Clinical Practice Guideline: **Vestibular Rehabilitation**

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GUIDELINES

American Specialty Health – Specialty (ASH) considers the use of vestibular rehabilitation, consisting of vestibular rehabilitation exercises, for the treatment of non-specific unilateral and bilateral peripheral vestibular dysfunction as medically necessary.

ASH considers the use of the Dix-Hallpike test for the diagnosis of benign paroxysmal positional vertigo (BPPV) as medically necessary. Additionally, the use of the Epley maneuver and the Semont (liberatory) maneuver for the treatment of BPPV are medically necessary for the treatment of BPPV.

ASH considers manual therapy mobilization or manipulation as not medically necessary for the treatment of isolated cervicogenic dizziness. The literature is insufficient to conclude that it is either clinically effective or ineffective in the treatment of this condition. Additional clinical trials are required to determine the effectiveness of manual therapy mobilization or manipulation for the treatment of cervicogenic dizziness for individual patients in order to determine its benefit: risk profile.

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DESCRIPTION/BACKGROUND

Dizziness is a common patient complaint resulting in an estimated 7 million doctor visits per year (Hillier and McDonnell, 2011). Vertigo is a related symptom that occurs when subjects perceive movement despite being still. In a 2009 review, Neuhauser and Lempert summarized the epidemiology of vertigo (Neuhauser and Lempert, 2009). Per the review findings, community-based surveys indicated that as many as 20-30% of the population reports complaints of dizziness or vertigo. A more detailed neurologic screening indicated that the lifetime prevalence of vertigo is 7.4%, the one-year prevalence is 4.9%, and the annual incidence is 1.4% in adults ages 18-79. Additional epidemiology findings showed that the incidence of vertigo is 2.7 times more common in females than males and prevalence increases steadily with age.

According to Hillier and McDonnell (2011), the most common source of dizziness and vertigo is the vestibular system which accounts for 25% of cases. Various conditions can cause vestibular pathology including surgical procedures in this region, head or neck trauma, Meniere's disease, vestibular neuritis or labyrinthitis, perilymphatic fistula, acoustic neuroma, and benign paroxysmal positional vertigo (BPPV). Differential diagnosis can be difficult, so many studies group patients under the category unilateral peripheral vestibular dysfunction (UPVD) or hypofunction. Central nervous system pathologies may also cause vestibular dysfunction, but these are less common and are often excluded from studies of vestibular rehabilitation.

Patients with UPVD will report dizziness with associated visual or gaze disturbance, disequilibrium, and balance abnormalities. Oscillopsia may be reported which is a visual disturbance characterized by blurring or movement of the surroundings during gaze. Gaze disturbances may be mediated through interruption of the vestibular-ocular reflex (VOR), which functions to coordinate eye and head movements to allow for steady gaze as the body moves through space. Various tests and measures have been used to measure baseline status and change over time. There was considerable variation in the applied outcomes measures within the studies under investigation, with authors reporting results on various scales ranging from one item dichotomous (symptom resolution/not), ordinal, or visual analog measures to the Vertigo Symptom Scale (14 items; 0-60 scoring). Gait disturbances may be measured with gait speed or the Dynamic Gait Index (8 tasks, 0-24 scale), while the Dizziness Handicap Inventory measures participation restrictions. More objective physiological measures such as electronystagmography tests for VOR were not considered because they have not been correlated with function (Hillier and McDonnell, 2011).

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Vestibular rehabilitation (VR) is frequently recommended to manage the signs and symptoms of UPVD. VR typically consists of various components, each targeted to a specific aspect of the pathology, including:

- Habituation exercises, which utilize repeated symptom producing motions to decrease the sensitivity to stimuli via neural plasticity. These may also be termed compensatory or neuroplastic strategies (Hillier and McDonnell, 2011).
- Adaptation exercises, where patients fix their gaze on a distant point while turning their head in various directions. These are designed to train the VOR and reduce retinal "slip" (Herdman, 2013).
- Substitution exercises, designed to sharpen other sensory organs to assist the vestibular system in balance.
- Education on strategies to avoid provocatory motions and promote safe activity despite vestibular hypofunction.

Medications for UPVD such as anti-nausea drugs or vestibular suppressants may be used to reduce symptoms but are seldom long-term solutions. Surgery may be used for extreme cases, including procedures such as labyrinthectomy or vestibular nerve resection. They may also be useful for specific pathologies such as an acoustic neuroma or peri-lymphatic fistula (Hillier and McDonnell, 2011). Other conservative interventions for vertigo and dizziness include canalith repositioning maneuvers, specifically for BPPV, and manual therapy, advocated for cervicogenic dizziness.

Benign paroxysmal positional vertigo (BPPV) is characterized by short bouts of vertigo or dizziness, often with nausea, brought on by changes in position (e.g., bending down) or rapid head movements, particularly neck extension. Symptoms may be resolved spontaneously and may also recur after a period of time without symptoms. BPPV may be associated with a variety of causes such as head trauma (including concussion), vestibular neuritis, and ear infection. Most cases are idiopathic. The female to male ratio is 2:1 for idiopathic; other causes are more evenly distributed. It is more common among ages 50-70. A positive Dix-Hallpike test is diagnostic for BPPV. This maneuver involves taking a patient through rapid changes in position that produce nystagmus, dizziness, and nausea.

Persistent postural-perceptual dizziness (PPPD) is a disorder of functional dizziness that in the International Classification of Diseases in its 11th revision (ICD-11) supersedes phobic postural vertigo and chronic subjective dizziness. PPPD manifests with one or more symptoms of dizziness, unsteadiness, or non-spinning vertigo that are present on most days for three months or more and are exacerbated by upright posture, active or passive movement, and exposure to moving or complex visual stimuli. PPPD may be precipitated by conditions that disrupt balance or cause vertigo, unsteadiness, or dizziness, including peripheral or central vestibular disorders, other medical illnesses, or psychological distress. PPPD may be present alone or co-exist with other conditions.

EVIDENCE REVIEW

Vestibular Rehabilitation (VR)

Hillier and McDonnell (2011) provided a comprehensive systematic review of vestibular rehabilitation. Their comprehensive literature review included community dwelling subjects with a physician's diagnosis of UPVD and symptoms of vertigo, dizziness, a balance disorder, and/or visual or gaze disturbances. Subjects with Meniere's disease could be included if they were in later, non-fluctuating stages. There was no age limitation although the majority of patients in the studies were age 65 and over. Studies which utilized exercise and movement-based therapies were included, while studies that focused on specific repositioning maneuvers were excluded. Comparison groups received placebo, sham, usual care, no treatment, specific alternative treatment such as medication or surgery, or another type of vestibular rehabilitation. Relevant outcomes included symptoms, functional measures including balance, or an alternative vestibular rehabilitation approach.

The authors' exhaustive search included articles published through July 2010. A total of 27 studies were included, with 10 additional articles added since the previous update was published in 2007. Sample size for these articles ranged from 14-360 subjects with an average of 64. Four of the studies took place in the acute hospital setting, while the rest of the studies were performed in outpatient clinics. Most studies utilized a combination of therapy approaches (habituation, adaptation, substitution, balance training, and education); only a few studies isolated a particular therapeutic approach. Controls were most often usual care or a sham exercise approach. There was a great deal of heterogeneity in outcome measures, as there appears to be no generally accepted standardized measure of vestibular symptoms. In their assessment of risk of bias, the authors noted generally poor reporting of randomization and allocation procedures with generally low risk of bias in 4 other categories.

There were 13 studies that compared VR to a sham or usual care control. Most studies favored VR, but the variety of outcome measures made it difficult to formulate an overall summary. When subjective improvement of dizziness was dichotomized (4 studies), VR was favored with an odds ratio of 2.67 (95% CI: 1.85-3.86). Hillier and McDonald reported combined standardized mean difference (SMD) of -0.67 on the Vertigo Symptom Scale (3 studies), -0.80 on the DHI (4 studies), and -0.92 on the Dynamic Gait Index (DGI) (3 studies). Various other secondary outcomes also generally supported the use of VR versus a control intervention. VR was compared to alternative treatment in 6 trials. There were 2 studies involving subjects with a diagnosis of benign paroxysmal positional vertigo (BPPV). VR was much less effective in "curing" BPPV induced dizziness than physical maneuvers (odds ratio=0.13; 95% CI: 0.03-0.51); however, VR plus physical maneuvers was more effective than physical maneuvers alone for the DGI (SMD=-0.87), while there were non-significant findings for dizziness symptoms. One weak study, which was not included in the meta-analysis due to inadequate data, compared home VR exercise to betahistine medication (a vestibular suppressant) and found VR superior for relief of dizziness symptoms and quality of life. Other studies comparing VR to electrical stimulation or physical maneuvers had either non-significant or mixed findings.

There were 5 studies that compared one type of VR to another. In general, there were no significant differences between VR approaches. There were significant differences on the Vertigo Symptom Scale for a home VR program plus simulator activities versus home VR alone, and for a formal program for balance and fall prevention versus a home program. Hillier and McDonald noted there were generally low drop-out rates in the studies reviewed and some studies showed gains lasting to 12 months (moderate evidence). The optimal dosage is unclear from the literature, but they noted that "even a minimalist approach" can be effective. No adverse effects were reported in any of the studies included in their review.

A systematic review published by Ricci et al. (2010) focused on the effectiveness of VR in studies published in the previous 10 years that included subjects > 40 years old. They located 4 studies with subjects >40 years of age, and 5 with subjects > 60 years of age. Most studies included subjects with general diagnoses such as vestibular hypofunction with subject complaints of dizziness, vertigo, or imbalance. They utilized the PEDro criteria for scoring study quality. Nine studies were included, with 4 of 9 rated as "good" quality (≥6/11 on PEDro scale). Most interventions were based on a Cawthorne and Cooksey approach originally developed in the 1940s. Control subjects generally received no exercise or placebo exercise; in one study, control subjects received Tai Chi. These authors reported results that generally favored VR on various outcomes when compared to no treatment or placebo (6 studies) but generally no significant differences when compared to an alternative treatment. There were no reports of adverse reactions to VR.

In an informal review of the literature, Herdman located two additional small randomized controlled trials and one crossover study that supported the effectiveness of VR for patients with dizziness complaints (Herdman, 2013). McDonnell and Hillier (2015) completed an update of a Cochrane review first published in 2007 and previously updated in 2011 to assess the effectiveness of vestibular rehabilitation in the adult, community-dwelling population of people with symptomatic unilateral peripheral vestibular dysfunction. Thirty-nine studies involving 2,441 participants with unilateral peripheral vestibular disorders were included in the review. Authors concluded that there was moderate to strong evidence that vestibular rehabilitation is a safe, effective management for unilateral peripheral vestibular dysfunction, based on several high-quality randomized controlled trials. There was moderate evidence that vestibular rehabilitation resolves symptoms and improves functioning in the medium term. However, there is evidence that for the specific diagnostic group of BPPV, physical (repositioning) maneuvers are more effective in the short term than exercise-based vestibular rehabilitation; although a combination of the two is effective for longer-term functional recovery. There was insufficient evidence to discriminate between differing forms of vestibular rehabilitation. Hall et al. (2016) authored an evidence-based clinical practice guideline on vestibular rehabilitation for peripheral vestibular hypofunction. A systematic review of the literature was performed in 5 databases published after 1985 and 5 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. A total of 135 articles were identified as relevant to this clinical practice guideline. Based on strong evidence and a preponderance of benefit over harm, clinicians should offer vestibular rehabilitation 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 in isolation (i.e., without head movement) as specific exercises for gaze stability. 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 rehabilitation. As a general guide, persons without significant comorbidities that affect mobility and with acute or subacute unilateral vestibular hypofunction may need once a week supervised sessions for 2 to 3 weeks; persons with chronic unilateral vestibular hypofunction may need once-a-week sessions for 4 to 6 weeks; and persons with bilateral vestibular hypofunction may need once-a-week sessions for 8 to 12 weeks. In addition to supervised sessions, patients are to be provided a daily home exercise program.

Arnold et al. (2017) compared the effectiveness of vestibular rehabilitation interventions (adaptation, substitution, and habituation) in people with unilateral peripheral vestibular hypofunction, exclusionary of benign paroxysmal positional vertigo and Meniere's disease. Seven papers were selected for inclusion. Results suggest that vestibular therapy for unilateral peripheral vestibular hypofunction is effective. When considering all 7 studies, it was difficult to determine the superiority of one intervention over another in treating unilateral peripheral vestibular hypofunction except when patient outcomes are captured by the dynamic gait index or dizziness handicap inventory. Maslovara et al. (2019) compared the impact of VR in patients with chronic unilateral vestibular hypofunction (UVH) and bilateral vestibular hypofunction (BVH). Authors concluded that well-planned and individually adjusted system of vestibular exercises leads to a significant decrease in clinical symptoms and improvement of functioning and confidence in activities in both the chronic UVH and the BVH patient.

Tramontano et al. (2021) critically assessed the effectiveness of VR administered either alone or in combination with other neurorehabilitation strategies in patients with neurologic disorders. All clinical studies carried out on adult patients with a diagnosis of neurologic disorders who performed VR provided alone or in combination with other therapies were included. Twelve studies were included in the review. All the included studies, with 1 exception, report that improvements provided by customized VR in subject affected by a central nervous system diseases are greater than traditional rehabilitation programs alone.

Authors concluded that because of the lack of high-quality studies and heterogeneity of treatments protocols, clinical practice recommendations on the efficacy of VR cannot be made. Results show that VR programs are safe and could easily be implemented with standard neurorehabilitation protocols in patients affected by neurologic disorders. Hence, more high-quality randomized controlled trials of VR in patients with neurologic disorders are needed.

Hall et al. (2022) authored a revision of the 2016 guidelines published by the American Physical Therapy Association and the Academy of Neurologic Physical Therapy and involved a systematic review of the literature published since 2015 through June 2020 across 6 databases. Article types included meta-analyses, systematic reviews, randomized controlled trials, cohort studies, case-control series, and case series for human subjects, published in English. Sixty-seven articles were identified as relevant to this clinical practice guideline and critically appraised for level of evidence. The purpose of this revised clinical practice guideline is to improve quality of care and outcomes for individuals with acute, subacute, and chronic unilateral and bilateral vestibular hypofunction by providing evidence-based recommendations regarding appropriate exercises. The following are reported:

- Based on strong evidence, clinicians should offer vestibular rehabilitation to adults with unilateral and bilateral vestibular hypofunction who present with impairments, activity limitations, and participation restrictions 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 in isolation (i.e., without head movement) to promote gaze stability.
- Based on moderate to strong evidence, clinicians may offer specific exercise techniques to target identified activity limitations and participation restrictions, including virtual reality or augmented sensory feedback.
- Based on strong evidence and in consideration of patient preference, clinicians should offer supervised vestibular rehabilitation.
- Based on moderate to weak evidence, clinicians may prescribe weekly clinic visits plus a home exercise program of gaze stabilization exercises consisting of a minimum of: (a) 3 times per day for a total of at least 12 minutes daily for individuals with acute/subacute unilateral vestibular hypofunction; (b) 3 to 5 times per day for a total of at least 20 minutes daily for 4 to 6 weeks for individuals with chronic unilateral vestibular hypofunction; (c) 3 to 5 times per day for a total of 20 to 40 minutes daily for approximately 5 to 7 weeks for individuals with bilateral vestibular hypofunction.
- Based on moderate evidence, clinicians may prescribe static and dynamic balance exercises for a minimum of 20 minutes daily for at least 4 to 6 weeks for individuals with chronic unilateral vestibular hypofunction and based on expert opinion, for a minimum of 6 to 9 weeks for individuals with bilateral vestibular hypofunction.

- Based on moderate evidence, clinicians may use achievement of primary goals, resolution of symptoms, normalized balance and vestibular function, or plateau in progress as reasons for stopping therapy.
- Based on moderate to strong evidence, clinicians may evaluate factors, including time from onset of symptoms, comorbidities, cognitive function, and use of medication that could modify rehabilitation outcomes.

In summary, recent evidence supports the original recommendations from the 2016 guidelines. There is strong evidence that vestibular physical therapy provides a clear and substantial benefit to individuals with unilateral and bilateral vestibular hypofunction. Limitations of this guideline includes that the focus of the guideline was on peripheral vestibular hypofunction; thus, the recommendations of the guideline may not apply to individuals with central vestibular disorders. One criterion for study inclusion was that vestibular hypofunction was determined based on objective vestibular function tests. This guideline may not apply to individuals who report symptoms of dizziness, imbalance, and/or oscillopsia without a diagnosis of vestibular hypofunction. These recommendations are intended as a guide to optimize rehabilitation outcomes for individuals undergoing vestibular physical therapy.

Rezaeian et al. (2023) aimed to investigate the effect of vestibular rehabilitation (VR) versus control/other interventions on the quality of life in patients with Meniere's disease (MD) in a systematic review and meta-analysis. Overall, 3 studies with a total of 465 patients were included in the meta-analysis. Authors concluded that VR could improve the quality of life in patients with MD immediately after treatment. Since all the included studies had a high risk of bias and none had long-term follow-ups, further high-quality research is required to determine the short-, intermediate-, and long-term effects of VR compared to control/other interventions.

Meng et al. (2023) aimed to evaluate the effects of vestibular rehabilitation therapy (VRT) in addition to usual rehabilitation compared with usual rehabilitation on improving balance and gait for patients after stroke in a systematic review. Fifteen randomized controlled trials with 769 participants were included. VRT was effective in improving balance for patients after stroke, particularly for patients after stroke that occurred within 6 months with moderate certainty of evidence. Subgroup analysis showed that VRT provided as gaze stability exercises combined with swivel chair training and head movements could significantly improve balance. Four-week VRT had better effect on balance improvement than the less than 4-week VRT. The pooled mean difference of values of Timed Up-and-Go test showed that VRT could significantly improve gait function for patients after stroke, particularly for patients after stroke that occurred within 6 months with moderate certainty of evidence. Authors concluded that there is moderate certainty of evidence supporting the positive effect of VRT in improving balance and gait of patients after stroke.

Kamo et al. (2023) investigated the effect of early vestibular rehabilitation on physical function and dizziness in patients with acute vestibular disorders. The inclusion criteria in terms of the study participants were patients 20 years and older with an acute unilateral peripheral vestibular disorder. Early vestibular rehabilitation was defined as rehabilitation within 14 days of vestibular disorder onset or surgery. Main outcome measures were gait, balance (eyes open, eyes closed), activities of daily living, dizziness, and vestibular function. Twelve trials involving 542 participants were included. Early vestibular rehabilitation improved the Dizziness Handicap Inventory by -7.18, and dizziness by -1.47 compared with no intervention or placebo. Authors concluded that this study demonstrated that early vestibular rehabilitation improved the Dizziness Handicap Inventory, balance (eyes closed), and subjective dizziness in a patient with acute vestibular disorders. This result indicates that early vestibular rehabilitation can promote vestibular compensation.

Edwards and Franklin (2023) summarized vestibular rehabilitation in a StatPearls article. They note that research has indicated moderate to strong evidence to support exercise-based rehabilitation of the vestibular system as an effective treatment in populations including unilateral and bilateral vestibular hypofunction. It has shown promising research in treatments for central vestibular hypofunction.

Huang et al. (2024) evaluated the efficacy of vestibular rehabilitation in vestibular neuritis in a systematic review and meta-analysis. This study included 12 randomized controlled trials involving 536 patients with vestibular neuritis. Vestibular rehabilitation was comparable with steroids in dizziness handicap inventory score at the first, sixth, and 12th months; caloric lateralization at the third, sixth, and 12th months; and abnormal numbers of vestibular-evoked myogenic potentials at the first, sixth, and 12th months. Patients receiving a combination of rehabilitation and steroid exhibited significant improvement in dizziness handicap inventory score at the first, third, and 12th months; caloric lateralization at the first and third months; and numbers of vestibular-evoked myogenic potentials at the first and third months than did those receiving steroids alone. Authors concluded that vestibular rehabilitation is recommended for patients with vestibular neuritis. A combination of vestibular rehabilitation and steroids is more effective than steroids alone in the treatment of patients with vestibular neuritis.

do Amaral et al. (2024) summarized the evidence on the effectiveness of vestibular rehabilitation on postural balance in patients with Parkinson's disease in a systematic review. From the 485 studies found in the searches, only 3 studies were deemed eligible for the systematic review involving a total of 130 participants. The Berg Balance Scale was described as the tool for evaluation of postural balance in all studies. The meta-analysis showed statistically significant results in favor of vestibular rehabilitation, regardless of the stage of Parkinson's disease. Although the effect size was suggested as a useful functional gain, the analysis was done with caution, as it only included 3 randomized controlled trials. The risk of bias was considered as being of "some concern" in all studies.

Furthermore, the quality of the evidence based on the Grading of Recommendations Assessment Development and Evaluation system, produced by pooling the included studies was considered very low. Authors concluded that compared to other interventions, vestibular rehabilitation has potential to assist the postural balance of patients with Parkinson's disease. However, the very low quality of the evidence demonstrates uncertainty about the impact of this clinical practice. More robust studies are needed to confirm the benefits of this therapy in patients with Parkinson's disease.

Agger-Nielson et al. (2024) investigated the impact of early vestibular rehabilitation training combined with corticosteroids initiated within 2 weeks, compared with corticosteroid treatment, after the peripheral acute vestibular syndrome (pAVS) onset. Five studies involving 235 patients were included in this systematic review and meta-analysis. The subjective outcome measure Dizziness Handicap Inventory (DHI) was pooled for a meta-analysis and was statistically significantly in favor of early vestibular rehabilitation training (early VRT) plus corticosteroids compared with corticosteroids alone: at one-month follow-up and 12 months follow-up. DHI was a critical outcome for measuring the differences in effect of early VRT. This meta-analysis showed that early VRT in combination with corticosteroids was more effective for treating pAVS than corticosteroid treatment alone. No adverse effects were reported for early VRT.

Reynard et al. (2024) published recommendations to establish guidelines for vestibular rehabilitation (VR) in children with vestibular impairment. The guidelines were developed based on a systematic review of the international literature, validated by a multidisciplinary group of French-speaking otorhinolaryngologists, scientists, and physiotherapists. It is recommended that a vestibular assessment be carried out before VR, including a study of vestibulo-ocular reflex, otolithic function, and postural control. In cases of vestibular dysfunction, physiotherapy treatment is recommended from an early age to train different aspects of postural control, including anticipatory and reactive postural adjustments. VR adapted to the pediatric population is recommended for children whose vestibular dysfunction leads to functional disorders or symptoms of vertigo for those who have suffered head trauma. It is recommended that children with bilateral vestibular impairment be treated using gaze stabilization exercises for adaptation and substitution. Optokinetic stimulation and virtual reality are not recommended for children and young adolescents.

Yap et al. (2024) determined the effect of vestibular physical therapy on subjective and objective measures of vestibular symptoms and function in people with vestibular schwannoma in a systematic review. Included studies were experimental or observational in design and featured patients with vestibular schwannoma who had undergone vestibular physical therapy. Twenty-three studies were included. Overall, the effect of vestibular physical therapy for patients with vestibular schwannoma was uncertain. Outcomes of dizziness, static and dynamic balance, and vestibular function all showed very low certainty on the Grading of Recommendations Assessment, Development and Evaluation assessment. Multimodal physical therapist interventions consistent with clinical practice guidelines (e.g., gaze stability, habituation, balance training, gait training) demonstrated potential for improvement in dizziness, balance, and vestibular function, respectively. Results were mostly insignificant when a single modality was used. Authors concluded that there may be benefit in multimodal vestibular physical therapy for people with vestibular schwannoma to improve symptoms and function. More high-quality studies specific to vestibular schwannoma prehabilitation and rehabilitation are needed to increase the certainty in the evidence.

Nairn et al. (2025) aimed to determine what the effects of VRT or dual-task training (DTT) are on balance and gait for reducing the risk of falls among survivors of late subacute and chronic stroke. Authors report that evidence supports that vestibular rehabilitation therapy (VRT) improves the static and dynamic balance of survivors of stroke, yet VRT is rarely included in stroke rehabilitation guidelines. Eleven studies (n=509 participants) were included in the systematic review, and 10 studies (n=413 participants) were included in a meta-analysis. The average participant age was 60.9 years, with 62.11% male. On average, 36 months had passed since stroke onset. The pooled effect standardized mean difference suggests that VRT has a significantly large effect for improving balance, particularly from balance-specific training. Dual-task training (DTT) moderately improved gait, with greater benefits from DTT compared with single-task training. Authors concluded that despite substantial heterogeneity across studies, the evidence supports that VRT, can probably improve balance, and DTT may improve gait outcomes among survivors of late subacute and chronic stroke. An optimal program for this population should focus on balance and DTT with subcomponents of gait and strength training. Further research is required to determine the optimal number of weeks, sessions/week, and duration (minutes) of VRT sessions.

Sun et al. (2025) aimed to address the current need for a systematic evaluation of VRT's efficacy. The meta-analysis examined the impact of VRT on the dizziness handicap inventory (DHI) and Berg balance scale (BBS). For the DHI, VRT resulted in a significant mean improvement of 7.63 points, despite high heterogeneity. Similarly, the BBS exhibited significant improvement. Authors concluded that VRT significantly enhanced patient outcomes as measured with both the DHI and BBS. These findings provide strong evidence supporting VRT's effectiveness, though the substantial heterogeneity underscores the need for further research to refine patient selection and intervention protocols.

Benign Paroxysmal Positional Vertigo (BPPV)

Helminski et al. (2010) explains the two mechanisms that have been proposed to explain BPPV. In normal vestibular function, calcite particles (otoconia) are attached to the sensory membrane in the semicircular canals. They serve as weights which make hair-like sensors in the canals sensitive to acceleration movements in their fluid-filled environment. In the mechanism known as canalithiasis, BPPV is hypothesized to result when otoconia break loose and float free in the endolymph, where their movement continues even after the head has stopped moving, thereby causing vestibular symptoms. The other mechanism is termed cupulolithiasis, where the calcite particles become embedded in the cupula, the gelatinous membrane of the canal, causing abnormal weighting in the sensory organ. BPPV may be divided into three types based on canal involvement: posterior, horizontal, and anterior semicircular canal BPPV. The posterior semicircular canal is most often involved in this mechanism. BPPV cases involving the horizontal semicircular canal are reportedly less common and can be more difficult to treat. Anterior Canal BPPV is considered rare and deemed more likely to be self-treated, or resolved, due to gravity (Gupta et al., 2019).

The first treatments for BPPV were habituation exercise, reported in the 1950s. Later, a physical maneuver was advocated by Epley that uses gravity and 4 position changes designed to move any loose particles through the posterior semicircular canal into the vestibule, where they will not produce symptoms. The success of the Epley maneuver as a treatment for BPPV has led to favoring of the canalithiasis mechanism for BPPV (Hilton and Pinder, 2004). Following, a second physical maneuver known as the Semont or liberatory maneuver was developed to address cases of cupulolithiasis and canalithiasis, involving a rapid 180-degree movement from side-lying on the involved side to side-lying on the uninvolved side to loosen any particles lodged in the cupula. Collectively, these are known as particle repositioning maneuvers. There are home versions of each maneuver and postural/neck range of motion restrictions may be advised for 24-48 hours following treatment.

In an update of a 2004 Cochrane review by Hilton and Pinder (2014) included studies published through May 2010 that included patients with a positive Dix-Hallpike test, limited to randomized controlled trials studying the Epley versus no treatment, placebo, or an alternative mode of treatment. Key outcomes for inclusion were incidence and severity of vertigo, patient ratings of improvement, and/or a negative Dix-Hallpike test. Their search yielded 22 RCTs, however 17 were excluded due to high risk of bias (mostly randomization procedure and lack of blinded allocation). For the 5 studies with low risk of bias, the sample sizes were generally small (36-81 total) and included patients with symptoms less than 2 weeks. Four of the studies used a sham control while one study used a no treatment control group. Four weeks was the longest follow-up. Meta-analysis revealed a pooled odds ratio of 4.42 (2.62, 7.44) in favor of the Epley maneuver for complete resolution of symptoms, and a pooled odds ratio of 6.4 (3.6, 11.3) for a negative Dix-Hallpike outcome. They found widely varying estimates of natural recovery, from 15-84%. Only one study reported adverse effects – inability to tolerate the Epley maneuver due to vomiting or pre-existing neck pain – but the adverse event rate was not reported.

A companion systematic review by Hunt et al. (2012) focused on adjuncts to the Epley maneuver including limiting cervical movements and maintaining upright posture for 24-48 hours following maneuver, perhaps with a soft collar, and mastoid vibration, using a mechanical device attached to a headband. They included randomized controlled trials involving patients with confirmed BPPV. They located 11 randomized controlled trials that met their inclusion criteria; nine investigated postural restrictions and 2 studies involved oscillation to mastoid during the Epley maneuver. Sample sizes varied from 38-106, and follow-up was typically 1 week, although a few studies had a longer follow-up period. They found that the addition of postural restrictions yielded significantly better results for conversion of the Dix-Hallpike test with a risk ratio = 1.13 (1.05, 1.22). Adverse events were tracked in 5 studies; neck stiffness was more common in the intervention group (27% versus none in one study); development of horizontal BPPV, transient nausea and disequilibrium also occurred rarely but not more common in the experimental versus the control group. The Epley maneuver plus mastoid oscillation was compared to the Epley maneuver alone in 2 studies; there were no significant differences in conversion of Dix-Hallpike or in the intensity of symptoms.

Helminski et al. (2010) performed a systematic review to determine the effectiveness of particle positioning maneuvers, including the Epley or the Semont (liberatory) method, to treat BPPV. Their search included RCTs or quasi randomized controlled trials published through 2009. Randomized controlled trials provided strong evidence that the canalith repositioning procedure (CRP) resolves posterior canal (PC) benign paroxysmal positional nystagmus (BPPN); whereas quasi-RCTs suggested that the CRP or the liberatory maneuver performed by a health care practitioner, or with proper instruction at home by the patient, resolves PC BPPN. Their preferred measure of success was the conversion from a positive to a negative Dix-Hallpike test since vertigo symptoms are dependent on activity levels. Their search yielded 10 studies total:

- There were 2 true RCTs and 2 quasi-randomized controlled trials that all found the Epley maneuver superior (67-95% success) to a sham intervention (10-38% success). In the 2 true RCTs the odds of resolution of the Dix-Hallpike test were 22-37 times higher for the treatment group.
- There were 2 quasi-RCTs that compared the Semont (liberatory) maneuver to no treatment that favored the experimental group with 80-85% success versus 35-38% in controls, with an odds ratio of 7-10.
- There were 2 quasi-RCTs that compared the Semont (liberatory) maneuver to the Epley maneuver but found no difference overall.
- There were 3 quasi-RCTs that looked at the effectiveness of self-treatment using a particle repositioning maneuver with or without an in-clinic treatment. They found 90-95% success overall, with 58% for liberatory and 24% for VR exercise only. The odds ratio was 3.5 for Epley + self-administered versus Epley alone. Self-treatment using the Epley maneuver was more effective than using the self-liberatory maneuver (odds ratio = 12.5).

Clinical practice guidelines by the American Academy of Otolaryngology—Head and Neck Surgery Foundation (Bhattacharyya et al., 2008) strongly supported use of the Dix-

Hallpike test for diagnosis and canalith repositioning maneuvers for treatment of posterior canal BPPV. Wegner et al. (2014) evaluated the effectiveness the Epley maneuver compared to vestibular rehabilitation for BPPV. Only 5 of 373 relevant articles satisfied the eligibility criteria. Results demonstrated that the Epley maneuver is more effective in treating BPPV than vestibular rehabilitation at 1-week follow-up. There is inconsistent evidence for the effectiveness of the Epley maneuver compared with vestibular rehabilitation at 1-month follow-up. An update of the Cochrane Review (Hilton and Pinder, 2014) concluded that there is evidence that the Epley maneuver is a safe, effective treatment for posterior canal BPPV, based on the results of 11, mostly small, randomized controlled trials with relatively short follow-up. There is a high recurrence rate of BPPV after treatment (36%). Outcomes for Epley maneuver treatment are comparable to treatment with Semont and Gans maneuvers, but superior to Brandt-Daroff exercises. Adverse effects were infrequently reported. There were no serious adverse effects of treatment. Rates of nausea during the repositioning maneuver varied from 16.7% to 32%. Some patients were unable to tolerate the maneuver because of cervical spine problems. Oh et al. (2017) compared the efficacy between repetition of Epley maneuver and switch to alternate Semont maneuver in treating posterior canal benign paroxysmal positional vertigo (PC-BPPV) that does not respond to the initial Epley maneuver. 144 (28.5%) patients, who did not respond to the therapy, were randomized to the repetition of Epley maneuver (n = 70) or switch to Semont maneuver (n = 74). The therapeutic efficacy was determined within 1 hour by a blinded examiner after the trial of each second maneuver. The efficacy did not differ between the repetition of Epley maneuver and switch to Semont maneuver groups. However, the patients with a long duration ($p < 0.001$, linear regression) and latency ($p = 0.01$) of the positional nystagmus during Dix-Hallpike maneuver showed a higher rate of the initial and second treatment failures. Either Epley or Semont maneuver may be applied as a second treatment to the patients with PC-BPPV refractory to the initial Epley maneuver. This study provides Class I evidence that repeated Epley and switch to Semont maneuver shows a similar efficacy in treating PC-BPPV that does not respond to the initial Epley maneuver.

Bhattacharyya et al. (2017) updated the clinical practice guideline. Changes from the prior guideline include a consumer advocate added to the update group; new evidence from 2 clinical practice guidelines, 20 systematic reviews, and 27 randomized controlled trials; enhanced emphasis on patient education and shared decision making; a new algorithm to clarify action statement relationships; and new and expanded recommendations for the diagnosis and management of BPPV. The primary purposes of this guideline were to improve the quality of care and outcomes for BPPV by improving the accurate and efficient diagnosis of BPPV, reducing the inappropriate use of vestibular suppressant medications, decreasing the inappropriate use of ancillary testing such as radiographic imaging, and increasing the use of appropriate therapeutic repositioning maneuvers. The primary outcome considered in this guideline was the resolution of the symptoms associated with BPPV. Secondary outcomes considered included an increased rate of accurate diagnoses of BPPV, a more efficient return to regular activities and work, decreased use of inappropriate medications and unnecessary diagnostic tests, reduction in recurrence of BPPV, and reduction in adverse events associated with undiagnosed or untreated BPPV. The update group made strong recommendations that clinicians should diagnose posterior semicircular canal BPPV when vertigo associated with torsional, upbeating nystagmus is provoked by the Dix-Hallpike maneuver, and treat, or refer to a clinician who can treat, patients with posterior canal BPPV with a canalith repositioning procedure. The update group made a strong recommendation against postprocedural postural restrictions after canalith repositioning procedure for posterior canal BPPV. The update group also made recommendations that the clinician should (1) perform, or refer to a clinician who can perform, a supine roll test to assess for lateral semicircular canal BPPV if the patient has a history compatible with BPPV and the Dix-Hallpike test exhibits horizontal or no nystagmus; (2) differentiate, or refer to a clinician who can differentiate, BPPV from other causes of imbalance, dizziness, and vertigo; (3) assess patients with BPPV for factors that modify management, including impaired mobility or balance, central nervous system disorders, a lack of home support, and/or increased risk for falling; (4) reassess patients within 1 month after an initial period of observation or treatment to document resolution or persistence of symptoms; (5) evaluate, or refer to a clinician who can evaluate, patients with persistent symptoms for unresolved BPPV and/or underlying peripheral vestibular or central nervous system disorders; and (6) educate patients regarding the impact of BPPV on their safety, the potential for disease recurrence, and the importance of follow-up. The update group made recommendations against (1) radiographic imaging for a patient who meets diagnostic criteria for BPPV in the absence of additional signs and/or symptoms inconsistent with BPPV that warrant imaging, (2) vestibular testing for a patient who meets diagnostic criteria for BPPV in the absence of additional vestibular signs and/or symptoms inconsistent with BPPV that warrant testing, and (3) routinely treating BPPV with vestibular suppressant medications such as antihistamines and/or benzodiazepines. The guideline update group provided the options that clinicians may offer observation with follow-up as initial management for patients with BPPV and vestibular rehabilitation, either self-administered or with a clinician, in the treatment of BPPV.

Rodrigues et al. (2019) evaluated the additional effects of vestibular rehabilitation exercises as a therapeutic resource in the treatment of BPPV, to improve symptoms and reduce recurrence. Thirty-two individuals, both men and women, over 18 years of age with BPPV were randomly assigned to two groups: the control group (n=15) performing only the maneuver technique as treatment and the experimental group (n=17) performing the maneuvers and vestibular rehabilitation exercises. Results demonstrated that the experimental group had a lower level of dizziness in the posttreatment period ($p<0.05$) and a lower incidence of recurrences ($p=0.038$) than the control group. Authors concluded that vestibular exercises performed after repositioning treatments for BPPV increased the overall efficacy of treatment by improving symptoms with a lower rate of recurrence. Power et al. (2020) outlined the incidence of BPPV in specialized vestibular physiotherapy clinics and discusses the various nuances encountered during assessment and treatment of BPPV. Interventions included canalith repositioning maneuvers (CRP) for posterior canal (PC) or horizontal canal (HC) BPPV depending on the canal and variant of BPPV. Outcome measures included negative Dix-Hallpike or supine roll test examination. Results indicated that in 91% of cases, PC BPPV was effectively treated in 2 maneuvers or less. Similarly, 88% of HC BPPV presentations were effectively managed with 2 treatments. Bilateral PC, multiple canal or canal conversions required a greater number of treatments. There was no noticeable difference in treatment outcomes for patients who had nystagmus and symptoms during the Epley maneuver (EM) versus those who did not have nystagmus and symptoms throughout the EM. Nineteen percent of patients experienced post treatment down-beating nystagmus and vertigo or "otolithic crisis" after the first or even the second consecutive EM. Authors concluded that based on the data collected, repeated testing and treatment of BPPV within the same session is promoted as a safe and effective approach to the management of BPPV with a low risk of canal conversion. Secondly, vertigo and nystagmus throughout the EM is not indicative of treatment success. Thirdly, clinicians must remain vigilant and mindful of the possibility of post treatment otolithic crisis following the treatment of BPPV. This is to ensure patient safety and to prevent possible injurious falls.

Li et al. (2022) compared the efficacy of different treatments for posterior semicircular canal benign paroxysmal positional vertigo (PC-BPPV) by using direct and indirect evidence from existing randomized data. A total of 41 parallel, randomized controlled studies were included. The Epley with vestibular rehabilitation (EVR), Epley, Semont and Hybrid maneuvers were effective in eliminating nystagmus during a Dix-Hallpike test at 1 week of follow-up, among which EVR showed the best efficacy. However, at 1 month of follow-up, only the Semont and Epley maneuvers were effective in eliminating nystagmus during a Dix-Hallpike test. In the pairwise subgroup meta-analysis, for patients younger than 55 years of age, the efficacy of the Epley maneuver was comparable to that of the Semont maneuver; for patients with a longer duration before treatment, the effect of the Epley maneuver was equivalent to that of a sham maneuver. Authors concluded that among the 12 types of PC-BPPV treatments, the Epley, Semont, EVR, and Hybrid maneuvers were effective in eliminating nystagmus during a Dix-Hallpike test for PC-BPPV at 1 week of follow-up, whereas only the Epley and Semont maneuvers were effective at 1 month of follow-up.

Pauwels et al. (2023) assessed the influence of BPPV and treatment effects of particle repositioning maneuvers (PRM) on gait, falls, and fear of falling. Twenty of the 25 included studies were suitable for meta-analysis. BPPV increases the odds of falls and negatively impacts spatiotemporal parameters of gait. PRM improves falls, fear of falling, and gait during level walking. Additional rehabilitation might be necessary to improve gait while walking with head movements or tandem walking.

Alashram (2024a) examined the effects of Brandt-Daroff exercises (BDEs) on individuals with posterior canal Benign Paroxysmal Positional Vertigo (BPPV) and provided recommendations for future research on this topic. In total, ten randomized controlled trials met our eligibility criteria. A total of 880 individuals with BPPV (63.6% females) were included in this review. The available literature showed that BDEs do not significantly reduce symptoms or promote recovery in people with posterior canal BPPV compared to other interventions, such as Epley and Semont maneuvers. This author concluded that the evidence for the effects of BDEs on patients with BPPV is limited. Further high-quality studies with long-term follow-ups are strongly required to investigate the long-term effects of BDEs in posterior canal BPPV, define the optimal application of BDEs, and identify the factors associated with treatment response and recovery.

Valsted et al. (2024) reported the effectiveness of Epley maneuver compared to other manual repositioning maneuvers (RM) for treatment of posterior benign paroxysmal positional vertigo (P-BPPV). Primary outcomes focused on complete resolution of vertiginous symptoms measured by either a Visual Analog Scale (VAS) or the Dix-Hallpike (DH) test. Secondary outcomes included conversion of a positive DH test to a negative DH test exclusively looking at positional nystagmus and assessment of side effects (cervical/back pain, posttreatment dizziness, and nausea). Both outcomes were assessed within a maximum of 4-week follow-up. Following systematic search and review, nine randomized controlled trials were found. The studies reported on the effectiveness of the Epley maneuver compared to three other specific RM: Semont, Li, and Gans maneuvers. Results revealed a low to very low certainty of evidence. With the primary outcomes, Epley maneuver was superior to Gans maneuver 24-hr posttreatment but not after 1 week. No significant differences were found between the remaining maneuvers. In summary, evidence of low to very low certainty indicates that Epley maneuver is comparable with Semont, Gans, and Li maneuvers for vertiginous symptoms in patients with P-BPPV. Further high-quality studies are needed.

Alashram (2024b) examined the effects of the Semont maneuver on posterior canal benign paroxysmal positional vertigo (BPPV). In total, 18 randomized controlled trials met the eligibility criteria. A total of 2237 participants with BPPV (mean age = 58.10 years) were included in this review. Among them, 37.5% were males, and 58% presented with right-sided BPPV. The included studies ranked from 5 to 9 out of 10 (Median = 7), suggesting good to excellent quality on the PEDro scale. The available literature revealed that the Semont maneuver is effective in improving posterior canal BPPV symptoms. The Semont maneuver is considered a standard option for treating posterior canal BPPV, with a high success rate of around 80%. It is suggested as the primary option for managing posterior canal BPPV in individuals who complain of cervical or lumbar problems, severe cardiac or respiratory conditions. Further studies are strongly needed to understand the long-term effects of the Semont maneuver and to identify the recurrence rate.

Alashram (2024c) investigated the effects of the Gufoni maneuver on horizontal semicircular canal benign paroxysmal positional vertigo (HC-BPPV). Ten randomized controlled trials were included in this review with a total of 1025 HC-BPPV patients (mean age = 58.58 years; 63% female; 55% right-side HC-HBPPV; 49% geotropic HC-BPPV). The included RCTs ranged from 4 to 9 out of 10 (median = 6.5) on the PEDro scale. The included studies showed that the Gufoni maneuver revealed efficacy when compared to the sham maneuver but not when compared to other maneuvers such as the Barbecue roll maneuver, the Appiani maneuver, the Mastoid oscillation, the head shaking, and the modified Gufoni maneuver. This author concluded that the Gufoni maneuver can be considered an option for treating patients with geotropic or apogeotropic HC-BPPV. Precise diagnosis of the BPPV, the subtype of HC-BPPV, symptom duration, history of previous BPPV attacks, the applied methods of maneuver and the proficiency of the clinician performing the maneuver, proper diagnosis, presence of any underlying health conditions are critical for successful treatment. Further studies are strongly warranted.

Alashram (2025) investigated the effects of the Barbecue roll maneuver on horizontal semicircular canal benign paroxysmal positional vertigo (HC-BPPV) recovery. Nine studies met the inclusion criteria with 768 HC-BPPV patients (mean age = 56.16 years; 64% female; 52% right-side HC-BPPV; 90% geotropic HC-BPPV). The findings showed that the Barbecue roll maneuver is not superior in reducing HC-BPPV symptoms compared to other maneuvers, such as the Gufoni, the Gufoni-Appiani and the Li repositioning. Authors concluded that the initial findings indicated that the Barbecue roll maneuver is considered a treatment option for treating geotropic HC-BPPV. Performing Barbecue roll maneuver for 1 to 3 times can yield meaningful effects. Accurate diagnosis of HC-BPPV is essential for optimal treatment outcomes. The success rate of recovery depends on patient characteristics and therapist proficiency. Additional studies are recommended.

Si et al. (2025) explored the effect of different maneuver repositioning on benign paroxysmal vertigo in a network meta-analysis. Twenty-two articles (n = 2,507) were included in this study, and the results of network meta-analysis suggested the following odds ratios relative to the control group (UT): Epley maneuver vs UT; Gufoni maneuver vs UT; Gans Repositioning Maneuvers vs UT; Modified Epley maneuver vs UT; Semont's maneuver vs UT. Authors concluded that based on their current findings, Gans Repositioning Maneuvers, Modified Epley maneuver and Self-Epley are effective for benign paroxysmal positional vertigo symptoms, but due to the existence of study limitations, more high quality multicenter large sample randomized controlled studies are needed to testify to our conclusions.

Concussion

Murray et al. (2017) systematically evaluated the evidence supporting the efficacy, prescription, and progression patterns of VRT in patients with concussion. Following a double review of abstract and full-text articles, 10 studies met the inclusion criteria:

randomized controlled trial (*n*=2), uncontrolled studies (*n*=3) and case studies (*n*=5). 4 studies evaluated VRT as a single intervention. 6 studies incorporated VRT in multimodal interventions (including manual therapy, strength training, occupational tasks, counselling, or medication). Nine studies reported improvement in outcomes but level I evidence from only 1 study was found that demonstrated increased rates of medical clearance for return to sport within 8 weeks, when VRT (combined with cervical therapy) was compared with usual care. Heterogeneity in study type and outcomes precluded meta-analysis. Habituation and adaptation exercises were employed in 8 studies and balance exercises in 9 studies. Authors concluded that the current evidence for optimal prescription and efficacy of VRT in patients with mTBI/concussion is limited. Available evidence, although weak, shows promise in this population. Further high-level studies evaluating the effects of VRT in patients with mTBI/concussion with vestibular and/or balance dysfunction are required.

Park et al. (2018) investigated whether VRT, rather than continued prescription of rest (cognitive and physical), reduce recovery time and persistent symptoms of dizziness, unsteadiness, and imbalance in adolescents (12-18 y) who suffer post-concussive syndrome following a sports-related concussion. Authors noted that VRT was an effective intervention for this population. Adolescents presenting with this cluster of symptoms may also demonstrate verbal and visual memory loss linked to changes in the vestibular system post-concussion. Authors concluded that moderate evidence supports that adolescents who suffer from persistent symptoms of dizziness, unsteadiness, and imbalance following sport concussion should be evaluated more specifically and earlier for vestibular dysfunction and can benefit from participation in individualized VRT. Early evaluation and treatment may result in a reduction of time lost from sport as well as a return to their premorbid condition. For these adolescents, VRT may be more beneficial than continued physical and cognitive rest when an adolescent’s symptoms last longer than 30 days. Storey et al. (2018) sought to determine whether active vestibular rehabilitation is associated with an improvement in visuovestibular signs and symptoms in children with concussion. One hundred nine children were included in the study with a mean age of 11.8 (3.4) years. Among this group, 59 (54%) were male and 48 (44%) had a sports-related concussion. Authors concluded that vestibular rehabilitation in children with concussion is associated with improvement in symptoms as well as visuovestibular performance. This active intervention may benefit children with persistent symptoms after concussion. Future prospective studies are needed to determine the efficacy and optimal postinjury timing of vestibular rehabilitation. Schlemmer and Nicholson (2022) synthesized the best available evidence regarding the effectiveness of VRT as a treatment option for adults with mTBIs. Five studies were included in the systematic review: 1 randomized controlled trial, 2 retrospective chart reviews, 1 pre-/post-intervention study, and 1 case series. Four of the 5 studies found VRT to be effective at reducing post-concussion symptoms after head injury. Self-reported measures were included in all studies; performance-based measures were included in four out of five studies. None of the studies reported adverse effects of intervention. Authors concluded that results suggest VRT is an effective treatment option for patients with persistent/lingering symptoms after concussion/mTBI, as demonstrated by self-reported and performance-based outcome measures.

Reid et al. (2022) investigated the effect of physical interventions (subthreshold aerobic exercise, cervical, vestibular and/or oculomotor therapies) on days to recovery and symptom scores in the management of concussion. Twelve trials met the inclusion criteria: 7 on subthreshold aerobic exercise, 1 on vestibular therapy, 1 on cervical therapy and 3 on individually tailored multimodal interventions. The trials were of fair to excellent quality on the PEDro scale. Eight trials were included in the quantitative analysis. Subthreshold aerobic exercise had a significant small to moderate effect in improving symptom scores but not in reducing days to symptom recovery in both acutely concussed individuals and those with persistent symptoms. There was limited evidence for stand-alone cervical, vestibular and oculomotor therapies. Concussed individuals with persistent symptoms (>2 weeks) were approximately 3 times more likely to have returned to sport by 8 weeks if they received individually tailored, presentation-specific multimodal interventions (cervical, vestibular, and oculo-motor therapy). In addition, the multimodal interventions had a moderate effect in improving symptom scores when compared with control. Authors concluded that subthreshold aerobic exercise appears to lower symptom scores but not time to recovery in concussed individuals. Individually tailored multimodal interventions have a worthwhile effect in providing faster return to sport and clinical improvement, specifically in those with persistent symptoms.

LeMarshall et al. (2023) aimed to identify, synthesize, and assess the quality of studies reporting on the effectiveness of virtual reality for the rehabilitation of vestibular and balance impairments post-concussion in a scoping review. Additionally, this review aimed to summarize the volume of scientific literature and identify the knowledge gaps in current research pertaining to this topic. Data was charted from studies and outcomes were categorized into one of three categories: balance, gait, or functional outcome measures. Three RCTs, 3 quasi-experimental studies, 3 case studies, and 1 retrospective cohort study were ultimately included, using a thorough eligibility criteria. All studies were inclusive of different virtual reality interventions. The ten studies had a 10-year range and identified 19 different outcome measures. Authors concluded that findings from this review suggests that virtual reality is an effective tool for the rehabilitation of vestibular and balance impairments post-concussion. Current literature shows sufficient but low level of evidence, and more research is necessary to develop a quantitative standard and to better understand appropriate dosage of virtual reality intervention.

Schneider et al. (2023) evaluated interventions to facilitate recovery in children, adolescents, and adults with a sport-related concussion (SRC). Thirteen studies met inclusion (10 RCTs, 1 quasi-experimental and 2 cohort studies; 1 high-quality study, 7 acceptable and 5 at high risk of bias). Interventions, comparisons, timing, and outcomes varied, precluding meta-analysis. For adolescents and adults with dizziness, neck pain and/or headaches >10 days following concussion, individualized cervicovestibular rehabilitation may decrease time to return to sport compared with rest followed by gradual exertion and when compared with a subtherapeutic intervention. For adolescents with vestibular symptoms/impairments, vestibular rehabilitation may decrease time to medical clearance (vestibular rehab group 50.2 days compared with control 58.4). For adolescents with persisting symptoms >30 days, active rehabilitation and collaborative care may decrease symptoms. Authors concluded that cervicovestibular rehabilitation is recommended for adolescents and adults with dizziness, neck pain and/or headaches for >10 days. Vestibular rehabilitation (for adolescents with dizziness/vestibular impairments >5 days) and active rehabilitation and/or collaborative care (for adolescents with persisting symptoms >30 days) may be of benefit.

Aljabri et al. (2024) aimed to determine the efficacy of vestibular rehabilitation therapy (VRT) as a treatment option for mild traumatic brain injury (mTBI). Eight articles met the inclusion criteria, from which 6 randomized controlled trials were included in the meta-analysis. VRT demonstrated significant improvement in decreasing perceived dizziness at the end of the intervention program as shown by Dizziness Handicap Inventory (DHI) scores. However, no significant reduction in DHI was evident after 2 months of follow-up. Quantitative analysis also depicted significant reduction in both Vestibular/Ocular Motor Screening and Post-Concussion Symptom Scale following the intervention. Finally, there was no significant difference between intervention groups on Balance Error Scoring System scores and return to sport/function. Authors conclude that current evidence on the efficacy of VRT for mTBI is limited. This review and analysis provides evidence that supports the role of VRT in improving perceived symptoms following concussion. Although findings from this analysis suggest positive effects of VRT on included outcomes, the low certainty of evidence limits the conclusions drawn from this study. There is still a need for high-quality trials evaluating the benefit of VRT using a standardized approach.

Anderson et al. (2024) examined the association between the timing of vestibular rehabilitation initiation and recovery time in adolescent patients with sports-related concussion (SRC). One hundred-twelve patients with SRC were referred to vestibular rehabilitation at a specialty concussion clinic. Vestibular rehabilitation initiation was defined as days from date of injury to date of first vestibular rehabilitation assessment. Patients were dichotomized by vestibular rehabilitation initiation: EARLY (8-10 days) and LATE (>10 days). Recovery time was defined as days between injury and medical clearance from the clinic. Sixty (average age 15.22 ± 1.61 years; 51.7 % male) patients were in the EARLY group and 52 (average age 15.37 ± 1.31 years, 28.9 % male) patients were in the LATE group. There were more female patients in the LATE group and the LATE group had their first clinic visit later than the EARLY group. The EARLY group had shorter recovery time compared to the LATE group days. After controlling for confounding variables, the LATE group had recovery times that were 1.39 times as long as the EARLY group. Authors concluded that for patients with vestibular issues after SRC, early vestibular rehabilitation initiation is associated with faster recovery time after SRC.

Persistent Postural-Perceptual Dizziness (PPPD)

Dieterich and Staab (2017) reviewed nomenclature, clinical features, possible pathomechanisms, and comorbidities of functional dizziness. The prevalence of functional dizziness as a primary cause of vestibular symptoms amounts to 10% in neuro-otology centers. Rates of psychiatric comorbidity in patients with structural vestibular syndromes are much higher with nearly 50% and with highest rates in patients with vestibular migraine, vestibular paroxysmia, and Ménière's disease. Correct and early diagnosis of functional dizziness, as primary cause, or secondary disorder after a structural vestibular syndrome, is very important to prevent further chronification and enable adequate treatment. Treatment plans that include patient education, vestibular rehabilitation, cognitive and behavioral therapies, and medications substantially reduce morbidity and offer the potential for sustained remission when applied systematically.

Popkirov et al. (2018) reviewed different treatment strategies for this common functional neurological disorder. Authors noted that an emerging understanding of the underlying pathophysiology that considers vestibular, postural, cognitive, and emotional aspects can enable patients to profit from vestibular rehabilitation, as well as cognitive-behavioral therapy (CBT). Most importantly, approaches from CBT should inform and augment physiotherapeutic techniques, and vestibular exercises or relaxation techniques can be integrated into CBT programs. They conclude that, in PPPD and related disorders, vestibular rehabilitation combined with CBT can help patients escape a cycle of maladaptive balance control, recalibrate vestibular systems, and regain independence in everyday life. Staab (2020) reports in an article on PPPD that the diagnosis is made by identifying key symptoms in patients' histories and conducting physical examinations and diagnostic testing of sufficient detail to establish PPPD as opposed to other illnesses. Ongoing research is providing insights into the pathophysiological mechanisms underlying PPPD and support for multimodality treatment plans incorporating specially adapted vestibular rehabilitation, serotonergic medications, and cognitive-behavior therapy. Cha (2021) authored an article that covered distinct causes of chronic dizziness including persistent postural perceptual dizziness, mal de débarquement syndrome, motion sickness and visually induced motion sickness, bilateral vestibulopathy, and persistent dizziness after mild concussion. Cha states that to date, none of these disorders has a cure but are considered chronic syndromes with fluctuations that are both innate and driven by environmental stressors. As such, the mainstay of therapy for chronic disorders of dizziness involves managing factors that exacerbate symptoms and adding vestibular rehabilitation or cognitive-behavioral therapy alone or in combination, as appropriate. These therapies are supplemented by serotonergic antidepressants that modulate sensory gating and reduce anxiety. Besides expectation management, ruling out concurrent disorders and recognizing behavioral and lifestyle factors that affect symptom severity are critical issues in reducing morbidity for each disorder.

Rogers et al. (2023) summarized dizziness and its evaluation and management in an article. The physical examination may include orthostatic blood pressure measurement, a full cardiac and neurologic examination, assessment for nystagmus, the Dix-Hallpike maneuver (for patients with triggered dizziness), and the HINTS (head-impulse, nystagmus, test of skew) examination when indicated. The treatment for dizziness is dependent on the etiology of the symptoms. Canalith repositioning procedures (e.g., Epley maneuver) are the most helpful in treating benign paroxysmal positional vertigo. Vestibular rehabilitation is helpful in treating many peripheral and central etiologies. Other etiologies of dizziness require specific treatment to address the cause. Pharmacologic intervention is limited because it often affects the ability of the central nervous system to compensate for dizziness.

Webster et al. (2023) assessed the benefits and harms of non-pharmacological interventions for PPPD. Primary outcomes were: 1) improvement in vestibular symptoms 2) change in vestibular and 3) serious adverse events. Secondary outcomes were: 4) disease-specific health-related quality of life, 5) generic health-related quality of life and 6) other adverse effects. Outcomes were reported at three time points: 3 to < 6 months, 6 to ≤ 12 months and > 12 months. Of the few studies identified, only one followed up with participants for at least three months, therefore most were not eligible for inclusion in this review. Authors concluded that further work is necessary to determine whether any non-pharmacological interventions may be effective for the treatment of PPPD and to assess whether they are associated with any potential harms. As this is a chronic disease, future trials should follow up participants for a sufficient period of time to assess whether there is a persisting impact on the severity of the disease, rather than only observing short-term effects.

PRACTITIONER SCOPE AND TRAINING

Practitioners should practice only in the areas in which they are competent based on their education, training, and experience. Levels of education, experience, and proficiency may vary among individual practitioners. It is ethically and legally incumbent on a practitioner to determine where they have the knowledge and skills necessary to perform such services.

It is best practice for the practitioner to appropriately render services to a patient only if they are trained, equally skilled, and adequately competent to deliver a service compared to others trained to perform the same procedure. If the service would be most competently delivered by another health care practitioner who has more skill and expert training, it would be best practice to refer the patient to the more expert practitioner.

Best practice can be defined as a clinical, scientific, or professional technique, method, or process that is typically evidence-based and consensus driven and is recognized by a majority of professionals in a particular field as more effective at delivering a particular outcome than any other practice (Joint Commission International Accreditation Standards for Hospitals, 2020).

Depending on the practitioner's scope of practice, training, and experience, a member's condition and/or symptoms during examination or the course of treatment may indicate the need for referral to another practitioner or even emergency care. In such cases it is prudent for the practitioner to refer the member for appropriate co-management (e.g., to their primary care physician) or if immediate emergency care is warranted, to contact 911 as appropriate. See the *Managing Medical Emergencies (CPG 159 – S)* clinical practice guideline for information.

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