Vestibular Rehabilitation SIG
Archived Abstract of the Week
for the year 2023

January Topic: BPPV

January 4, 2023

Liu, Y., Zhang, X., Deng, Q., Liu, Q., Wen, C., Wang, W., & Chen, T. (2022). **The 3D characteristics of nystagmus in posterior semicircular canal benign paroxysmal positional vertigo**. Frontiers in neuroscience, 16, 988733. https://doi.org/10.3389/fnins.2022.988733

Objective: The aim of this study was to observe the 3-dimensional (3D; horizontal, vertical, and torsional) characteristics of nystagmus in patients with posterior semicircular canal canalithiasis (PSC-can)-related benign paroxysmal positional vertigo (BPPV) and investigate its correlation with Ewald's.

Methods: In all, 84 patients with PSC-can were enrolled. The latency, duration, direction, and slow-phase velocity induced by the Dix-Hallpike test in the head-hanging and sitting positions were recorded using 3D video nystagmography (3D-VNG). The characteristics of the horizontal, vertical, and torsional components of nystagmus were quantitatively analyzed.

Results: 3D-VNG showed that the fast phase of the vertical components and torsional components of left and right ear PSC-can as induced by the head-hanging position of the Dix-Hallpike test were upward, clockwise and counterclockwise, and horizontal components were mainly contralateral. The median slow-phase velocity of each of the three components for consecutive 5 s was 26.3°/s (12.3-45.8), 25.0°/s (15.7-38.9), and 9.2°/s (4.9-13.7). When patients were returned to the sitting position, the fast phase of the vertical and torsional components of nystagmus was reversed. Only 54 patients had horizontal components of nystagmus, and 32 of them remained in the same direction. The median slow-phase velocity of the three components for consecutive 5 s was 9.4°/s (6.0-11.7), 6.8°/s (4.5-11.8), and 4.9°/s (2.8-8.0). The ratios of the slow-phase velocity of the horizontal, vertical, and torsional components of the head-hanging position to the sitting position were close to 1.85 (1.0-6.6), 3.7 (1.9-6.6), and 5.1 (2.6-11.3). The ratios of the slow-phase velocity of the vertical to horizontal component, the torsional to horizontal component, and the vertical to torsional component of the head-hanging position were close to 3.3 (1.7-7.6), 3.9 (1.8-7.6), and 1.0 (0.5-1.8). The ratios of the slow-phase velocity of the vertical to horizontal component, the torsional to horizontal component, and the vertical to torsional component of the sitting position were close to 2.1 (1.1-6.8), 1.5 (1.0-3.8), and 1.2 (0.8-2.8).

Conclusion: There were three components of nystagmus induced by the Dix-Hallpike test in patients with PSC-can. The vertical component was the strongest and the horizontal component was the weakest. The 3D characteristics of nystagmus were consistent with those of physiological nystagmus associated with the same PSC with a single-factor stimulus, in accordance with Ewald's law.
Keywords: Ewald’s law; benign positional paroxysmal vertigo; canalithiasis; semicircular canal; three-dimensional video nystagmography.

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Keywords: Clinical neurology; Nystagmus; Vertigo.

PMID: 36583103

January 11, 2023

Wu, Y., Song, N., Ling, X., Li, X., Feng, Y., Xing, Y., Gu, P., & Yang, X. (2022). **Canal switch in benign paroxysmal positional vertigo: Clinical characteristics and possible mechanisms**. Frontiers in neurology, 13, 1049828. https://doi.org/10.3389/fneur.2022.1049828

Background: Canal switch-benign paroxysmal positional vertigo (CS-BPPV) refers to the phenomenon in which otolith particles move from one canal to another (on the ipsilateral side) during or after canalith repositioning procedure (CRP). However, the clinical characteristics of CS-BPPV and the underlying pathological mechanisms remain unclear. In this study, we investigated the incidence of canal switch (CS) for the different semicircular canals in benign paroxysmal positional vertigo (BPPV), examined nystagmus characteristics, and explored the underlying mechanisms.

Methods: Clinical data for 1,099 patients with single-canal BPPV were collected and retrospectively analyzed. The incidences of CS in the different types of BPPV were analyzed. Patients were divided into CS-BPPV and non-CS (NCS)-BPPV groups according to whether they exhibited CS after CRP. The baseline characteristics and nystagmus characteristics of patients were compared between the two groups.

Results: Patients with BPPV who developed or did not develop CS accounted for 4.6% (51/1,099) and 95.4% (1,048/1,099), respectively, of the patients included in the study. There were no statistically significant differences between the two groups in terms of sex, age, side of the canals involved, hypertension, or diabetes. CS was observed in 3.7% (25/677) of patients with PC-BPPV, including conversion between posterior canal (PC) and horizontal canal (HC) (1.6%, 11/677), and between PC and anterior canal (AC) (2.1%, 14/677). CS was observed in 5.2% (17/327) of patients with HC-BPPV, including from HC to PC (4.3%, 14/327), and from HC to AC (0.9%, 3/327). CS was found in 9.5% (9/95) of patients with AC-BPPV, including from AC to PC (8.4%, 8/95), and from AC to HC (1.1%, 1/95). The intensity of nystagmus was significantly greater in the CS-BPPV group compared with that in the NCS-BPPV group [24.00 (11-39) vs. 12.00 (7-24), $P < 0.001$]. Furthermore, the incidence of direction-reversing nystagmus was significantly higher in the CS-BPPV group than in the NCS-BPPV group [31.4% (16/51) vs. 4.3% (45/1,048), $P < 0.001$].

Conclusions: CS in BPPV is uncommon. Patients with AC-BPPV are more likely to develop CS, followed by patients with HC-BPPV and PC-BPPV. The occurrence of CS-BPPV may be related to the anatomical structure of the semicircular canals. When the canals contain large/heavy accumulations of otolith particles, CS may be more common during re-examination after CRP.

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Keywords: benign paroxysmal positional vertigo; canal conversion; canal switch; direction-reversing nystagmus; nystagmus characteristics.

PMID: 36452167

January 18, 2023

Zhao, C., Yang, Q., & Song, J. (2022). **Dynamic changes of otolith organ function before and after repositioning in patients with benign paroxysmal positional vertigo detected by virtual reality auxiliary technology: A cohort study**. Frontiers in neurology, 13, 1007992. https://doi.org/10.3389/fneur.2022.1007992

Objectives: To dynamically investigate otolith function in patients with benign paroxysmal positional vertigo (BPPV) before, after, and 1 month after repositioning, and explore the possible compensation mechanisms.

Methods: Thirty-six patients confirmed with BPPV (canal lithiasis) treated in our hospital between August 2020 and March 2021, as well as 36 health controls matched for age and gender (normal control group, NC group) were enrolled. For NC group, the virtual reality (VR) auxiliary static subjective visual vertical (SVV), subjective visual horizontal (SVH), and SVV of dynamic unilateral centrifugation (DUC), were measured at inclusion. For the BPPV group, visual analog scale (VAS) was used to assess the vertigo degree, while static SVV, SVH, and DUC were performed before, after, and 1 month after repositioning. First, we compare the deviations of SVV0/SVH0° when the subject's head is in the positive position, and SVV of DUC between BPPV and NC groups before repositioning, after which we compared the deviations in SVV45, SVV90, SVH45, SVH90°, and SVV of DUC between the affected and unaffected sides before repositioning. Finally, paired t-test was used to compare the VAS score, deviations in static SVV0, SVV45, SVV90, SVH0, SVH45, and SVH90°, and deviations in SVV of DUC before, after, and 1 month after repositioning. (Here, 0, 45, and 90° refer to the angle which the center axis of head deviates from the gravity line.).

Results: SVV0 SVH0°, and SVV of DUC at 120 and 180°/s 0 significantly differed between BPPV and NC group before repositioning. The deviations in SVV45, SVV90, SVH45, SVH90°, and SVV of DUC at 120°/s-2 and 180°/s-4.5 did not significantly differ between bilateral sides in BPPV patients before repositioning. The deviation in SVH90° was significantly lower after repositioning than before. The deviation in SVH45° was significantly higher 1 month after repositioning than before. The deviation angle of SVV of DUC at 180°/s-0 was significantly lower after repositioning than before. The vertigo VAS score of patient with BPPV continued to decrease after repositioning.

Conclusion: Before repositioning, the otolithic organ function of BPPV patients was obviously impaired, with no significant difference between the healthy and affected ear. After repositioning, there was a

transient recovery of otolithic organ dysfunction followed by a sustained decline to similar levels to before repositioning.

Keywords: BPPV; dynamic change; dynamic unilateral centrifugation; otolith organ function; subjective visual horizontal; subjective visual vertical; virtual reality auxiliary.

PMID: 36425796

January 25, 2023

Ranju, R. L., Lepcha, A., Mammen, M. D., Vasanthan, L. T., Augustine, A. M., & Philip, A. (2022). **An Effective Home-Based Particle Repositioning Procedure for Posterior Canal Benign Paroxysmal Positional Vertigo (BPPV).** Indian journal of otolaryngology and head and neck surgery : official publication of the Association of Otolaryngologists of India, 74(4), 516–523. https://doi.org/10.1007/s12070-021-03021-w

Patients with benign paroxysmal positional vertigo (BPPV) find it difficult to visit the hospital many times for a standard Epley's maneuver performed only by a specialist. The aim of this study was to compare the efficacy of a home-based particle repositioning procedure (HBPRP) with the standard Epley's maneuver in treating patients with posterior canal BPPV. A prospective non-blinded randomized controlled study was conducted. Patients were randomized into two groups, where one group received the standard treatment and other received a new HBPRP. The vertigo scale, duration of nystagmus during Dix-Hallpike test and frequency of vertigo, were documented on first, second and third visits, with complications noted during the second and third visits. These parameters were compared between both the groups following the treatment, during all visits. The patients were randomized into 2 arms with 15 each. Those belonging to group 1 received Epley's maneuver and group 2 received HBPRP. There was no significant difference in the baseline characteristics of patients in both groups. Both groups of patients had significant improvement of symptoms at the end of the study. A comparison of both groups at 2nd and 3rd visits showed no differences in frequency of vertigo, reduction in vertigo scale and duration of nystagmus following Dix-Hallpike test between both groups. HBPRP is a safe and effective procedure and can be taught as a home-based treatment for patients diagnosed with posterior canal BPPV.

Keywords: BPPV; Dix–Hallpike test; Epley’s maneuver; Home-based particle repositioning procedure.

PMID: 36514424

Vestibular Rehabilitation SIG
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February Topic: Coexistence of Vestibular Deficits and Psychiatric Disorders

February 1, 2023
Chow MR, Ayiotis AI, Schoo DP, et al. **Posture, Gait, Quality of Life, and Hearing with a Vestibular Implant**. N Engl J Med. 2021;384(6):521-532. doi:10.1056/NEJMoa2020457

METHODS: Persons who had had ototoxic (7 participants) or idiopathic (1 participant) bilateral vestibular hypofunction for 2 to 23 years underwent unilateral implantation of a prosthesis that electrically stimulates the three semicircular canal branches of the vestibular nerve. Clinical outcomes included the score on the Bruininks–Oseretsky Test of Motor Proficiency balance subtest (range, 0 to 36, with higher scores indicating better balance), time to failure on the modified Romberg test (range, 0 to 30 seconds), score on the Dynamic Gait Index (range, 0 to 24, with higher scores indicating better gait performance), time needed to complete the Timed Up and Go test, gait speed, pure-tone auditory detection thresholds, speech discrimination scores, and quality of life. We compared participants' results at baseline (before implantation) with those at 6 months (8 participants) and at 1 year (6 participants) with the device set in its usual treatment mode (varying stimulus pulse rate and amplitude to represent rotational head motion) and in a placebo mode (holding pulse rate and amplitude constant).

RESULTS: The median scores at baseline and at 6 months on the Bruininks–Oseretsky test were 17.5 and 21.0, respectively (median within-participant difference, 5.5 points; 95% confidence interval [CI], 0 to 10.0); the median times on the modified Romberg test were 3.6 seconds and 8.3 seconds (difference, 5.1; 95% CI, 1.5 to 27.6); the median scores on the Dynamic Gait Index were 12.5 and 22.5 (difference, 10.5 points; 95% CI, 1.5 to 12.0); the median times on the Timed Up and Go test were 11.0 seconds and 8.7 seconds (difference, 2.3; 95% CI, −1.7 to 5.0); and the median speeds on the gait-speed test were 1.03 m per second and 1.10 m per second (difference, 0.13; 95% CI, −0.25 to 0.30). Placebo-mode testing confirmed that improvements were due to treatment-mode stimulation. Among the 6 participants who were also assessed at 1 year, the median within-participant changes from baseline to 1 year were generally consistent with results at 6 months. Implantation caused ipsilateral hearing loss, with the air-conducted pure-tone average detection threshold at 6 months increasing by 3 to 16 dB in 5 participants and by 74 to 104 dB in 3 participants. Changes in participant-reported disability and quality of life paralleled changes in posture and gait.

CONCLUSIONS: Six months and 1 year after unilateral implantation of a vestibular prosthesis for bilateral vestibular hypofunction, measures of posture, gait, and quality of life were generally in the direction of improvement from baseline, but hearing was reduced in the ear with the implant in all but 1 participant. (Funded by the National Institutes of Health and others; ClinicalTrials.gov number, NCT02725463.)

PMID: 33567192

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February 8, 2023

Vaz FC, Petrus L, Martins WR, et al. **The effect of cochlear implant surgery on vestibular function in adults: A meta-analysis study**. Front Neurol. 2022;13:947589. Published 2022 August 10. doi:10.3389/fneur.2022.947589

Issue: The findings in literature indicate inconsistency in the complications caused by the implant of electrodes in the cochlea; vestibular alterations and balance disorders are mentioned as the most likely.

Purpose: To evaluate, in literature, through the results of multiple vestibular function tests, the effects of cochlear implant surgery on postural stability in adult patients and to analyze.

Hypothesis: From the PICO strategy, where the Population focuses on adults, Intervention is cochlear implant surgery, Comparisons are between implanted patients, and Outcomes are the results of the assessment of cochlear function, the research question was formulated: Are there deficits in vestibular function in adults undergoing cochlear implant placement?

Method: Systematic review based on cohort, case-control, and cross-sectional observational studies. Information sources: Databases between 1980 and 2021, namely, PubMed, Cinahl, Web Of Science, Cochrane, and Scopus. Search strategy using Mesh terms: "Adult," "Cochlear Implant," "Postural Balance," "Posturography," "Cochlear Implant," "Dizziness," "Vertigo," "Vestibular Functional Tests,"and "Caloric Tests." Populational inclusion criteria: studies with adult patients; intervention: cochlear implant placement surgery; comparison: analysis of a vestibular function with vestibular test results and pre- and postoperative symptoms; outcome: studies with at least one of the vestibular function tests, such as computerized vectoelectronystagmography (VENG), vestibular-evoked myogenic potentials (VEMPs), caloric test, video head impulse test (VHIT), head impulse test (HIT), videonystagmography, (VNG) and static and dynamic posturography. Exclusion criteria: studies without records of pre- and postoperative data collection and studies with populations under 18 years of age. Screening based on the reading of abstracts and titles was performed independently by two reviewers. In the end, with the intermediation of a third reviewer, manuscripts were included. Risk of bias analysis, performed by two other authors, occurred using the JBI "Critical Appraisal Checklist."

Results: Of the 757 studies, 38 articles met the inclusion criteria. VEMP was the most commonly used test by the studies (44.7%), followed by the caloric test (36.8%) and vHIT (23.6%). Most studies performed more than one test to assess vestibular function.

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Conclusion: Among all vestibular tests investigated, the deleterious effects on vestibular function after cochlear implant surgery were detected with statistical significance ($P < 0.05$) using VEMP and caloric test. Comparing abnormal and normal results after implant surgery, the vestibular apparatus was evaluated as having abnormal results after cochlear implant surgery only in the VEMP test. The other tests analyzed maintained a percentage mostly considered normal results.

Systematic review registration: identifier: CRD42020198872.

Keywords: balance; cochlear implant; dizziness; vertigo; vestibular function; vestibular loss.

PMID: 36034277

February 15, 2023
Wackym PA, Hannley MT, Runge-Samuelson CL, Jensen J, Zhu YR. **Gamma Knife surgery of vestibular schwannomas: longitudinal changes in vestibular function and measurement of the Dizziness Handicap Inventory**. J Neurosurg. 2008;109 Suppl:137-143. doi:10.3171/JNS/2008/109/12/S21

Object: Gamma Knife surgery (GKS) is one of the methods available to treat vestibular schwannomas (VSs), in addition to microsurgical resection; however, clear information regarding balance function outcomes and the impact of treatment on patients' quality of life over time remains an important clinical need. The purpose of this study was to assess the longitudinal balance outcomes and Dizziness Handicap Inventory (DHI) following GKS for VSs.

Methods: This was a prospective clinical study of balance outcomes in all patients with VSs treated in the Acoustic Neuroma and Skull Base Surgery Program at a tertiary referral center by the senior author and the Gamma Knife team between June 2000 and May 2008. The main outcome measures included preoperative vestibular testing and postoperative caloric testing performed at 6-month intervals to determine vestibular function. The DHI questionnaires were administered retrospectively to assess the impact of GKS on self-perceived disability.

Results: Between June 2000 and May 2008, 55 sporadic VSs were treated. There was a >or= 60-month follow-up available in 27 of these patients, >or= 48 months in 32, >or= 36 months in 38, >or= 24 months in 43, >or= 12 months in 51, and >or= 6 months in 54 (1 patient was excluded from the analysis because the follow-up was < 6 months). Various patterns of changes in vestibular function were observed in either positive or negative directions. A significant difference in total DHI score was seen only in the elderly (> 65 years old) patients pre-GKS compared with post-GKS ($t = 1.34$, $p = 0.05$).

Conclusions: Longitudinal changes in vestibular function occur over time, with the largest changes seen in the first 6 months after treatment. Potential for clinical intervention, such as vestibular rehabilitation therapy, exists during this interval; however, larger cohorts must be studied to determine the timing and

efficacy of this intervention. The statistically significant improvement in the DHI score in the patient cohort > 65 years old treated with GKS suggests that this group may benefit from this option when considering the symptom of dizziness.

PMID: 19123900

February 22, 2023

Zobeiri OA, Mischler GM, King SA, Lewis RF, Cullen KE. **Effects of vestibular neurectomy and neural compensation on head movements in patients undergoing vestibular schwannoma resection**. Sci Rep. 2021;11(1):517. Published 2021 January 12. doi:10.1038/s41598-020-79756-3

Objective: The aim of this study was to investigate the relation between visual and vestibular hypersensitivity, and Depersonalization/Derealization symptoms in patients with chronic dizziness.

Materials and Methods: 319 adult patients with chronic dizziness for more than 3 months (214 females and 105 males, mean age: 58 years, range: 13-90) were included in this prospective cross-sectional study. Patients underwent a complete audio-vestibular workup and 3 auto questionnaires: Hospital Anxiety and Depression (HAD), Depersonalization/Derealization Inventory (DDI), and an in-house questionnaire (Dizziness in Daily Activity, DDA) assessing 9 activities with a score ranging from 0 (no difficulty) to 10 (maximal discomfort) and 11 (avoidance) to detect patients with visual and vestibular hypersensitivity (VVH, a score > 41 corresponding to mean + 1 standard deviation).

Results: DDI scores were higher in case of VVH (6.9 ± 6.79, n = 55 vs. 4.2 ± 4.81, n = 256 without VVH, $p < 0.001$, unpaired t-test), migraine (6.1 ± 6.40, n = 110 vs. 4.0 ± 4.42, n = 208no migraine, $p < 0.001$, unpaired t-test), and motion sickness (6.8 ± 5.93, n = 41 vs. 4.4 ± 5.11, n = 277 no motion sickness, $p < 0.01$, unpaired t-test). Women scored DDI higher than men (5.1 ± 5.42, n = 213 vs. 3.9 ± 4.91, n = 105, respectively, $p < 0.05$, unpaired t-test). DDI scores were also related to depression and anxiety. DDI score was also higher during spells than during the basal state.

Conclusion: During chronic dizziness, Depersonalization/Derealization symptoms seem to be related to anxiety and depression. Moreover, they were prominent in women, in those with visual and vestibular hypersensitivity, migraine, and motion sickness.

Keywords: anxiety; chronic vertigo; depersonalization/derealization disorder; depression; migraine; motion sickness; optic flow vertigo; persistent postural-perceptual dizziness.

PMID: 30814972

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February 22, 2023

Riccelli, R., Indovina, I., Staab, J. P., Nigro, S., Augimeri, A., Lacquaniti, F., & Passamonti, L. (2017). **Neuroticism modulates brain visuo-vestibular and anxiety systems during a virtual rollercoaster task**. Human Brain Mapping, 38(2), 715-726.

Background: Research suggest that anxiety-related personality traits may influence the visual and vestibular control of balance, although the brain mechanisms underlying this effect remain unclear. To our knowledge, this is the first functional magnetic resonance imaging (fMRI) study that investigates how individual differences in neuroticism and introversion, two key personality traits linked to anxiety, modulate brain regional responses and functional connectivity patterns during a fMRI task simulating self-motion.

Methods: 24 healthy individuals with variable levels of neuroticism and introversion underwent fMRI while performing a virtual reality rollercoaster task that included two main types of trials: (1) trials simulating downward or upward self-motion (vertical motion), and (2) trials simulating self-motion in horizontal planes (horizontal motion). Regional brain activity and functional connectivity patterns when comparing vertical versus horizontal motion trials were correlated with personality traits of the Five Factor Model (i.e., neuroticism, extraversion-introversion, openness, agreeableness, and conscientiousness).

Results: There was a positive correlation between neuroticism scores and regional activity in the left parieto-insular vestibular cortex (PIVC). There was also an increased functional connectivity between the left PIVC and right amygdala was also detected as a function of higher neuroticism scores.

Conclusion: Findings provide new evidence that individual differences in personality traits linked to anxiety are significantly associated with changes in the activity and functional connectivity patterns within visuo-vestibular and anxiety-related systems during simulated vertical self-motion.

PMID: 6866907

February 27, 2023

Zhao C, Yang Q, Song J. **Dynamic changes of otolith organ function before and after repositioning in patients with benign paroxysmal positional vertigo detected by virtual reality auxiliary technology: A cohort study**. Front Neurol. 2022;13:1007992. Published 2022 November 08. doi:10.3389/fneur.2022.1007992

Background: Persistent postural perceptual dizziness (PPPD) describes a persistent sensation of dizziness and/or unsteadiness (without vertigo) aggravated by upright posture that generates increased postural sway. This article introduces a novel measure of perceived instability to investigate the relationship

between observed sway and perceived instability in patients with PPPD compared with patients with persistent 'objective' instability due to bilateral vestibulopathy (BV).

Methods: 19 individuals with PPPD and 10 controls with BV were included in the study. PPPD patients were randomly allocated to an 'intervention' and 'no intervention' groups. Ten healthy controls were also recruited to validate the novel measure of perceived instability. All participants performed three identical 20-second trials of quiet standing on a firm surface with eyes closed, arms by the sides and feet together. Observed sway was measured using a force plate. Participants verbally rated their initial perceived instability and then replicated their perceived instability by moving their body how they thought they were swaying during the initial measurement. The perceived instability was quantified by measuring sway whilst standing on the force plate with eyes open. Participants also completed two self-administered questionnaires: the State-Trait Anxiety Inventory scale (STAI-S) and the Dizziness Handicap Inventory (DHI). PPPD participants in the intervention group were shown a video recording of themself during the observed sway measurements. The observed, perceived and reproduced instability measurements were then repeated.

Results: Observed sway tended to be less in PPPD than BV patients, but, despite this, PPPD patients perceived significantly greater instability than BV

Conclusion: Future biomarkers of PPPD may need to include measures of perceptual impairment, rather than relying on observed postural sway outcomes, where differences between patients with PPPD and even healthy controls are inconsistent

PMID: 35995549

February 27, 2023
Fipps, D. C., Staab, J. P., & Allen, N. D. (2022). **Case Report: Right Insular Stroke Causing Simultaneous Onset of a Functional Vestibular Disorder and Psychiatric Disorder—Persistent Postural–Perceptual Dizziness and Post–stroke Depression**. Frontiers in Psychiatry, 13.

Case Report: A 40-year-old woman developed new, debilitating chronic dizziness exacerbated by her own motion and exposure to visual motion stimuli plus prolonged depressive symptoms, both beginning within days after a localized right insular stroke. A collaborative evaluation by specialists in neurology, otorhinolaryngology, optometry, and psychiatry concluded that the insular stroke caused simultaneous onset of persistent postural-perceptual dizziness (PPPD) and post-stroke depression (PSD).

Discussion: Chronic dizziness and motion sensitivity continued in the absence of focal neurologic deficits, invoking the possibility that changes in functioning of brain networks subserving spatial orientation persisted despite otherwise adequate recovery from the stroke, a mechanism previously proposed for PPPD. This case also reinforced prior work implicating pathways through the insula in PSD. Co-

occurrence of PPPD and PSD offers insights into simultaneous functions of the insula in multiple networks in human brain.

PMID: 35530020

March Topic: Vestibular Migraine

March 01, 2023
Beh SC. **Vestibular Migraine**. Curr Neurol Neurosci Rep. 2022 Oct;22(10):601-609. doi: 10.1007/s11910-022-01222-6. Epub 2022 August 31. PMID: 36044103.

Purpose of review: To explore recent developments in vestibular migraine (VM).

Recent findings: This review discusses the current diagnostic criteria for VM in the adult and pediatric populations, as proposed by the International Headache Society and Bárány Society. Recent VM studies confirm the prior findings and reveal new insights, including the wide range of vestibular symptoms, symptoms in the attack-free period, and triggers. Many patients experience persistent vestibular symptoms, even in the absence of acute attacks, which often significantly impact patients' quality of life. The syndrome of benign recurrent vertigo and its relationship to migraine, VM, and Meniere's disease is also discussed. There is a dearth of randomized controlled trials in VM treatment. Prospective and retrospective studies support the benefit of many migraine treatments are effective in VM, including neuromodulation, and calcitonin gene-related peptide monoclonal antibodies. VM affects almost 3% of the population, but remains under-diagnosed. Recent diagnostic criteria can help clinicians diagnose VM in adults and children.

Keywords: Dizziness; Migraine; Vertigo; Vestibular migraine.

PMID: 36044103

March 08, 2023
Smyth D, Britton Z, Murdin L, Arshad Q, Kaski D. **Vestibular migraine treatment: a comprehensive practical review**. Brain. 2022;145(11):3741-3754. doi:10.1093/brain/awac264

Vestibular migraine is an underdiagnosed but increasingly recognized neurological condition that causes episodic vertigo associated with other features of migraine. It is now thought to be the most common cause of spontaneous (non-positional) episodic vertigo, affecting up to 1% of the population. A meta-analysis of preventative treatments for vestibular migraine was published in 2021, but the authors were unable to establish a preferred treatment strategy due to low quality of evidence and heterogeneity of study design and outcome reporting. Therefore, there remains a clinical need for pragmatic

management guidelines specific to vestibular migraine using the available evidence. Here, we provide a practical review utilizing a systematic qualitative assessment of the evidence for abortive and preventative interventions in adults. The overall evidence base for vestibular migraine treatment is of low quality. Nevertheless, we provide practical treatment recommendations based on the available evidence and our experience to help guide clinicians treating patients with vestibular migraine. We also discuss how future clinical trials could be designed to improve the quality of evidence in this condition.

Keywords: clinical trials; outcomes; prophylaxis; treatment; vestibular migraine.

PMID: 35859353

March 15, 2023

Stancel-Lewis J, Lau JWL, Male A, et al. **Vestibular Rehabilitation Therapy for the Treatment of Vestibular Migraine, and the Impact of Traumatic Brain Injury on Outcome: A Retrospective Study**. Otol Neurotol. 2022;43(3):359-367. doi:10.1097/MAO.0000000000003452

Introduction: Vestibular migraine (VM) is a common condition; individuals experience dizziness with migraine symptoms. Vestibular rehabilitation therapy (VRT) has been reported as an effective treatment for VM, however, evidence is limited. VM and traumatic brain injury (TBI) can co-occur, and some suggest that TBI can induce VM. There is limited evidence on the effect a history of TBI has on VRT in patients with VM.

Methods: Retrospective case series of 93 (f = 63, m = 30) participants with VM and underwent VRT (mean age 48.62; SD 15.92). Pre- and post-treatment self-reported outcome measures and functional gait assessment were extracted from the participants health records and evaluated. The impact of TBI on VRT outcome in participants with VM was analyzed. Individuals with TBI and no history of migraine (n = 40) were also extracted to act as a control.

Results: VRT significantly improved self-reported dizziness on the Dizziness Handicap Inventory (DHI), with a mean change of -18 points ($p < 0.000$) and +5 points on the functional gait assessment (FGA) ($p < 0.000$) in patients with VM. A history of TBI significantly impacted outcome on the DHI ($p = 0.018$) in patients with VM.VRT significantly improved all outcome measures for individuals with TBI, with a mean change of -16 points on the DHI ($p = 0.001$) and +5 points on the FGA ($p < 0.000$). VM presence significantly impacted outcome.

Conclusion: VRT should be considered as a treatment option to reduce dizziness and the risk of falls in individuals with VM. TBI may negatively impact VRT outcomes in individuals with VM.

PMID: 35147607

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March 22, 2023

Chen JY, Guo ZQ, Wang J, et al. **Vestibular migraine or Meniere's disease: a diagnostic dilemma** [published online ahead of print, 2022 December 23]. J Neurol. 2022;10.1007/s00415-022-11532-x. doi:10.1007/s00415-022-11532-x

Meniere's disease (MD) represents one of the vertigo disorders characterized by triad symptoms (recurrent vertigo, fluctuating hearing loss, tinnitus or ear fullness). The diagnosis of MD relies on the accurate and detailed taking of medical history, and the differentiation between MD and vestibular migraine (VM) is of critical importance from the perspective of the treatment efficacy. VM is a highly prevalent vertigo condition and its typical symptoms (headache, vestibular symptoms, cochlear symptoms) mimic those of MD. Furthermore, the misdiagnosis in MD and VM could lead to VM patients mistakenly receiving the traumatic treatment protocol designed for MD, and sustaining unnecessary damage to the inner ear. Fortunately, thanks to the advances in examination technologies, the barriers to their differentiation are being gradually removed. These advances enhance the diagnostic accuracy of vertigo diseases, especially VM and MD. This review focused on the differentiation of VM and MD, with an attempt to synthesize existing data on the relevant battery of differentiation diagnosis (covering core symptoms, auxiliary tests [audiometry, vestibular tests, endolymphatic hydrops tests]) and longitudinal follow-up. Since the two illnesses are overlapped in all aspects, no single test is sufficiently specific on its own, however, patterns containing all or at least some features boost specificity.

Keywords: Audiometry; Dizziness; Meniere’s disease; Vertigo; Vestibular function tests; Vestibular migraine.

PMID: 36562849

March 29, 2023

Preysner TA, Gardi AZ, Ahmad S, Sharon JD. **Vestibular Migraine: Cognitive Dysfunction, Mobility, Falls**. Otol Neurotol. 2022;43(10):1216-1221. doi:10.1097/MAO.0000000000003700

Objective: Recent evidence has shown that vestibular migraine is strongly associated with cognitive difficulties. However, limited data exist on real-world effects of that dysfunction. The objective of this study is to understand the epidemiology of cognitive dysfunction with vestibular migraine and associated sequelae using National Health Interview Survey data.

Study design: Randomized, population-based survey study of US adults.

Setting: We generated a case definition approximating probable vestibular migraine based on Bárány Society criteria and validated that definition in a tertiary care vestibular clinic.

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Patients: Adult respondents to the 2016 NHIS, which queries a representative sample of the civilian, noninstitutionalized US population.

Intervention: Diagnostic.

Main outcome measures: We evaluated incidence of self-reported cognitive dysfunction with vestibular migraine and whether individuals were more likely to have impaired mobility, falls, and work absenteeism than those without either condition.

Results: Among individuals with vestibular migraine, 40% reported "some" and 12% reported "a lot" of difficulty thinking versus 13% and 2% of those without vestibular migraine, respectively. Vestibular migraine sufferers were more likely to have difficulty thinking or remembering compared with respondents without dizziness (odds ratio, 7.43; 95% confidence interval, 6.06-9.10; $p < 0.001$) when controlled for age, sex, education, stroke, smoking, heart disease, and diabetes. Individuals with both vestibular migraine and cognitive dysfunction had fivefold increased odds of falls and 10-fold increased odds of mobility issues compared with those without either condition. Furthermore, individuals with both vestibular migraine and cognitive dysfunction missed 12.8 more days of work compared to those without either condition.

Conclusion: Our findings indicate vestibular migraine is not only associated with cognitive dysfunction, but they are together associated with mobility issues, fall risk, and work absenteeism.

PMID: 36136612

April Topic: The Vestibulo-Perceptual System

April 05, 2023
Wurthmann, S., Holle, D., Obermann, M., Roesner, M., Nsaka, M., Scheffler, A., Kleinschnitz, C., & Naegel, S. (2021). **Reduced vestibular perception thresholds in persistent postural-perceptual dizziness- a cross-sectional study**. BMC neurology, 21(1), 394. https://doi.org/10.1186/s12883-021-02417-z

Background: Persistent postural-perceptual dizziness (PPPD) is the most common functional vestibular disorder. A multisensory mismatch altered by psychological influences is considered to be an important pathophysiological mechanism. Increased cortical and subcortical excitability may play a role in the pathophysiology of PPPD. We hypothesized that decreased motion perception thresholds reflect one mechanism of the abnormal vestibular responsiveness in this disorder. We investigated the vestibular perception thresholds and the vestibular ocular reflex with a rotatory chair experiment to gain insights in the processing and adaption to vestibular provocation.

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Methods: In this cross-sectional study 26 female PPPD patients and 33 healthy female age matched controls (HC) were investigated sitting in a motorized rotary chair shielded regarding visual and acoustic stimuli. The chair was rotated for 20 minutes with slowly increasing velocity to a maximum of 72°/s. We functionally tested motion perception thresholds and vegetative responses to rotation as well as vestibular-ocular reflex thresholds. We additionally investigated several psychological comorbidities (i.e. depression, anxiety, somatosensory amplification) using validated scores. Conventional dizziness scores were obtained to quantify the experienced dizziness and impact on daily life.

Results: PPPD patients showed a significant reduced vestibulo-perceptual threshold (PPPD: 10.9°/s vs. HC: 29.5°/s; $p<0.001$) with increased motion sensitivity and concomitant vegetative response during and after the chair rotation compared to healthy controls. The extent of increased vestibular sensitivity was in correlation with the duration of the disease ($p=0.043$). No significant difference was measured regarding nystagmus parameters between both groups.

Conclusion: PPPD patients showed increased vegetative response as well as decreased vestibulo-perceptual thresholds which are related to disease duration. This is of interest as PPPD might be sustained by increased vestibular excitability leading to motion intolerance and induction of dizziness when exposed to movement.
Keywords: Persistent postural-perceptual dizziness; functional vestibular disorder; motion sensitivity; vestibular perceptual threshold.

PMID: 34641808

April 12, 2023

Choi, J. Y., Koo, Y. J., Song, J. M., Kim, H. J., & Kim, J. S. (2023). **Effect of a False Inertial Cue in the Velocity-Storage Circuit on Head Posture and Inertia Perception**. The Journal of neuroscience : the official journal of the Society for Neuroscience, 43(9), 1530–1539.
https://doi.org/10.1523/JNEUROSCI.1148-22.2023

The velocity-storage circuit participates in the vestibulopostural reflex, but its role in the postural reflex requires further elucidation. The velocity-storage circuit differentiates gravitoinertial information into gravitational and inertial cues using rotational cues. This implies that a false rotational cue can cause an erroneous estimation of gravity and inertial cues. We hypothesized the velocity-storage circuit is a common gateway for all vestibular reflex pathways and tested that hypothesis by measuring the postural and perceptual responses from a false inertial cue estimated in the velocity-storage circuit. Twenty healthy human participants (40.5 ± 8.2 years old, 6 men) underwent two different sessions of earth-vertical axis rotations at 120°/s for 60 s. During each session, the participants were rotated clockwise and then counterclockwise with two different starting head positions (head-down and head-up). During the first (control) session, the participants kept a steady head position at the end of rotation.

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During the second (test) session, the participants changed their head position at the end of rotation, from head-down to head-up or vice versa. The head position and inertial motion perception at the end of rotation were aligned with the inertia direction anticipated by the velocity-storage model. The participants showed a significant correlation between postural and perceptual responses. The velocity-storage circuit appears to be a shared neural integrator for the vestibulopostural reflex and vestibular perception. Because the postural responses depended on the inertial direction, the postural instability in vestibular disorders may be the consequence of the vestibulopostural reflex responding to centrally estimated false vestibular cues.
SIGNIFICANCE STATEMENT The velocity-storage circuit appears to participate in the vestibulopostural reflex, which stabilizes the head and body position in space. However, it is still unclear whether the velocity-storage circuit for the postural reflex is in common with that involved in eye movement and perception. We evaluated the postural and perceptual responses to a false inertial cue estimated by the velocity-storage circuit. The postural and perceptual responses were consistent with the inertia direction predicted in the velocity-storage model and were correlated closely with each other. These results show that the velocity-storage circuit is a shared neural integrator for vestibular-driven responses and suggest that the vestibulopostural response to a false vestibular cue is the pathomechanism of postural instability clinically observed in vestibular disorders.
Keywords: perception; posture; velocity-storage; vestibular system.

PMID: 36669887

April 19, 2023
Bonsu, A. N., Nousi, S., Lobo, R., Strutton, P. H., Arshad, Q., & Bronstein, A. M. (2021). **Vestibulo-perceptual influences upon the vestibulo-spinal reflex.** Experimental brain research, 239(7), 2141–2149. https://doi.org/10.1007/s00221-021-06123-7

The vestibular system facilitates gaze and postural stability via the vestibulo-ocular (VOR) and vestibulo-spinal reflexes, respectively. Cortical and perceptual mechanisms can modulate long-duration VOR responses, but little is known about whether high-order neural phenomena can modulate short-latency vestibulo-spinal responses. Here, we investigate this by assessing click-evoked cervical vestibular myogenic-evoked potentials (VEMPS) during visual roll motion that elicited an illusionary sensation of self-motion (i.e. vection). We observed that during vection, the amplitude of the VEMPs was enhanced when compared to baseline measures. This modulation in VEMP amplitude was positively correlated with the subjective reports of vection strength. That is, those subjects reporting greater subjective vection scores exhibited a greater increase in VEMP amplitude. Control experiments showed that simple arousal (cold-induced discomfort) also increased VEMP amplitude but that, unlike vection, it did not modulate VEMP amplitude linearly. In agreement, small-field visual roll motion that did not induce vection failed to increase VEMP amplitude. Taken together, our results demonstrate that vection can modify the response of vestibulo-collic reflexes. Even short-latency brainstem vestibulo-spinal reflexes are influenced by high-order mechanisms, illustrating the functional importance of perceptual

mechanisms in human postural control. As VEMPs are inhibitory responses, we argue that the findings may represent a mechanism whereby high-order CNS mechanisms reduce activity levels in vestibulo-collic reflexes, necessary for instance when voluntary head movements need to be performed.
Keywords: Vection; Vestibular-evoked myogenic potentials; Vestibulo-spinal reflexes.

PMID: 33969437

April 26, 2023

Diaz-Artiles, A., & Karmali, F. (2021). **Vestibular Precision at the Level of Perception, Eye Movements, Posture, and Neurons**. Neuroscience, 468, 282–320.
https://doi.org/10.1016/j.neuroscience.2021.05.028

Precision and accuracy are two fundamental properties of any system, including the nervous system. Reduced precision (i.e., imprecision) results from the presence of neural noise at each level of sensory, motor, and perceptual processing. This review has three objectives: (1) to show the importance of studying vestibular precision, and specifically that studying accuracy without studying precision ignores fundamental aspects of the vestibular system; (2) to synthesize key hypotheses about precision in vestibular perception, the vestibulo-ocular reflex, posture, and neurons; and (3) to show that groups of studies that are thoughts to be distinct (e.g., perceptual thresholds, subjective visual vertical variability, neuronal variability) are actually "two sides of the same coin" - because the methods used allow results to be related to the standard deviation of a Gaussian distribution describing the underlying neural noise. Vestibular precision varies with age, stimulus amplitude, stimulus frequency, body orientation, motion direction, pathology, medication, and electrical/mechanical vestibular stimulation, but does not vary with sex. The brain optimizes precision during integration of vestibular cues with visual, auditory, and/or somatosensory cues. Since a common concern with precision metrics is time required for testing, we describe approaches to optimize data collection and provide evidence that fatigue and session effects are minimal. Finally, we summarize how precision is an individual trait that is correlated with clinical outcomes in patients as well as with performance in functional tasks like balance. These findings highlight the importance of studying vestibular precision and accuracy, and that knowledge gaps remain.
Keywords: human experiments; signal detection theory; standard deviation; thresholds; variability; vestibulo-ocular reflex.

PMID: 34087393

May Topic: Meniere's

May 03, 2023

Mammarella F, Loperfido A, Keeling EG, Bellocchi G, Marsili L. **Ménière's Disease: Insights from an Italian Nationwide Survey**. Audiol Res. 2023;13(2):160-168. Published 2023 February 28. doi:10.3390/audiolres13020016

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The aim of the present study was to obtain data from a large community sample of patients with Ménière's disease (MD) in Italy through a web-based nationwide survey. Demographic, clinical, and epidemiological features of MD among members of the Italian Association of Ménière's Disease (AMMI) were collected through a web-based survey. The questionnaire was posted on the AMMI website between 01/SEP/2021 and 31/OCT/2021. A total of 520 patients (374 F, 146 M) with MD were included. The age at interview (average ± standard deviation, SD) was 51.4 ± 10.9 years, with a disease duration of 9.9 ± 9.8 years. Eighty percent of cases were unilateral. No patients reported neurocognitive disorders or Parkinson's disease. A positive family history of MD was reported in 13% of participants, while a history of allergic diseases was reported in 33%. Comorbid thyroid disorders were present in 25% of participants, and 28% used betahistine as the main treatment. To our knowledge, this is the first study that has investigated the epidemiology and current patterns of care of MD in Italy, using an anonymous survey directly sent to patients, thus implying their active participation. We hope that future studies will support the utilization of web-based surveys to address the unmet needs in the management of patients with MD.

Keywords: Ménière's disease; otologic disorders; survey.

PMID: 36960977

May 10, 2023

Leng Y, Fan W, Liu Y, et al. **Comparison between audio-vestibular findings and contrast-enhanced MRI of inner ear in patients with unilateral Ménière's disease**. Front Neurosci. 2023;17:1128942. Published 2023 March 13. doi:10.3389/fnins.2023.1128942

Objective: The diagnosis of Ménière's disease (MD), characterized by idiopathic endolymphatic hydrops (ELH), remains a clinical priority. Many ancillary methods, including the auditory and vestibular assessments, have been developed to identify ELH. The newly emerging delayed magnetic resonance imaging (MRI) of the inner ear after intratympanic gadolinium (Gd) has been used for identifying ELH in vivo. We aimed to investigate the concordance of audio-vestibular and radiological findings in patients with unilateral MD.

Methods: In this retrospective study, 70 patients with unilateral definite MD underwent three-dimensional fluid-attenuated inversion recovery (3D-FLAIR) sequences following intratympanic application of Gd. Audio-vestibular evaluations were performed, including pure tone audiometry, electrocochleogram (ECochG), glycerol test, caloric test, cervical and ocular vestibular evoked myogenic potentials (VEMPs), and video head impulse test (vHIT). The relationship between imaging signs of ELH and audio-vestibular results was investigated.

Results: The incidence of radiological ELH was higher than that of neurotological results, including the glycerol test, caloric test, VEMPs, and vHIT. Poor or slight agreement was observed between audio-vestibular findings and radiological ELH in cochlear and/or vestibular (kappa values <0.4). However, the pure tone average (PTA) in the affected side significantly correlated with the extent of both cochlear (r = 0.26795, p = 0.0249) and vestibular (r = 0.2728, p = 0.0223) hydrops. Furthermore, the degree of vestibular hydrops was also positively correlated with course duration (r = 0.2592, p = 0.0303) and glycerol test results (r = 0.3944, p = 0.0061) in the affected side.

Conclusion: In the diagnosis of MD, contrast-enhanced MRI of the inner ear is advantageous in detecting ELH over the conventional audio-vestibular evaluations, which estimates more than hydropic dilation of endolymphatic space.

Keywords: Ménière’s disease; caloric test; electrocochleogram; endolymphatic hydrops; glycerol test; magnetic resonance imaging; vestibular evoked myogenic potentials; video head impulse test (vHIT).

PMID: 36992853

May 31, 2023

Webster KE, Galbraith K, Lee A, et al. **Intratympanic gentamicin for Ménière's disease**. Cochrane Database Syst Rev. 2023;2(2):CD015246. Published 2023 Feb 27. doi:10.1002/14651858.CD015246.pub2

Background: Ménière's disease is a condition that causes recurrent episodes of vertigo, associated with hearing loss and tinnitus. Aminoglycosides are sometimes administered directly into the middle ear to treat this condition. The aim of this treatment is to partially or completely destroy the balance function of the affected ear. The efficacy of this intervention in preventing vertigo attacks, and their associated symptoms, is currently unclear.

Objectives: To evaluate the benefits and harms of intratympanic aminoglycosides versus placebo or no treatment in people with Ménière's disease.

Search methods: The Cochrane ENT Information Specialist searched the Cochrane ENT Register; Central Register of Controlled Trials (CENTRAL); Ovid MEDLINE; Ovid Embase; Web of Science; ClinicalTrials.gov; ICTRP and additional sources for published and unpublished trials. The date of the search was September 14 2022.

Selection criteria: We included randomised controlled trials (RCTs) and quasi-RCTs in adults with a diagnosis of Ménière's disease comparing intratympanic aminoglycosides with either placebo or no treatment. We excluded studies with follow-up of less than three months, or with a cross-over design (unless data from the first phase of the study could be identified). DATA COLLECTION AND ANALYSIS: We used standard Cochrane methods. Our primary outcomes were: 1) improvement in vertigo (assessed as

a dichotomous outcome - improved or not improved), 2) change in vertigo (assessed as a continuous outcome, with a score on a numerical scale) and 3) serious adverse events. Our secondary outcomes were: 4) disease-specific health-related quality of life, 5) change in hearing, 6) change in tinnitus and 7) other adverse effects. We considered outcomes reported at three time points: 3 to < 6 months, 6 to ≤ 12 months and > 12 months. We used GRADE to assess the certainty of evidence for each outcome. MAIN RESULTS: We included five RCTs with a total of 137 participants. All studies compared the use of gentamicin to either placebo or no treatment. Due to the very small numbers of participants in these trials, and concerns over the conduct and reporting of some studies, we considered all the evidence in this review to be very low-certainty. Improvement in vertigo This outcome was assessed by only two studies, and they used different time periods for reporting. Improvement in vertigo was reported by more participants who received gentamicin at both 6 to ≤ 12 months (16/16 participants who received gentamicin, compared to 0/16 participants with no intervention; risk ratio (RR) 33.00, 95% confidence interval (CI) 2.15 to 507; 1 study; 32 participants; very low-certainty evidence) and at > 12 months follow-up (12/12 participants receiving gentamicin, compared to 6/10 participants receiving placebo; RR 1.63, 95% CI 0.98 to 2.69; 1 study; 22 participants; very low-certainty evidence). However, we were unable to conduct any meta-analysis for this outcome, the certainty of the evidence was very low and we cannot draw any meaningful conclusions from the results. Change in vertigo Again, two studies assessed this outcome, but used different methods of measuring vertigo and assessed the outcome at different time points. We were therefore unable to carry out any meta-analysis or draw any meaningful conclusions from the results. Global scores of vertigo were lower for those who received gentamicin at both 6 to ≤ 12 months (mean difference (MD) -1 point, 95% CI -1.68 to -0.32; 1 study; 26 participants; very low-certainty evidence; four-point scale; minimally clinically important difference presumed to be one point) and at > 12 months (MD -1.8 points, 95% CI -2.49 to -1.11; 1 study; 26 participants; very low-certainty evidence). Vertigo frequency was also lower at > 12 months for those who received gentamicin (0 attacks per year in participants receiving gentamicin compared to 11 attacks per year for those receiving placebo; 1 study; 22 participants; very low-certainty evidence). Serious adverse events None of the included studies provided information on the total number of participants who experienced a serious adverse event. It is unclear whether this is because no adverse events occurred, or because they were not assessed or reported. AUTHORS' CONCLUSIONS: The evidence for the use of intratympanic gentamicin in the treatment of Ménière's disease is very uncertain. This is primarily due to the fact that there are few published RCTs in this area, and all the studies we identified enrolled a very small number of participants. As the studies assessed different outcomes, using different methods, and reported at different time points, we were not able to pool the results to obtain more reliable estimates of the efficacy of this treatment. More people may report an improvement in vertigo following gentamicin treatment, and scores of vertigo symptoms may also improve. However, the limitations of the evidence mean that we cannot be sure of these effects. Although there is the potential for intratympanic gentamicin to cause harm (for example, hearing loss) we did not find any information about the risks of treatment in this review. Consensus on the appropriate outcomes to measure in studies of Ménière's disease is needed (i.e. a core outcome set) in order to guide future studies in this area and enable meta-

analysis of the results. This must include appropriate consideration of the potential harms of treatment, as well as the benefits.

PMID: 36847592

June Topic: Vascular Vertigo

June 07, 2023
Kim, J. S., Newman-Toker, D. E., Kerber, K. A., Jahn, K., Bertholon, P., Waterston, J., Strupp, M. (2022). **Vascular vertigo and dizziness: Diagnostic criteria**. Journal of Vestibular Research, (Preprint), 1-18.

Background: This paper presents diagnostic criteria for vascular vertigo and dizziness as formulated by the Committee for the Classification of Vestibular Disorders of the Bárány Society. The classification includes vertigo/dizziness due to stroke or transient ischemic attack as well as isolated labyrinthine infarction/hemorrhage, and vertebral artery compression syndrome. Vertigo and dizziness are among the most common symptoms of posterior circulation strokes. Vascular vertigo/dizziness may be acute and prolonged (≥24 hours) or transient (minutes to < 24 hours). Vascular vertigo/dizziness should be considered in patients who present with acute vestibular symptoms and additional central neurological symptoms and signs, including central HINTS signs (normal head-impulse test, direction-changing gaze-evoked nystagmus, or pronounced skew deviation), particularly in the presence of vascular risk factors. Isolated labyrinthine infarction does not have a confirmatory test, but should be considered in individuals at increased risk of stroke and can be presumed in cases of acute unilateral vestibular loss if accompanied or followed within 30 days by an ischemic stroke in the anterior inferior cerebellar artery territory. For diagnosis of vertebral artery compression syndrome, typical symptoms and signs in combination with imaging or sonographic documentation of vascular compromise are required.

PMID: 35367974

June 14, 2023
Steinmetz, K., Becker-Bense, S., Strobl, R., Grill, E., Seelos, K., & Huppert, D. (2022). **Vestibular paroxysmia: clinical characteristics and long-term course**. Journal of Neurology, 269(12), 6237-6245.

Background: In 1975, Jannetta and colleagues were the first who described a neurovascular compression syndrome of the eighth cranial nerve, which they named “disabling positional vertigo”. The term “vestibular paroxysmia” (VP) was introduced in 1994 by Brandt and Dieterich, who also proposed the first diagnostic criteria. Recently, new diagnostic criteria for vestibular paroxysmia were defined by the Classification Committee of The International Bárány Society differentiating between definite and probable forms. The core symptoms are frequently recurring, short attacks of spinning or non-spinning

vertigo lasting for seconds to minutes. The currently favored hypothesis is that vestibular paroxysmia is an excitatory rather than a hypofunctional vestibular phenomenon with the underlying mechanism being a vessel–nerve contact, mostly by the anterior inferior cerebellar artery (AICA). The aim of this study was (1) to describe clinical symptoms and laboratory findings of vestibular paroxysmia in a well-diagnosed large patient cohort according to the Bárány Society diagnostic criteria, and (2) to evaluate the long-term course over years in patients diagnosed with definite vestibular paroxysmia.

Methods: Data extraction and analysis was completed on 146 patients (73 with definite vestibular paroxysmia and 73 with probable paroxysmia) from a tertiary dizziness center registry. Data extraction consisted of structured history-taking, clinical neurological, neuro-ophthalmological/otological examinations as well as MRI imaging.

Results: Mean age at symptom onset was about 50 years without gender preference. Attack frequency ranged between 5 and 30 attacks per day; spinning vertigo was the most frequent type. In two-thirds of patients, attacks occurred spontaneously; in one-quarter, they were triggered by head movements. The majority (approximately 70%) reported no accompanying symptoms; in those with symptoms, mild unilateral cochlear symptoms prevailed. One-third of patients initially showed hyperventilation-induced nystagmus without specific direction, and a deviation of the subjective visual vertical between 3° and 6°. Complete loss of peripheral vestibular function was never evident. Patients with definite vs probable vestibular paroxysmia significantly differed concerning the vertigo type. Spinning vertigo was more frequent patients with definite vestibular paroxysmia. Fortunately, three-quarters these patients remained attack-free during follow-up (mean 4.8 years, standardized questionnaire), more than half of them even without any medication. Patients with ongoing attacks showed significantly higher attack frequency at baseline, but reported persistent frequency reduction.

Conclusion: Long-term prognosis of vestibular paroxysmia appears favorable, not necessarily requiring ongoing treatment.

PMID: 35595969

June 21, 2023

Tarnutzer, A. A., Gold, D., Wang, Z., Robinson, K. A., Kattah, J. C., Mantokoudis, G., ... & Newman-Toker, D. E. (2023**). Impact of clinician training background and stroke location on bedside diagnostic accuracy in the acute vestibular syndrome–a meta-analysis**. Annals of neurology.

Background: Acute dizziness/vertigo is usually due to benign inner-ear causes but is occasionally due to dangerous neurologic ones, particularly stroke. Because symptoms and signs overlap, misdiagnosis is frequent and overuse of neuroimaging is common. We assessed the accuracy of bedside findings to differentiate peripheral vestibular from central neurologic causes.

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Methods: MEDLINE and Embase systematic search to identify studies reporting on diagnostic accuracy of physical examination in adults with acute, prolonged dizziness/vertigo. Diagnostic test properties were calculated for findings. Results were stratified by examiner type and stroke location.

Results: 6,089 citations and included 14 articles representing 10 study cohorts were identified. The Head Impulse, Nystagmus, Test of Skew (HINTS) eye movement battery had high sensitivity (95.3%) and specificity (92.6%) with higher specificity among specialists and subspecialists. HINTS sensitivity was lower in anterior cerebellar artery (AICA) than posterior inferior cerebellar artery (PICA) strokes, but was "rescued" by the addition of bedside hearing tests (HINTS+). Early magnetic resonance imaging (MRI)-diffusion-weighted imaging (DWI; within 24-48 hours) was falsely negative in 15% of strokes.

Conclusion: In AVS, HINTS examination by appropriately trained clinicians can differentiate peripheral from central causes and has higher diagnostic accuracy for stroke than MRI-DWI in the first 24-48 hours.

PMID: 37038843

June 28, 2023
Wang, H., Shi, T., Shang, Y., Chen, X., Xu, J., & Geng, Y. (2022). **Case report: Spiller syndrome initially mimicking vestibular neuritis**. Frontiers in Neurology, 13.

Background: Spiller syndrome is a rare subtype of medial medullary infarction characterized by a triad of contralateral hemiparesis sparing the face, the contralateral loss of deep sensation, and ipsilateral hypoglossal paralysis. Owing to the complexity and variability of the vascular supply to the medial medulla oblongata, a typical triadic presentation of Spiller syndrome is uncommon. Acute vestibular syndrome (AVS) manifests as recent-onset continuous vertigo, nausea, vomiting, motion intolerance, and gait instability lasting from days to weeks. Vestibular neuritis is a common etiology of AVS. However, it also occurs in patients with stroke involving the cerebellum or brainstem, i.e., pseudo-vestibular neuritis. This has rarely been reported in Spiller syndrome. This case report describes a patient with a progressing stroke who initially presented with the features of both acute peripheral vestibulopathy and MMI (Spiller syndrome), as confirmed by magnetic resonance imaging (MRI).

PMID: 36698901

July Topic: Persistent Postural-Perceptual Dizziness (PPPD)

July 12, 2023
Webster KE, Harrington-Benton NA, Judd O, et al. **Pharmacological interventions for persistent postural-perceptual dizziness (PPPD)**. Cochrane Database Syst Rev. 2023;3(3):CD015188. Published 2023 Mar 9. doi:10.1002/14651858.CD015188.pub2

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Background: Persistent postural-perceptual dizziness (PPPD) is a chronic balance disorder, which is characterised by subjective unsteadiness or dizziness that is worse on standing and with visual stimulation. The condition was only recently defined and therefore the prevalence is currently unknown. However, it is likely to include a considerable number of people with chronic balance problems. The symptoms can be debilitating and have a profound impact on quality of life. At present, little is known about the optimal way to treat this condition. A variety of medications may be used, as well as other treatments, such as vestibular rehabilitation.

Objectives: To evaluate the benefits and harms of pharmacological interventions for persistent postural-perceptual dizziness (PPPD).

Search methods: The Cochrane ENT Information Specialist searched the Cochrane ENT Register; Central Register of Controlled Trials (CENTRAL); Ovid MEDLINE; Ovid Embase; Web of Science; ClinicalTrials.gov; ICTRP and additional sources for published and unpublished trials. The date of the search was November 21 2022.

Selection criteria: We included randomised controlled trials (RCTs) and quasi-RCTs in adults with PPPD, which compared selective serotonin reuptake inhibitors (SSRIs) or serotonin and norepinephrine reuptake inhibitors (SNRIs) with either placebo or no treatment. We excluded studies that did not use the Bárány Society criteria to diagnose PPPD and studies that followed up participants for less than three months.

Data collection and analysis: We used standard Cochrane methods. Our primary outcomes were: 1) improvement in vestibular symptoms (assessed as a dichotomous outcome - improved or not improved), 2) change in vestibular symptoms (assessed as a continuous outcome, with a score on a numerical scale) and 3) serious adverse events. Our secondary outcomes were: 4) disease-specific health-related quality of life, 5) generic health-related quality of life and 6) other adverse effects. We considered outcomes reported at three time points: 3 to < 6 months, 6 to ≤ 12 months and > 12 months. We planned to use GRADE to assess the certainty of evidence for each outcome.

Main results: We identified no studies that met our inclusion criteria.

Authors' conclusions: At present, there is no evidence from placebo-controlled randomised trials regarding pharmacological treatments - specifically SSRIs and SNRIs - for PPPD. Consequently, there is great uncertainty over the use of these treatments for this condition. Further work is needed to establish whether any treatments are effective at improving the symptoms of PPPD, and whether their use is associated with any adverse effects.

PMID: 36906836

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July 19, 2023

Yagi C, Morita Y, Yamagishi T, et al. **Gaze instability after exposure to moving visual stimuli in patients with persistent postural-perceptual dizziness**. Front Hum Neurosci. 2022;16:1056556. Published 2022 November 25. doi:10.3389/fnhum.2022.1056556

Introduction: Persistent postural-perceptual dizziness (PPPD) is a chronic vestibular syndrome lasting more than 3 months. The core vestibular symptoms are dizziness, unsteadiness, and non-spinning vertigo, which are exacerbated by upright posture or walking, active or passive motion, and exposure to moving or complex visual stimuli. Among these, visual exacerbation is a key feature of PPPD for which the neural mechanisms are unknown. We hypothesized that vestibular symptoms may be exacerbated by visual stimuli through gaze behavioral change after exposure to moving or complex visual stimuli. The study aimed to examine gaze stability after exposure to moving visual stimuli in patients with PPPD.

Methods: Fourteen healthy controls (HCs), 27 patients with PPPD, and 12 patients with unilateral vestibular hypofunction (UVH), showing chronic vestibular symptoms for >3 months, were enrolled in the study. The participants were instructed to fixate on the gazing point at the center of a screen for 30 s before and after 90 s of exposure to moving visual stimuli. Gaze stability, best represented by the bivariate contour ellipse area (BCEA), was compared among three groups, both before and after exposure to the moving visual stimuli. Comparisons between pre- and post-moving visual stimuli in BCEA were also conducted. Correlation between the post/pre ratio of BCEA and vestibular tests, several clinical symptom scales including the Dizziness Handicap Inventory, Niigata PPPD Questionnaire, and Hospital Anxiety and Depression Scale, and the exacerbation of dizziness by exposure to moving visual stimuli was examined in the PPPD group.

Results: BCEA, both before and after exposure to moving visual stimuli in the PPPD group, was not different from that in HC and UVH groups. In the PPPD group, BCEA increased significantly after exposure to moving visual stimuli. The post/pre ratio of BCEA correlated with the occurrence of exacerbation of the dizziness sensation by exposure to moving visual stimuli; however, it did not correlate with vestibular tests or clinical symptom scales.

Conclusion: Patients with PPPD were more likely to exhibit gaze instability after exposure to moving visual stimuli, which potentially exacerbated vestibular symptoms. This phenomenon may help elucidate the neural mechanisms of visual exacerbation in patients with PPPD.

Keywords: chronic dizziness, persistent postural-perceptual dizziness, gaze instability, eyetracking test, visual stimuli

PMID: 36504627

July 26, 2023

Vestibular Rehabilitation SIG
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Herdman D, Norton S, Murdin L, Frost K, Pavlou M, Moss-Morris R. The INVEST trial: a randomised feasibility trial of psychologically informed vestibular rehabilitation versus current gold standard physiotherapy for people with Persistent Postural Perceptual Dizziness. J Neurol. 2022;269(9):4753-4763. doi:10.1007/s00415-022-11107-w

Background: Persistent postural perceptual dizziness (PPPD) is a common and disabling functional neuro-vestibular disorder. We aimed to determine the feasibility and acceptability of conducting a randomised controlled trial of cognitive-behavioural therapy informed vestibular rehabilitation (INVEST intervention) designed for persistent dizziness.

Methods: A two-armed parallel groups randomised feasibility study of INVEST vs. a time-matched gold standard vestibular rehabilitation (VRT) control. Participants with PPPD were recruited from a specialist vestibular clinic in London, UK. Participants were individually randomised using a minimisation procedure with allocation concealment. Measures of feasibility and clinical outcome were collected and assessed at 4 months.

Results: Forty adults with PPPD were randomised to six sessions of INVEST (n = 20) or gold standard VRT (n = 20). Overall, 59% of patients screened met the inclusion criteria, of which 80% enrolled. Acceptability of INVEST, as assessed against the theoretical framework of acceptability (TFA), was excellent and 80% adhered to all 6 sessions. There were small to moderate treatment effects in favour of INVEST across all measures, including dizziness handicap, negative illness perceptions, symptom focussing, fear avoidance, and distress (standardised mean difference [SMD]g = 0.45; SMDg = 0.77; SMDg = 0.56; SMDg = 0.50, respectively). No intervention-related serious adverse events were reported.

Conclusions: The study results give strong support for the feasibility of a full-scale trial. Both arms had high rates of recruitment, retention, and acceptability. There was promising support of the benefits of integrated cognitive-behavioural therapy-based vestibular rehabilitation compared to gold standard vestibular rehabilitation. The study fulfilled all the a-priori criteria to advance to a full-scale efficacy trial.

Trial registration number: ISRCTN10420559.

Keywords: Vestibular rehabilitation, PPPD, Cognitive behavioral therapy, Dizziness, Vestibular, Feasibility

PMID: 35397754

August Topic: Expectancies and Predictive Processing

August 18, 2023

Arshad Q, Saman Y, Sharif M, Kaski D, Staab JP. **Magnitude Estimates Orchestrate Hierarchal Construction of Context-Dependent Representational Maps for Vestibular Space and Time:**

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Theoretical Implications for Functional Dizziness. Front Integr Neurosci. 2022;15:806940. Published 2022 February 04. doi:10.3389/fnint.2021.806940

Maintaining balance necessitates an accurate perceptual map of the external world. Neuro-physiological mechanisms of locomotor control, sensory perception, and anxiety systems have been viewed as separate entities that can on occasion affect each other (i.e., walking on ice). Emerging models are more integrated, that envision sensory perception and threat assessment as a fundamental component of balance. Here we present an empirically based theoretical argument that vestibular cortical areas construct magnitude estimates of our environment via neural integration of incoming sensory signals. In turn, these cortically derived magnitude estimates, construct context-dependent vestibulo-spatial and vestibulo-temporal, representational maps of the external world, and ensure an appropriate online scaling factor for associated action-perceptual risk. Thus, threat signals are able to exert continuous influence on planning movements, predicting outcomes of motion of self and surrounding objects, and adjusting tolerances for discrepancies between predicted and actual estimates. Such a process affects the degree of conscious attention directed to spatial and temporal aspects of motion stimuli, implying that maintaining balance may follow a Bayesian approach in which the relative weighting of vestibulo-spatial and vestibulo-temporal signals and tolerance for discrepancies are adjusted in accordance with the level of threat assessment. Here, we seek to mechanistically explain this process with our novel empirical concept of a Brainstem Cortical Scaling Metric (BCSM), which we developed from a series of neurophysiological studies illustrating the central role of interhemispheric vestibulo-cortical asymmetries for balance control. We conclude by using the BCSM to derive theoretical predictions of how a dysfunctional BCSM can mechanistically account for functional dizziness.

Keywords: functional dizziness; interhemisphere asymmetry; space perception; time perception; vestibular cortex.

PMID: 35185485

August 21, 2023
Castro P, Papoutselou E, Mahmoud S, et al. **Priming overconfidence in belief systems reveals negative return on postural control mechanisms**. Gait Posture. 2022;94:1-8. doi:10.1016/j.gaitpost.2022.02.015

Background: Modulation of postural control strategies and heightened perceptual ratings of instability when exposed to postural threats, illustrates the association between anxiety and postural control.

Research question: Here we test whether modulating prior expectations can engender postural-related anxiety which, in turn, may impair postural control and dissociate the well-established relationship between sway and subjective instability.

Methods: We modulated expectations of the difficulty posed by an upcoming postural task via priming. In the visual priming condition, participants watched a video of an actor performing the task with either a stable or unstable performance, before themselves proceeding with the postural task. In the verbal priming paradigm, participants were given erroneous verbal information regarding the amplitude of the forthcoming platform movement, or no prior information.

Results: Following the visual priming, the normal relationship between trunk sway and subjective instability was preserved only in those individuals that viewed the stable but not the unstable actor. In the verbal priming experiment we observed an increase in subjective instability and anxiety during task performance in individuals who were erroneously primed that sled amplitude would increase, when in fact it did not.

Significance: Our findings show that people's subjective experiences of instability and anxiety during a balancing task are powerfully modulated by priming. The contextual provision of erroneous cognitive priors dissociates the normally 'hard wired' relationship between objective measures and subjective ratings of sway. Our findings have potential clinical significance for the development of enhanced cognitive retraining in patients with balance disorders, e.g. via modifying expectations.

Keywords: Expectation; Postural control; Postural instability; Priming.

PMID: 35189573

August 25, 2023

Harris DJ, Wilkinson S, Ellmers TJ. **From fear of falling to choking under pressure: A predictive processing perspective of disrupted motor control under anxiety**. Neurosci Biobehav Rev. 2023;148:105115. doi:10.1016/j.neubiorev.2023.105115

Under the Predictive Processing Framework, perception is guided by internal models that map the probabilistic relationship between sensory states and their causes. Predictive processing has contributed to a new understanding of both emotional states and motor control but is yet to be fully applied to their interaction during the breakdown of motor movements under heightened anxiety or threat. We bring together literature on anxiety and motor control to propose that predictive processing provides a unifying principle for understanding motor breakdowns as a disruption to the neuromodulatory control mechanisms that regulate the interactions of top-down predictions and bottom-up sensory signals. We illustrate this account using examples from disrupted balance and gait in populations who are anxious/fearful of falling, as well as 'choking' in elite sport. This approach can explain both rigid and inflexible movement strategies, as well as highly variable and imprecise action and conscious movement processing, and may also unite the apparently opposing self-focus and distraction approaches to choking. We generate predictions to guide future work and propose practical recommendations.

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Keywords: Active inference; Anxiety; Bayesian; Choking; Gait; Threat.

PMID: 36906243

August 28, 2023

D'Amour S, Harris LR, Berti S, Keshavarz B. **The role of cognitive factors and personality traits in the perception of illusory self-motion (vection)**. Atten Percept Psychophys. 2021;83(4):1804-1817. doi:10.3758/s13414-020-02228-3

Vection is a perceptual phenomenon that describes the visually induced subjective sensation of self-motion in the absence of physical motion. Previous research has discussed the potential involvement of top-down cognitive mechanisms on vection. Here, we quantified how cognitive manipulations such as contextual information (i.e., expectation) and plausibility (i.e., chair configuration) alter vection. We also explored how individual traits such as field dependence, depersonalization, anxiety, and social desirability might be related to vection. Fifty-one healthy adults were exposed to an optic flow stimulus that consisted of horizontally moving black-and-white bars presented on three adjacent monitors to generate circular vection. Participants were divided into three groups and given experimental instructions designed to induce either strong, weak, or no expectation with regard to the intensity of vection. In addition, the configuration of the chair (rotatable or fixed) was modified during the experiment. Vection onset time, duration, and intensity were recorded. Results showed that expectation altered vection intensity, but only when the chair was in the rotatable configuration. Positive correlations for vection measures with field dependence and depersonalization, but no sex-related effects were found. Our results show that vection can be altered by cognitive factors and that individual traits can affect the perception of vection, suggesting that vection is not a purely perceptual phenomenon, but can also be affected by top-down mechanisms.

Keywords: Anxiety; Cognition; Depersonalization; Expectation; Field dependence; Self-motion; Sex; Social desirability; Vection.

PMID: 33409903

August 30, 2023

Cullen, K. E., & Zobeiri, O. A. (2021). **Proprioception and the predictive sensing of active self-motion**. Current opinion in physiology, 20, 29–38. https://doi.org/10.1016/j.cophys.2020.12.001

As we actively explore the environment, our motion relative to the world stimulates numerous sensory systems. Notably, proprioceptors provide feedback about body and limb position, while the vestibular system detects and encodes head motion. When the vestibular system is functioning normally, we are unaware of a distinct sensation because vestibular information is integrated with proprioceptive and other sensory

inputs to generate our sense of motion. However, patients with vestibular sensory loss experience impairments that provide important insights into the function of this essential sensory system. For these patients, everyday activities such as walking become difficult because even small head movements can produce postural and perceptual instability. This review describes recent research demonstrating how the proprioceptive and vestibular systems effectively work together to provide us with our "6 th sense" during everyday activities, and in particular, considers the neural computations underlying the brain's predictive sensing of head movement during voluntary self-motion.

September Topic: BPPV Updates

September 06, 2023
Barreto RG, Yacovino DA, Cherchi M, Teixeira LJ, Nader SN, Leão GF. **Universal Repositioning Maneuver: A New Treatment for Single Canal and Multi-Canal Benign Paroxysmal Positional Vertigo by 3-Dimensional Model Analysis**. J Int Adv Otol. 2023;19(3):242-247. doi:10.5152/iao.2023.22921

Background: Benign paroxysmal positional vertigo is the most common peripheral vestibular disorder and is currently treated by many types of repositioning maneuvers. A simplification of this procedure would be desirable. A new, anatomically realistic, 3-dimensional computational simulator of the human labyrinth provides a novel insight to evaluate the viability of any new maneuver. The purpose of this study is to propose a single maneuver with potential to treat canalolithiasis-type benign paroxysmal positional vertigo of any individual canal, or even multiple canals on the same side, based on a 3-dimensional model.

Methods: The benign paroxysmal positional vertigo Viewer, a 3-dimensional model of the human labyrinth, was used to analyze a "Universal Repositioning Maneuver."

Result: Through the gravity vector, the expected position of the otoliths was demonstrated by moving the model through a single sequence of head positions, successfully promoting otolith migration from the three semicircular canals to the utricular cavity, either individually or together.

Conclusion: The analysis with the 3-dimensional model predicts the effectiveness of the Universal Repositioning Maneuver for the resolution of each single canal or multiple-canal benign paroxysmal positional vertigo canalolithiasis, making treatment much more straightforward.

PMID: 37272643

September 13, 2023
Kim MW, Jin MH, Kim JK, Kwak MY. **Efficacy of the Head Rotation Test With Bowing for the Lateral Canal Benign Paroxysmal Positional vertigo** [published online ahead of print, 2023 August 09]. Otol Neurotol. 2023;10.1097/MAO.0000000000003982. doi:10.1097/MAO.0000000000003982

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Objectives: To evaluate the efficacy of the head rotation test with bowing (B-HRT) in the sitting position in diagnosing lateral semicircular canal benign paroxysmal positional vertigo (LSC-BPPV).

Methods: The efficacy outcomes of lateralization of 25 patients with LSC-BPPV were prospectively evaluated using B-HRT. Traditional head toration in the supine position (S-HRT) and the bow and lean test were also assessed for comparative effectiveness.

Results: Direction-changing nystagmus was detected in all patients with LSC-BPPV (100%) using B-HRT. The nystagmus direction (geotropic or apogeotropic) determined by B-HRT was consistent with that determined by S-HRT with a perfect level of agreement (Cohen $\kappa = 1.0$, $p < 0.001$**). In 76.0% of the cases, the determination of the affected ear was concordant between B-HRT and S-HRT (Cohen $\kappa = 0.409$, $p = 0.037$*). The concordance rate between B-HRT and bow and lean test showed a fair level of agreement (68.0%; Cohen $\kappa = 0.286$, $p = 0.126$) with no statistical significance. On comparing the peak slow-phase velocity (SPV), SPVs of positional nystagmus on the stronger side and weaker side did not differ statistically significantly between S-HRT and B-HRT. In 12 of the 25 cases, in which the peak SPV asymmetry was determined as less than 30% by S-HRT (average, 11.00 ± 6.87%), the asymmetry determined by B-HRT (average, 47.31 ± 34.78%) was significantly higher, facilitating lesion identification by performing B-HRT together ($p = 0.001$*).

Conclusion: B-HRT in the sitting position identified direction-changing nystagmus in LSC-BPPV. B-HRT is helpful in facilitating the diagnosis of LSC-BPPV in the sitting position and determination of the affected ears in cases with nonprominent differences in bilateral nystagmus intensity according to S-HRT.

PMID: 37590787

September 20, 2023
Pauwels S, Casters L, Lemkens N, et al. **Gait and Falls in Benign Paroxysmal Positional Vertigo: A Systematic Review and Meta-analysis**. J Neurol Phys Ther. 2023;47(3):127-138. doi:10.1097/NPT.0000000000000438

Background and purpose: Benign paroxysmal positional vertigo (BPPV) is one of the most common vestibular disorders, and is treated effectively with particle repositioning maneuvers (PRM). The aim of this study was to assess the influence of BPPV and treatment effects of PRM on gait, falls, and fear of falling.

Methods: Three databases and the reference lists of included articles were systematically searched for studies comparing gait and/or falls between (1) people with BPPV (pwBPPV) and controls and (2) pre- and posttreatment with PRM. The Joanna Briggs Institute critical appraisal tools were used to assess risk of bias.

Results: Twenty of the 25 included studies were suitable for meta-analysis. Quality assessment resulted in 2 studies with high risk of bias, 13 with moderate risk, and 10 with low risk. PwBPPV walked slower and demonstrated more sway during tandem walking compared with controls. PwBPPV also walked slower during head rotations. After PRM, gait velocity during level walking increased significantly, and gait became safer according to gait assessment scales. Impairments during tandem walking and walking with head rotations did not improve. The number of fallers was significantly higher for pwBPPV than for controls. After treatment, the number of falls, number of pwBPPV who fell, and fear of falling decreased.

Discussion and conclusions: 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.Video Abstract available for more insights from the authors (see the Supplemental Digital Content Video, available at: http://links.lww.com/JNPT/A421).

PMID: 36897200

September 27, 2023

Yeo BSY, Toh EMS, Lim NE, et al. **Association of Benign Paroxysmal Positional Vertigo with Depression and Anxiety-A Systematic Review and Meta-Analysis** [published online ahead of print, 2023 August 10]. Laryngoscope. 2023;10.1002/lary.30957. doi:10.1002/lary.30957

Objective: To evaluate the extent to which Benign Paroxysmal Positional Vertigo (BPPV) is associated with a higher prevalence of depression and anxiety in patients.

Data sources: Three databases including PubMed, Embase, and The Cochrane Library were searched by two independent authors from inception to June 12, 2022 for observational studies and randomized controlled trials investigating the association between BPPV and depression and anxiety. We included studies published as full-length articles in peer-reviewed journals with an adult population aged at least 18 years who have BPPV, detected through validated clinical methods like clinical diagnosis, interview and Dix-Hallpike test.

Results: A total of 23 articles met the final inclusion criteria and 19 articles were included in the meta-analysis. BPPV was associated with a 3.19 increased risk of anxiety compared to controls, and 27% (17%-39%) of BPPV patients suffered from anxiety. Furthermore, the weighted average Beck's Anxiety Inventory score was 18.38 (12.57; 24.18), while the weighted average State-Trait Anxiety Index score was 43.08 (37.57; 48.60).

Conclusion: There appears to be some association between BPPV and anxiety, but further studies are required to confirm these associations. Laryngoscope, 2023.

Keywords: Benign Paroxysmal Positional Vertigo; anxiety; depression; peripheral vertigo.

PMID: 37560919

October Topic: Aging and Vestibular Dysfunction

October 04, 2023
Chepisheva, M. K. (2023). **Spatial orientation, postural control and the vestibular system in healthy elderly and Alzheimer's dementia**. PeerJ, 11, e15040

Background: While extensive research has been advancing our understanding of the spatial and postural decline in health elderly (HE) and Alzheimer's disease (AD), much less is known about how the vestibular system contributes to the spatial and postural processing in these two populations. This is especially relevant during turning movements in the dark, such as while walking in our garden or at home at night, where the vestibular signal becomes central. As the prevention of falls and disorientation are of serious concern for the medical service, more vestibular-driven knowledge is necessary to decrease the burden for HE and AD patients with vestibular disabilities.

Methods: Literature review that included open and closed-access articles from PubMed and Google Scholar. Review consisted of articles in the English language only.

Results/Conclusion: Vestibular spatial and vestibular postural deficits present a considerable disadvantage and are felt not only on a physical but also on a psychological level by all those affected. Still, there is a clear need for more (central) vestibular-driven spatial and postural knowledge in healthy and pathological ageing, which can better facilitate our understanding of the etiology of these dysfunctions. A possible change can start with the more frequent implementation of the "vestibular system examination/rehabilitation/therapy" in the clinic, which can then lead to an improvement of future prognostication and disease outcome for the patients.

PMID: 37151287

October 11, 2023
Ozkul, A., & Konukseven, O. (2023). **The development of the cognitive vestibular function scale in the elderly complaints of imbalance: a study on validity and reliability**. Brazilian Journal of Otorhinolaryngology, 89(4), 101282

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Objectives: With a valid and reliable scale, it will make an important contribution to the assessment of cognitive functions such as spatial, spatial-visual, and memory functions, and raise awareness of older people with balance disorders. The purpose of this study is to develop a scale to assess vestibular and cognitive functions in the geriatric population with vestibular disorders and to evaluate its validity and reliability.

Methods: The study involved 75 individuals aged 60 years and older who complained of imbalance. In the first phase, scale items on balance, emotional, spatial, spatial-visual, and memory were created using the literature. The item analysis was completed by a pilot application, and 25 scale items were determined for the main application. The item analysis and validity and reliability analyzes were completed, and the scale was given its final form. For the statistical analysis of the data, a principal component analysis was performed for the validity analysis. The Cronbach alpha coefficient was used for the reliability analysis. Descriptive statistics were compiled on the participants' scale scores.

Results: The Cronbach's alpha value of the scale was found to be highly reliable at 0.86. Statistically significant values were found between the age variable and the spatial subscales, the spatial-visual subscales, and the Cognitive Vestibular Function Scale with a small positive effect (respectively: $r = 0.264$; $p = 0.022$; $r = 0.237$; $p = 0.041$; $r = 0.231$; $p = 0.046$). The results indicate that the Cognitive Vestibular Function Scale is a valid and reliable measurement tool at a good level in elderly people aged 60 years and older.

Conclusion: Cognitive Vestibular Function Scale; was developed to detect cognitive problems related to dizziness/balance. As a result, a preliminary study was conducted to investigate a rapid, easy-to-use, and reliable clinical scale to assess cognitive function in people with balance disorders.

Level II Randomized trials Prospective comparative study.

Keywords: Scale, Spatial, Cognition, Cognitive, Dizziness

PMID: 37418851

October 18, 2023
Fancello V, Hatzopoulos S, Santopietro G, et al. **Vertigo in the Elderly: A Systematic Literature Review**. J Clin Med. 2023;12(6):2182. Published 2023 March 11. doi:10.3390/jcm12062182
October 25, 2023

Background: Dizziness and vertigo are among the most prevalent complaints in the elderly and have a major negative influence on (i) the perception of the quality of life; and (ii) the risk of falling. Due to population aging, particularly in wealthy nations, vertigo represents a growing issue and a serious public health concern. In order to approach the patient correctly and to offer the best treatment options, it is

mandatory to identify vertigo's underlying causes. The aim of this paper was to identify the different etiologies of vertigo and possibly their frequency in the elderly population, by reviewing the scientific literature of the last decade (2012–2022).

Methods: A systematic review was performed according to PRISMA guidelines, searching the Medline database from January 2012 through to December 2022. The search identified 1025 candidate papers, but after the application of specific selection criteria, only five were considered for further analysis.

Results: A total of 2148 elderly patients (60–90 y old) presenting with vertigo were reported in the selected papers. A total of 3404 conditions were identified as the cause of vertiginous symptoms, (some patients presented multiple etiologies). All major diagnoses were categorized into different subgroups: the most common origin of vertigo was represented by audio-vestibular disorders (28.4%), followed by cardiovascular (20.4%) and neurological diseases (15.1%). Furthermore, 9.1% of patients were diagnosed with psychiatric conditions, whilst ophthalmologic and musculoskeletal disorders accounted for 7.5% and 6.3% of the cases respectively. Medication adverse effects and metabolic-related diseases were also considered among the causes. For 3.4% of cases the etiology remains unclear.

Conclusions: Audio-vestibular disorders represent the most frequent cause of vertigo in the elderly. The etiologies affecting the vertigo patient must be defined in order to identify potential life-threatening conditions, such as cardiovascular and neurological disorders, which according to the data of this review constitute the second and third common causes of vertigo. A multidisciplinary strategy, involving different specialists (such as ENTs, Neurologists, Cardiologists, Geriatricians) is recommended for the correct assessment of these disorders.

Keywords: vertigo, elderly, etiology, vestibular disorders, BPPV, endolymphatic hydrops, falls

PMID: 36983184

October 25, 2023

Suzuki, Y., Tsubaki, T., Nakaya, K., Kondo, G., Takeuchi, Y., Aita, Y., ... & Yahagi, N. (2023). **New balance capability index as a screening tool for mild cognitive impairment**. BMC geriatrics, 23(1), 74

Background: Mild cognitive impairment (MCI) is not just a prodrome to dementia, but a very important intervention point to prevent dementia caused by Alzheimer's disease (AD). It has long been known that people with AD have a higher frequency of falls with some gait instability. Recent evidence suggests that vestibular impairment is disproportionately prevalent among individuals with MCI and dementia due to AD. Therefore, we hypothesized that the measurement of balance capability is helpful to identify individuals with MCI.

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Methods: First, we developed a useful method to evaluate balance capability as well as vestibular function using Nintendo Wii balance board as a stabilometer and foam rubber on it. Then, 49 healthy volunteers aged from 56 to 75 with no clinically apparent cognitive impairment were recruited and the association between their balance capability and cognitive function was examined. Cognitive functions were assessed by MoCA, MMSE, CDR, and TMT-A and -B tests.

Results: The new balance capability indicator, termed visual dependency index of postural stability (VPS), was highly associated with cognitive impairment assessed by MoCA, and the area under the receiver operating characteristic (ROC) curve was more than 0.8, demonstrating high sensitivity and specificity (app. 80% and 60%, respectively).

Conclusion: Early evidence suggests that VPS measured using Nintendo Wii balance board as a stabilometer helps identify individuals with MCI at an early and preclinical stage with high sensitivity, establishing a useful method to screen MCI.

PMID: 36739383