moved his head as quickly as possible while ensuring that the target stayed in focus. These exercises were performed with near and far targets 4 to 5 times a day.[13] Static and dynamic balance exercises were performed on compliant surfaces with varied foot positions. Available visual input was altered by having Mr Luther close his eyes or wear blurry glasses to obscure his vision. He was asked to rate his dizziness at the beginning and end of each session using a visual analog scale to determine correct exercise intensity. A small increase in dizziness symptoms was deemed an acceptable response to the exercises. Periodically throughout his course of care, the physical therapist provided education about his diagnosis, course of treatment, and prognosis.

Due to the heterogeneity of the studies in the systematic review, the ideal dosage of vestibular rehabilitation is not clear. The physical therapist's treatment frequency and duration are consistent with those of several studies included in the Cochrane Review.[29–31] Some studies in the systematic review used a minimalist treatment approach of only 1 supervised visit to prescribe a home exercise program.[32] However, Mr Luther was typical of many patients in that he needed feedback to perform his exercises correctly and weekly monitoring to ensure that his home program continued to be challenging.

How well do the outcomes of the intervention provided to Mr Luther match those suggested by the systematic review?

The evidence presented in the systematic review shows that vestibular rehabilitation positively affects dizziness, gait, activities of daily living, gaze stability, and balance. After 7 weeks of treatment, Mr Luther reported 0/10 dizziness and scored an 8% on the DHI, indicating minimal perception of handicap from dizziness. With the exception of the DHI, the majority of vestibular outcome measures do not have established minimal clinically important difference (MCID) values. The MCID for the DHI is 18 points; therefore, Mr Luther's change of 28 points may be considered clinically important.[19] He had a normal score on computerized dynamic posturography and a score of 24/24 on the DGI. Over the 6.1-m-long walkway, he easily stayed inside a 30.48-cm-wide path. Mr Luther's gaze stability was within normal limits, with a change in visual acuity from 20/20 to 20/30 on the DVA test. He scored "independent" on the VD-ADL and was able to resume his premorbid roles and responsibilities without symptoms. Mr Luther attended all 7 treatment sessions and reported no adverse effects from his course of treatment.

Can you apply the results of the systematic review to your own patients?

The findings of this systematic review apply to community-dwelling adults. The ages of the participants in the reviewed studies varied, but they were predominantly 65 years or older. The participants had one of the following diagnoses: vestibular neuritis, labyrinthitis, acoustic neuroma, perilymphatic fistula, Ménière disease, or BPPV. The majority of the participants had unilateral hypofunction from acoustic neuroma resection, vestibular neuritis, or vestibular labyrinthitis. Therefore, the results of the systematic review apply mostly to those diagnoses.

What can be advised based on the results of this systematic review?

Patients with UPVD similar to that of Mr Luther will most likely benefit from vestibular rehabilitation to reduce functional deficits and symptoms of dizziness, visual disturbance, and imbalance. Participants in a vestibular rehabilitation program show a significant improvement in quality of life and resumption of premorbid roles and responsibilities.

Evidence for the appropriate dosage and ideal form of vestibular rehabilitation is inconclusive. It appears that even the most basic approach of providing education, encouraging movement, and prescribing home exercise may be effective. The evidence in the systematic review supports vestibular rehabilitation as an effective, safe treatment for people with UPVD; however, further research is needed to determine the appropriate dosage and delivery method of vestibular rehabilitation.

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Appendix.

Key Results of Vestibular Rehabilitation for Unilateral Peripheral Vestibular Dysfunction in the Systematic Review by Hillier and McDonnell[5,a]

Search date: July 1, 2010[5]
27 randomized controlled trials with a total of 1,668 participants were included in this review. The mean sample size was 65 participants (range=14–360).
The mode, duration, frequency, intensity, and setting for exercise varied across the studies: ● 13 studies compared VR with a control/sham treatment (placebo, sham treatment, or non-VR exercises) ● 6 studies compared VR with other non-VR treatment (eg, pharmacological, surgical, or CRM) ● 5 studies compared VR with other forms of VR (different combinations of habituation, gaze stabilization, balance, and gait/activity training)
The participants were community-dwelling adults with UPVD. Diagnoses included: ● vestibular neuritis/labyrinthitis ● acoustic neuroma ● perilymphatic fistula ● Ménière disease ● BPPV The age range varied, but participants were predominantly age 65 years or older, which reflects the increased incidence of UPVD with increasing age. Participant sex was not reported.
Overall risk of bias for the included studies was low. However, information regarding the methods used to randomly assign participants or to blind them to this process was lacking. Ten studies blinded participants, investigators, and outcome assessors. Six studies did not blind participants, investigators, or outcome assessors. One study blinded participants only, and 10 studies did not provide information regarding the blinding of participants, investigators, or outcome assessors.
VR was defined as exercise and movement based and did not include passive repositioning maneuvers.
A variety of outcome measures based on symptoms or functional abilities were utilized: ● Dizziness cure rate: a dichotomous scale. Participants report whether dizziness is cured or still remains. ● Subjective improvement in dizziness: a dichotomous scale. Participants rate dizziness symptoms as improved or same/worse. ● VSS: a 14-item scale rating frequency of dizziness/vertigo, imbalance, and related autonomic symptoms during the previous month. A higher score equated with greater symptoms (score range=0–60). ● DVA: tests for visual acuity during passive head rotation or active head rotation. Scored as number of recorded errors. ● Sharpened Romberg Test: times static balance test in seconds; longer time=better balance performance. ● Sway path: a measure of standing balance given as a total distance in meters per minute of the center of pressure sway. A smaller number equates with better balance performance. ● DGI: an 8-item scale of balance and mobility; each item is scored 0 to 3, with a possible total of 24 points. A higher score indicates better balance performance. ● Gait ataxia: a dichotomous scale. Gait incoordination is rated as absent or present during walking. ● VD-ADL: a 28-item, self-rated survey measuring the effect of vestibular dysfunction on ADL. Scores range from 1 (independent) to 10 (too difficult, no longer perform). Scores are reported for each of 3 subscales: ambulation, function, and instrumental ADL. A higher score indicates more severe involvement. ● VHQ: a 14-item survey measuring activity restriction caused by dizziness and the social effects of limiting activity (score range=0–56). ● DHI: a 25-item scale assessing the participant's perception of handicap caused by dizziness (score range=0–100). A higher score indicates greater perception of handicap.
Dizziness ● 13 trials compared VR with a control condition; VR was more effective in reducing dizziness: —Subjective improvement in dizziness (OR fixed=2.67, 95% CI=1.85 to 3.86, $P<.0001$); 136/278 treatment group participants rated themselves as better, whereas only 76/287 control group participants rated themselves as the same or worse. —VSS (SMD fixed=−0.68, 95% CI=−0.87 to −0.49, $P<.00001$); 270 participants in the treatment group and 273 participants in the control group. No MCID; however, Yardley et al[18] suggested a change of 3 as clinically significant. The clinical significance could be questioned, as the improvement in most of the studies was <3 points. —DHI (SMD fixed=−0.80, 95% CI=−1.00 to −0.60, $P<.00001$); 243 participants in the treatment group and 248 participants in the control group. MCID for the DHI is 18 points.[19] Improvement in most of the studies was well above the MCID. ● 6 studies compared VR with CRM; CRM was more effective in reducing dizziness: —Dizziness cure rate (OR fixed=1.3, 95% CI=0.03 to 0.51, $P=.004$); 18/29 participants in the treatment group reported dizziness was cured; 39/42 participants in the CRM group reported dizziness was cured, supporting CRM as a more effective treatment for BPPV. ● 5 studies compared VR with other forms of VR; VR combined with an optokinetic disc to produce visual-vestibular conflict was more effective than VR alone: —VSS-V (SMD fixed=1.12, 95% CI=0.45 to 1.80, $P=.001$); 20 participants in the treatment group and 20 participants in the control group. No MCID for this measure. The clinical significance could be questioned given the small improvement of 0.6 points in the optokinetic disc group.
Visual disturbance ● 13 studies compared VR with a control treatment; VR was more effective in improving gaze stability: —DVA (OR fixed=7.38, $P=.003$); 12/13 participants in the treatment group improved and returned to normal DVA for their age range, 0/8 participants in the control group returned to normal DVA for their age range, and only 1/8 participants had a statistically significant improvement in DVA. No MCID exists for this measure, but the return to normal DVA scores suggests clinical significance.

(*Continued*)

Appendix.

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Disequilibrium ● 13 studies compared VR with a control treatment; VR was more effective in reducing disequilibrium: —Gait ataxia (OR fixed=0.04, 95% CI=0.00 to 0.77, *P*=.03); 4/11 participants in the treatment group had ataxia; 8/8 participants in the control group had ataxia. —Sway path (posturography data) (SMD fixed=2.94, 95% CI=−3.87 to −2.01, *P*<.00001); 19/19 participants in the treatment group achieved a normal sway path score compared with 0/20 participants in the control group. —Sharpened Romberg Test scores (SMD fixed=0.35, 95% CI=0.02 to 0.68, *P*=.04); 67 participants in treatment the group and 76 participants in the control group. No MCID for this measure. The clinical significance could be questioned given the small improvement of 4.6 seconds in the treatment group. —DGI (SMD fixed=−0.92, 95% CI=−1.38 to −0.46, *P*<.0001); 51 participants in the treatment group and 42 participants in the control group. No MCID for this measure. The clinical significance is difficult to assess, as one study had an improvement of 5.8 points and another had a change of <2 points. ● 6 studies compared VR plus CRM with CRM alone; VR plus CRM was more effective in reducing disequilibrium: —DGI (SMD fixed=−0.87, 95% CI=−1.69 to −0.06, *P*=.03); 13 participants in the treatment group and 13 participants in the control group. No MCID for this measure. The treatment group improved by 4.3 points. Based on clinical experience, a change of 4 points appears clinically meaningful.
ADL ● 13 studies compared VR with a control treatment; VR was statistically more effective in improving ADL performance: —VHQ (SMD fixed=−0.33, 95% CI=−0.66 to 0.00, *P*=.05); 76 participants in the treatment group and 67 participants in the control group. No MCID for this measure. A decrease of 1 point from baseline is not clinically significant on this 56-point scale. —VD-ADL (SMD fixed=−2.71, 95% CI=−4.17 to −1.25, *P*=.0003); 8 participants in the treatment group and 8 participants in the control group. No MCID for this measure. Based on clinical experience, an average per item change of 4 is clinically meaningful (range=1–10). The clinical significance could be questioned given the small per item change of approximately 1.
Adverse events: No adverse events were reported in the review.

[a] VR=vestibular rehabilitation, UPVD=unilateral peripheral vestibular dysfunction, BPPV=benign paroxysmal positional vertigo, CRM=canalith repositioning maneuvers for BPPV, VSS=Vertigo Symptom Scale, DHI=Dizziness Handicap Inventory, VSS-V=Vertigo Symptom Scale–Vertigo Component, DVA=dynamic visual acuity, DGI=Dynamic Gait Index, ADL=activities of daily living, VHQ=Vertigo Handicap Questionnaire, VD-ADL=Vestibular Disorders Activities of Daily Living Scale, OR=odds ratio, CI=confidence interval, SMD=standardized mean difference, MCID=minimal clinically important difference.

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