



**Vestibular Rehabilitation SIG  
Archived Abstract of the Week  
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**June Topic: Visual Dependence**

**No 477: June 26, 2019**

Roberts RE, Da Silva Melo M, Siddiqui AA, Arshad Q, Patel M. **Vestibular and oculomotor influences on visual dependency.** J Neurophysiol. 2016 Sep 1;116(3):1480-7. doi: 10.1152/jn.00895.2015. Epub 2016 Jun 29.

Abstract

The degree to which a person relies on visual stimuli for spatial orientation is termed visual dependency (VD). VD is considered a perceptual trait or cognitive style influenced by psychological factors and mediated by central reweighting of the sensory inputs involved in spatial orientation. VD is often measured with the rod-and-disk test, in which participants align a central rod to the subjective visual vertical (SVV) in the presence of a background that is either stationary or rotating around the line of sight-dynamic SVV. Although this task has been employed to assess VD in health and vestibular disease, what effect torsional nystagmic eye movements may have on individual performance is unknown. Using caloric ear irrigation, 3D video-oculography, and the rod-and-disk test, we show that caloric torsional nystagmus modulates measures of VD and demonstrate that increases in tilt after irrigation are positively correlated with changes in ocular torsional eye movements. When the direction of the slow phase of the torsional eye movement induced by the caloric is congruent with that induced by the rotating visual stimulus, there is a significant increase in tilt. When these two torsional components are in opposition, there is a decrease. These findings show that measures of VD can be influenced by oculomotor responses induced by caloric stimulation. The findings are of significance for clinical studies, as they indicate that VD, which often increases in vestibular disorders, is modulated not only by changes in cognitive style but also by eye movements, in particular nystagmus.

PMID: 27358321

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5040385/>

**No 476: June 19, 2019**

Maire R, Mallinson A, Ceyte H, Caudron S, Van Nechel C, Bisdorff A, Magnusson M, Petersen H, Kingma H, Perrin P. **Discussion about Visual Dependence in Balance Control: European Society for Clinical Evaluation of Balance Disorders.** J Int Adv Otol. 2017 Dec;13(3):404-406. doi: 10.5152/iao.2017.4344.

Abstract

The executive committee of the European Society for the clinical evaluation of balance disorders meets annually to address equilibrium problems that are not well understood. This is a review paper on discussions in the latest meeting we held.



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**MATERIALS AND METHODS:** Seeing patients with vestibular disorders who end up depending on visual information as part of their compensation process is a common clinical occurrence. However, this "visual dependence" can generate symptoms, which include nausea, sensations of imbalance, and anxiety. It is unclear how this develops, as symptoms can be widely variable from patient to patient. There are several triggering factors to this symptom set, and quantifying it in a given patient is extremely difficult. **Results:** The committee agreed that the presence of this symptom set can be suggestive of vestibular pathology, but the pathology does not have to be present. As a result, there is no correlation between symptom severity and test results.

**CONCLUSION:** Visual dependence can often be present in a patient, although little, if any, measurable pathology is present. It is important to emphasize that although we cannot accurately measure this with either standardized testing or pertinent questionnaires, "hypersensitive" patients have a genuine disease and their symptoms are not of psychiatric origin.

PMID: 29360093

**No 475: June 12, 2019**

Bronstein AM, Dieterich M. **Long-term clinical outcome in vestibular neuritis.** *Curr Opin Neurol.* 2019 Feb;32(1):174-180. doi: 10.1097/WCO.0000000000000652.

**Abstract**

**PURPOSE OF REVIEW:** To review recent work on clinical and imaging aspects of vestibular neuritis (or acute vestibular syndrome), in particular with a view to identifying factors predicting long-term clinical outcome.

**RECENT FINDINGS:** Evidence for a role of inflammation in the vestibular nerve, and the presence of Gadolinium enhancement acutely in vestibular neuritis, is accruing. Visual dependence, anxiety and somatization traits predict the development of chronic dizziness after acute vestibular neuritis. Adaptation to asymmetric rotation is impaired in vestibular neuritis and this may indicate insufficient central compensation in chronic dizzy patients. Corticosteroids appear ineffective at improving long-term clinical outcome. Functional imaging changes during the central compensation period lead to structural brain changes; both processes correlate with clinical recovery.

**SUMMARY:** Vestibular neuritis appears to be the result of postviral neuroinflammation of the vestibular nerve. However, long-term prognosis is not dependent on the magnitude of the peripheral residual damage (as measured with caloric and video head-impulse test). Instead, a combination of visuovestibular psychophysical factors (visual dependence), psychological traits and dysfunctional vestibular perception are relevant. Several functional and structural neuroimaging changes develop after vestibular neuritis, which reflect and underlie the aforementioned psychophysiological and psychological features.



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PMID: 30566414

**No 474: June 7, 2019**

Smyth N, Flynn M, Rajcani J, F Hucklebridge M, Thorn L, Wood C, Golding J, Evans P, Clow A. **Attenuated cortisol reactivity to psychosocial stress is associated with greater visual dependency in postural control.** Psychoneuroendocrinology. 2019 Jun;104:185-190. doi: 10.1016/j.psyneuen.2019.02.028. Epub 2019 Mar 2.

Abstract

Despite known anatomical links between the hypothalamic-pituitary-adrenal (HPA) axis and the vestibular system, there are no studies on the relationship between postural control and HPA axis function. Visual dependence in postural control, often measured by increased postural sway on exposure to visual motion, is an indication of altered visual-vestibular integration with greater weighting towards visual cues for balance. Visual dependence is more common in older age and a range of vestibular and non-vestibular health conditions. The relationship between visual dependence in postural control was investigated in relation to cortisol reactivity to psychosocial stress (using the Trier Social Stress Test for groups: TSST-G), as an index of HPA axis function, in healthy young females. In those who exhibited a cortisol response ( $>2$  nmol/l), a negative relationship between stress-induced cortisol reactivity and visual dependence in postural control was observed, since those with the largest cortisol response showed less visual motion induced postural sway (measured by force platform). This finding in healthy females indicates that subtle non-clinical differences in vestibular function are associated with dysregulated HPA axis activity as indicated by lower cortisol reactivity to psychosocial stress. It adds to the growing body of evidence linking blunted cortisol reactivity to stress to poor homeostatic regulation and potential negative health and behavioural outcomes.

PMID: 30856424

**May Topic: Vestibular Schwannoma**

**No 473: May 29, 2019**

Berkowitz O, Han YY, Talbott EO, Iyer AK, Kano H, Kondziolka D, Brown MA, Lunsford LD. **Gamma Knife Radiosurgery for Vestibular Schwannomas and Quality of Life Evaluation.** Stereotact Funct Neurosurg. 2017;95(3):166-173. doi: 10.1159/000472156. Epub 2017 May 23.

Abstract

**BACKGROUND:** Further investigation is needed to look at the impact of vestibular schwannoma (VS) on the health-related quality of life (QOL) of participants who undergo Gamma Knife® radiosurgery (GKRS).



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**OBJECTIVES:** Investigators compared the QOL for VS participants to reported US population norms in order to evaluate disease burden and long-term QOL several years after GKRS.

**METHODS:** This cross-sectional study surveyed participants to assess hearing status, tinnitus, imbalance, vertigo, as well as the Short-Form 36-item Health Questionnaire (SF-36). The data were normalized, age adjusted, and functional status was correlated to determine clinically significant differences.

**RESULTS:** A total of 353 participants who underwent GKRS between 1997 and 2007 were included in this study with a median postoperative period of 5 years. SF-36 scores were very similar to population norms, and age-adjusted scores for participants followed the US population curve. Frequent vertigo and balance problems had the largest statistically and clinically significant effect on physical and mental component summary scores followed by nonuseful hearing in the tumor ear.

**CONCLUSIONS:** Participants reported a good long-term QOL that was very similar to the QOL of US population norms. Of the common VS symptoms, vertigo had the greatest impact on QOL followed by imbalance and then hearing loss.

PMID: 28531896

**No 472: May 23, 2019**

Batuecas-Caletrio A, Rey-Martinez J, Trinidad-Ruiz G, Matíño-Soler E, Cruz-Ruiz SS, Muñoz-Herrera A, Perez-Fernandez N. **Vestibulo-Ocular Reflex Stabilization after Vestibular Schwannoma Surgery: A Story Told by Saccades.** Front Neurol. 2017 Jan 25;8:15. doi: 10.3389/fneur.2017.00015. eCollection 2017

Abstract

**OBJECTIVE:** To evaluate vestibular compensation via measurement of the vestibulo-ocular reflex (VOR) following vestibular schwannoma surgery and its relationship with changes in saccades strategy after surgery.

**PATIENTS:** Thirty-six consecutive patients with vestibular schwannomas, without brainstem compression, underwent surgical resection. Patients were recruited from University Hospital of Salamanca, Spain.

**METHODS:** We assessed the age, sex, tumor size, degree of canalicular weakness, and preoperative video head impulse test (gain and saccade organization measured with PR score). Gain and saccade organization were compared with postoperative values at discharge and also at 1,3, and 6 months. PR scores are a measure of the scatter of refixation saccades.

**RESULTS:** Patients with normal preoperative caloric function had higher PR scores (saccades were scattered) following surgery compared to patients with significant preoperative canal paresis ( $p<0.05$ ).



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VOR gain and the presence of covert/overt saccades preoperatively did not influence the PR score ( $p>0.05$ ), but a group of patients with very low VOR gain ( $<0.45$ ) and covert/overt saccades before surgery had lower PR scores after surgery. The differences after 6 months were not significant.

**CONCLUSION:** Patients with more severe vestibular dysfunction before vestibular schwannoma surgery show significantly faster vestibular compensation following surgery, manifested by changes in VOR gain and PR score. The scatter of compensatory saccades (as measured by the PR score) may be a surrogate early marker of clinical recovery, given its relationship to the Dizziness Handicap Inventory.

PMID: 28179894

**No 471: May 16, 2019**

Constanzo F, Teixeira BCA, Sens P, Ramina R. **Video Head Impulse Test in Vestibular Schwannoma: Relevance of Size and Cystic Component on Vestibular Impairment.** *Otol Neurotol.* 2019 Apr;40(4):511-516. doi: 10.1097/MAO.0000000000002158.

Abstract

**OBJECTIVES:** Tumor factors that influence vestibular function in vestibular schwannoma (VS) have not been properly described. We evaluated whether cystic VSs have different vestibular function than solid VS. Tumor size on vestibular function was also evaluated.

**STUDY DESIGN:** Cross-sectional study.

**SETTING:** Tertiary referral center.

**PATIENTS:** Forty-one cases of sporadic, untreated VS.

**INTERVENTION:** Evaluation with video head impulse test and MRI.

**MAIN OUTCOME MEASURES:** Tumors were classified as solid, heterogeneous, or cystic and by size using the Hannover classification. Vestibulo-ocular reflex (VOR) gain was correlated to tumor size and cystic status.

**RESULTS:** Large VS had worse VOR gain than small lesions ( $p<0.001$ ). Cystic lesions had lower VOR gain than all other tumors ( $p=0.001$ ), Hannover T3 and T4 ( $p=0.014$ ), Hannover T4 ( $p=0.015$ ), solid tumors ( $p<0.001$ ), solid Hannover T3 and T4 ( $p=0.003$ ), and solid Hannover T4 ( $p=0.008$ ). Heterogeneous VSs had lower VOR gain compared to solid tumors ( $p=0.02$ ), solid Hannover T3 and T4 ( $p=0.08$ ), and solid Hannover T4 ( $p=0.14$ ). Heterogeneous and cystic VSs had lower VOR gain than solid tumors ( $p<0.001$ ), solid Hannover T3 and T4 ( $p=0.004$ ), and solid Hannover T4 ( $p=0.02$ ). VOR gain of solid T4 lesions was not significantly lower than solid Hannover T1-T3 ( $p=0.33$ ).



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**CONCLUSION:** Cystic status is directly associated with a worse vestibular dysfunction. Size did not significantly impact vestibular function in solid VS.

PMID: 30870368

**No 470: May 8, 2019**

Tranter-Entwistle I, Dawes P, Darlington CL, Smith PF, Cutfield N. **Video head impulse in comparison to caloric testing in unilateral vestibular schwannoma.** Acta Otolaryngol. 2016 Nov;136(11):1110-1114. Epub 2016 May 25.

Abstract

**CONCLUSIONS:** Although there was a statistically significant relationship between the results of the vHIT and the caloric test, the limited strength of this relationship suggests that, for unilateral vestibular schwannoma (UVS), caloric testing and vHIT may provide complementary information on vestibular function.

**OBJECTIVE:** There is limited information that can be used to determine which of the video head impulse test (vHIT) and caloric test might be better used in the diagnosis and management of UVS. In this study, a group of participants with un-operated UVS was studied using both methods.

**METHODS:** The subjects' vestibular function was assessed using the vHIT and caloric testing. Tumour size was quantified using MRI and their balance disturbance assessed using the Jacobsen Dizziness Handicap Inventory (DHI).

**RESULTS:** Twenty of 30 subjects had an abnormal canal paresis according to the Jongkees' criterion ( $>0.25$ ); however, only 10/30 had an ipsilesional vHIT gain of  $<0.79$ . Canal paresis could be predicted from the ipsilesional and contralesional vHIT gains. Tumour size could also be predicted from the ipsilesional vHIT gain and canal paresis. However, DHI scores could not be predicted from the degree of canal paresis, vHIT gain, or the MRI measures.

PMID: 27224664

**No 469: May 1, 2019**

Low Choy NL, Lucey MM, Lewandowski SL, Panizza BJ. **Impacts of small vestibular schwannoma on community ambulation, postural, and ocular control.** Laryngoscope. 2017 May;127(5):1147-1152. doi: 10.1002/lary.26105. Epub 2016 Aug 13.

Abstract



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**OBJECTIVES/HYPOTHESIS:** To investigate balance, community mobility, gaze instability, and dizziness handicap and assess falls risk in people who are conservatively managed with small vestibular schwannoma (VS).

**STUDY DESIGN:** Cross-sectional study with controls.

**METHODS:** The study involved 18 people (mean age  $58.7 \pm 12.2$  years) diagnosed with VS ( $<12$  mm) and 22 age-matched controls (mean age  $56.9 \pm 8.0$  years). Measures included standing on firm and foam surfaces with feet apart, then together with eyes open and closed, Timed Up and Go (TUG) test and dual TUG test, Dynamic Gait Index, 6-Minute Walk Test, Halmagyi Impulse Test, Dynamic Visual Acuity Test, and the Dizziness Handicap Inventory.

**RESULTS:** The clinical group failed more trials standing feet together on foam with eyes closed ( $P < .05$ ); had inferior mobility and walked more slowly with divided attention ( $P < .05$ ); had more difficulty walking with head movement, negotiating obstacles, and using stairs ( $P < .01$ ); and walked shorter distances ( $P < .001$ ) than controls. Reduced gaze stability ( $P < .01$ ) and higher total ( $P = .007$ ) and subcategory dizziness handicap scores ( $P < .05$ ) were revealed compared to age-matched controls.

**CONCLUSIONS:** Although outcomes for the clinical group are inferior to the control group across all measures and the dizziness impact is higher, the results fall in the low-risk category for falls. Preliminary data (level 4 evidence) support using a suite of clinical measures to monitor people with VS during conservative management.

PMID: 27519610

**Summary of April 2019 Topic: Biobehavioral Aspects of Vestibular Rehab**

**No 468: April 17, 2019**

Hsu CL, Tsai SJ, Shen CC, Lu T, Hung YM, Hu LY. **Risk of benign paroxysmal positional vertigo in patients with depressive disorders: a nationwide population-based cohort study.** *BMJ Open.* 2019 Mar 30;9(3):e026936. doi: 10.1136/bmjopen-2018-026936.

**OBJECTIVE:** The association between depression and benign paroxysmal positional vertigo (BPPV) remains debated. This study aimed to investigate the risk of BPPV in patients with depressive disorders.

**DESIGN:** Longitudinal nationwide cohort study.

**SETTING:** National health insurance research database in Taiwan.

**PARTICIPANTS:** We enrolled 10,297 patients diagnosed with depressive disorders between 2000 and 2009 and compared them to 41,188 selected control patients who had never been diagnosed with



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depressive disorders (at a 1:4 ratio matched by age, sex and index date) in relation to the risk of developing BPPV.

**METHODS:** The follow-up period was defined as the time from the initial diagnosis of depressive disorders to the date of BPPV, censoring or 31 December 2009. Cox proportional hazard regression analysis was used to investigate the risk of BPPV by sex, age and comorbidities, with HRs and 95% CIs.

**RESULTS:** During the 9-year follow-up period, 44 (0.59 per 1000 person-years) patients with depressive disorders and 99 (0.33 per 1000 person-years) control patients were diagnosed with BPPV. The incidence rate ratio of BPPV among both cohorts calculating from events of BPPV per 1000 person-years of observation time was 1.79 (95% CI 1.23 to 2.58,  $p=0.002$ ). Following adjustments for age, sex and comorbidities, patients with depressive disorders were 1.55 times more likely to develop BPPV (95% CI 1.08 to 2.23,  $p=0.019$ ) as compared with control patients. In addition, hyperthyroidism (HR=3.75, 95% CI 1.67-8.42,  $p<0.001$ ) and systemic lupus erythematosus (SLE) (HR=3.47, 95% CI 1.07 to 11.22,  $p=0.038$ ) were potential risk factors for developing BPPV in patients with depressive disorders.

**CONCLUSIONS:** Patients with depressive disorders may have an increased risk of developing BPPV, especially those who have hyperthyroidism and SLE.

PMID: 30928959

**No 467: April 11, 2019**

Sullivan KA, Kaye SA, Blaine H, Edmed SL, Meares S, Rossa K, Haden C. **Psychological approaches for the management of persistent postconcussion symptoms after mild traumatic brain injury: a systematic review.** *Disabil Rehabil.* 2019 Feb 11:1-9. doi: 10.1080/09638288.2018.1558292.

**BACKGROUND:** To evaluate the evidence for psychological treatments for persistent postconcussion symptoms following mild traumatic brain injury. There is scant evidence from limited clinical trials to direct the psychological management of persistent symptoms.

**METHOD:** Databases were searched for studies that: (1) included adults ( $\geq$  aged 16 years) following injury (from any cause); (2) tested interventions for postconcussion symptoms after the acute injury period (e.g., after hospital discharge), but prior to established chronicity (e.g., not more than 12 months post-injury), and; (3) applied one of five broadly-defined psychological interventions (cognitive behavioural therapy, counselling, psychoeducation, education/reassurance, or mindfulness). All controlled trials were eligible for inclusion.





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**RESULTS:** Of the 20,945 articles identified, 10 underwent risk-of-bias analysis by two independent reviewers. Nine were retained for data extraction. They used: cognitive behaviour therapy (n=2), counselling (n=2), psychoeducation (n=2), education/reassurance (n=2), or compared cognitive behaviour therapy to counselling (n=1).

**CONCLUSION:** Counselling or cognitive behaviour therapy have the most support but the evidence remains limited. We encourage further randomized controlled trials of early interventions in samples at risk for persistent symptoms, including closer study of psychological risk-factors and the 'active' ingredient. To advance the field, future trials must include additional methodological controls and improved reporting. Implications for rehabilitation Persistent symptoms following mild traumatic brain injury can be disabling and psychological management for rehabilitation may be proposed. However, Controlled trials show that while some psychological approaches hold promise for this purpose, there are significant gaps in the underpinning evidence. The best results are seen when postconcussion programs use counselling or cognitive behaviour therapy and are targeted for people with an increased risk of persistent symptoms.

PMID: 30741023

**No 466: April 3, 2019**

Walker A, Kantaris X, Chambers M. **Understanding therapeutic approaches to anxiety in vestibular rehabilitation: a qualitative study of specialist physiotherapists in the UK.** *Disabil Rehabil.* 2018 Apr;40(7):829-835. doi: 10.1080/09638288.2016.1277393. Epub 2017 Jan 27.

**PURPOSE:** People with vestibular disorders are typically treated by physiotherapists in vestibular rehabilitation. Anxiety is strongly associated with vestibular disorders; however, there is a lack of understanding about how physiotherapists respond to people presenting with anxiety within vestibular rehabilitation. This study aimed to explore physiotherapists' current practice in assessing and treating patients with anxiety in vestibular rehabilitation.

**MATERIALS AND METHODS:** A qualitative study using semi-structured interviews with 10 specialist physiotherapists in vestibular rehabilitation in three university teaching hospitals in England. Data were analyzed using thematic analysis.

**RESULTS:** Four themes were identified: (i) The therapeutic relationship, (ii) Adapting assessment and treatment, (iii) Psychological intervention and support, and (iv) Physiotherapists' education and training. Physiotherapists reported using a range of behavioral and cognitive techniques and adapting their therapeutic approach by placing greater emphasis on education, building trust and pacing treatment. Physiotherapists highlighted the need for more specialist psychological support for patients during



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vestibular rehabilitation and tailored training and guidance on addressing anxiety within vestibular rehabilitation.

**CONCLUSIONS:** Physiotherapists working in vestibular rehabilitation consider managing aspects of anxiety within their scope of practice and describe taking a psychosocial therapeutic approach. There is limited access to expert psychological support for patients with anxiety within vestibular rehabilitation. Implications for rehabilitation Anxiety is strongly associated with vestibular disorders and it is common for these patients to be managed by physiotherapists in vestibular rehabilitation. Vestibular rehabilitation services could improve access to psychological expertise through dedicated psychological input, more effective signposting and referral pathways, and better access to inter-professional support from psychologists and/or CBT practitioners in managing more complex patients. Physiotherapists requested tailored training and guidance to enhance their ability to manage patients with anxiety more effectively in vestibular rehabilitation.

PMID: 28129508

**Summary of March 2019 Topic: Vestibular Impairments with Thiamine Deficiency**

**No 465: March 27, 2019**

Lee SH, Kim SH, Kim JM, Tarnutzer AA. **Vestibular Dysfunction in Wernicke's Encephalopathy: Predominant Impairment of the Horizontal Semicircular Canals.** *Front Neurol.* 2018 Mar 12;9:141. doi: 10.3389/fneur.2018.00141. eCollection 2018.

**BACKGROUND:** Wernicke's encephalopathy (WE), a metabolic disorder due to thiamine deficiency, manifests with various neurological symptoms and signs. It has been known as a cause of vestibular dysfunction. Preliminary reports have proposed predominant involvement of the horizontal semicircular canals (HSCs).

**OBJECTIVE:** To better characterize the pattern of vestibular impairment in patients with WE using quantitative video head-impulse testing and to review the literature regarding this topic.

**METHOD:** From January 2014 to December 2016, we retrospectively enrolled five cases of WE that received quantitative video-head-impulse testing (vHIT). We retrieved the clinical features from the medical records and reviewed quantitative head-impulse testing (qHIT) and caloric irrigation. Based on the gain and the number of corrective saccades, the function (normal vs. impaired) of each semicircular canal was rated. In addition, we conducted a MEDLINE and EMBASE search to identify other published cases of WE that had received qHIT. Neuro-otologic and neuro-ophthalmologic findings and vestibular testing results were extracted.

**RESULTS:** A total of 17 patients (own series = 5; published cases = 12) aged  $54.6 \pm 11$  years were



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included. Key neurologic findings were ataxia of stance and gait (13/13, 100%), spontaneous nystagmus (7/14, 50%), gaze-evoked nystagmus (GEN) (17/17, 100%), positive bedside head-impulse testing for the horizontal canals (16/17, 94%), and memory impairment and mental changes (6/11, 54.5%). Regarding vestibular testing, vHIT (either video based or search-coil based) documented selective bilateral horizontal canal dysfunction with normal or minimal vertical canal impairment (14/14, 100%). On caloric irrigation, bilateral horizontal canal paresis was noted in most cases (10/11, 91%).

**CONCLUSION:** In WE, signs of both peripheral and central vestibular dysfunction (i.e., GEN, ataxia of stance and gait, abnormal head-impulse testing) were common. Selective or predominant impairment of the HSCs seems to be the most common finding of WE likely related to enhanced vulnerability of the medial vestibular nuclei neurons to thiamine deficiency. Quantitative vHIT of all six semicircular canals is therefore a useful tool for the diagnosis and should be applied in all patients with suspected WE.

PMID: 29593640

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5857915/>

**No 464: March 20, 2019**

Kattah JC, Guede C, Hassanzadeh B. **The medial vestibular nuclei, a vulnerable target in thiamine deficiency.** J Neurol. 2018 Jan;265(1):213-215. doi: 10.1007/s00415-017-8670-1. Epub 2017 Nov 15.

**BACKGROUND:** Bilateral medial vestibular nuclei (MVN) is a common target in thiamine depletion and results in acute vestibular failure. Involvement of the MVN was present in 27 out of 38 brainstem sections reported in the largest thiamine deficiency autopsy cohort with Wernicke's encephalopathy.

**METHOD:** Serial clinical, imaging and vestibulo-ocular reflex gain measured with the video head impulse (vHIT) in one patient with acute thiamine deficiency.

**RESULTS:** Low horizontal VOR gain correlated with an abnormal manual head impulse and with MRI evidence of MVN in an alcohol-dependent patient with low thiamine levels. The vertical VOR gain was either normal or mildly abnormal. Thiamine replacement and normal diet restored the VOR gain and MRI signal changes to normal.

**CONCLUSION:** This single case study provides clinical-imaging correlation for symmetric MVN compromise in thiamine deficiency, its effect on the VOR gain and the favorable response to thiamine and diet replacement when identified early.

PMID: 29143209

**No 463: March 13, 2019**



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Kattah JC. **The Spectrum of Vestibular and Ocular Motor Abnormalities in Thiamine Deficiency.** *Curr Neurol Neurosci Rep.* 2017 May;17(5):40. doi: 10.1007/s11910-017-0747-9.

**PURPOSE:** The first aim of this review is to summarize recent ocular motor signs in pre-encephalopathy patients with nutritional deficiency at risk of thiamine deficiency. Timely recognition of thiamine depletion in these patients, who may have a normal brain MRI, could lead to appropriate management and prevention of Wernicke's encephalopathy (WE) with full recovery. The second aim is to incorporate recent diagnostic testing on the revised WE diagnostic criteria and the identification of patients who may show slow, partial, or no response to treatment.

**RECENT FINDINGS:** Selective vulnerability of periventricular gray neurons in thiamine deficiency is well known. Involvement of the vestibular and abducens nuclei may precede encephalopathy. Studies have shown mild ophthalmoparesis and bilateral symmetric vestibular loss in thiamine deficiency. Moreover, quantitative data has shown decreased horizontal vestibulo-ocular reflex (VOR) gain and nystagmus, with a favorable response to timely treatment. Ophthalmoparesis, horizontal nystagmus, and decreased gain of the horizontal VOR, sparing the vertical VOR, may be present in the early pre-encephalopathy stage of thiamine deficiency. Rapid response to a loading dose of parenteral thiamine might be seen in some cases and normalization, albeit slower in others. In contrast, analogous to the Korsakoff's syndrome, ocular motor and vestibular abnormalities may show only partial improvement. Future studies in larger populations at risk are needed to confirm the results of these preliminary observations.

PMID: 28365885

**Summary of February 2019 Topic: Pediatric Concussion**

**No 462: February 27, 2019**

Iaccarino MA, Fitzgerald M, Pulli A, Woodworth KY, Spencer TJ, Zafonte R, Biederman J. **Sport concussion and attention deficit hyperactivity disorder in student athletes: A cohort study.** *Neurol Clin Pract.* 2018 Oct;8(5):403-411.

**BACKGROUND:** Attention deficit hyperactivity disorder (ADHD) is associated with impulsive behavior and inattention, making it a potential risk factor for sport-related concussion (SRC). The objectives of this study were to determine whether ADHD is an antecedent risk factor for SRC and whether ADHD complicates recovery from SRC in youth athletes.

**METHODS:** Student athletes with a history of SRC were evaluated for the presence of ADHD using diagnostic interview and to determine whether ADHD symptoms began before or after SRC. Concussion-specific measures of concussive symptoms and cognitive function were compared in SRC + ADHD and SRC + No ADHD groups to assess SRC recovery between groups.



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**RESULTS:** ADHD was overrepresented in youth with SRC compared with population rates. ADHD was found to be an antecedent risk factor for SRC, with age at ADHD onset earlier than the date of SRC. Student athletes with SRC and ADHD reported more concussive symptoms compared with athletes without ADHD and were more likely to have a history of greater than one concussion.

**CONCLUSIONS:** The results of this study support our hypothesis that ADHD is an antecedent risk factor for SRC and may contribute to a more complicated course of recovery from SRC. Future research should focus on determining whether screening, diagnosis, and treating ADHD in youth athletes may prevent SRC. Providers that care for youth athletes with ADHD should be aware of the vulnerabilities of this population toward SRC and its complications.

PMID: 30564494

**No 461: February 20, 2019**

Morgan CD, Zuckerman SL, Lee YM, King L, Beaird S, Sills AK, Solomon GS. **Predictors of postconcussion syndrome after sports-related concussion in young athletes: a matched case-control study.** *J Neurosurg Pediatr.* 2015 Jun;15(6):589-98. doi: 10.3171/2014.10.PEDS14356. Epub 2015 Mar 6.

**OBJECT** Sport-related concussion (SRC) is a major public health problem. Approximately 90% of SRCs in high school athletes are transient; symptoms recover to baseline within 1 week. However, a small percentage of patients remain symptomatic several months after injury, with a condition known as postconcussion syndrome (PCS). The authors aimed to identify risk factors for PCS development in a cohort of exclusively young athletes (9-18 years of age) who sustained SRCs while playing a sport.

**METHODS** The authors conducted a retrospective case-control study by using the Vanderbilt Sports Concussion Clinic database. They identified 40 patients with PCS and matched them by age at injury and sex to SRC control patients (1 PCS to 2 control). PCS patients were those experiencing persistent symptoms at 3 months after an SRC. Control patients were those with documented resolution of symptoms within 3 weeks of an SRC. Data were collected in 4 categories: 1) demographic variables; 2) key medical, psychiatric, and family history; 3) acute-phase postinjury symptoms (at 0-24 hours); and 4) subacute-phase postinjury features (at 0-3 weeks). The chi-square Fisher exact test was used to assess categorical variables, and the Mann-Whitney U-test was used to evaluate continuous variables. Forward stepwise regression models ( $P_{in} = 0.05$ ,  $P_{out} = 0.10$ ) were used to identify variables associated with PCS.

**RESULTS** PCS patients were more likely than control patients to have a concussion history ( $p = 0.010$ ), premorbid mood disorders ( $p = 0.002$ ), other psychiatric illness ( $p = 0.039$ ), or significant life stressors ( $p = 0.036$ ). Other factors that increased the likelihood of PCS development were a family history of mood disorders, other psychiatric illness, and migraine. Development of PCS was not predicted by race,



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insurance status, body mass index, sport, helmet use, medication use, and type of symptom endorsement. A final logistic regression analysis of candidate variables showed PCS to be predicted by a history of concussion (OR 1.8, 95% CI 1.1-2.8,  $p = 0.016$ ), preinjury mood disorders (OR 17.9, 95% CI 2.9-113.0,  $p = 0.002$ ), family history of mood disorders (OR 3.1, 95% CI 1.1-8.5,  $p = 0.026$ ), and delayed symptom onset (OR 20.7, 95% CI 3.2-132.0,  $p < 0.001$ ).

**CONCLUSIONS** In this age- and sex-matched case-control study of risk factors for PCS among youth with SRC, risk for development of PCS was higher in those with a personal and/or family history of mood disorders, other psychiatric illness, and migraine. These findings highlight the unique nature of SRC in youth. For this population, providers must recognize the value of establishing the baseline health and psychiatric status of children and their primary caregivers with regard to symptom reporting and recovery expectations. In addition, delayed symptom onset was an unexpected but strong risk factor for PCS in this cohort. Delayed symptoms could potentially result in late removal from play, rest, and care by qualified health care professionals. Taken together, these results may help practitioners identify young athletes with concussion who are at a greater danger for PCS and inform larger prospective studies for validation of risk factors from this cohort.

PMID: 25745949

**No 460: February 13, 2019**

Ellis MJ, Cordingley DM, Vis S, Reimer KM, Leiter J, Russell K. Clinical predictors of vestibulo-ocular dysfunction in pediatric sports-related concussion. *J Neurosurg Pediatr.* 2017 Jan;19(1):38-45. doi: 10.3171/2016.7. PEDS16310. Epub 2016 Sep 30.

**OBJECTIVE** There were 2 objectives of this study. The first objective was to identify clinical variables associated with vestibulo-ocular dysfunction (VOD) detected at initial consultation among pediatric patients with acute sports-related concussion (SRC) and postconcussion syndrome (PCS). The second objective was to reexamine the prevalence of VOD in this clinical cohort and evaluate the effect of VOD on length of recovery and the development of PCS.

**METHODS** A retrospective review was conducted for all patients with acute SRC and PCS who were evaluated at a pediatric multidisciplinary concussion program from September 2013 to May 2015. Acute SRC was defined as presenting < 30 days postinjury, and PCS was defined according to the International Classification of Diseases, 10th Revision criteria and included being symptomatic 30 days or longer postinjury. The initial assessment included clinical history and physical examination performed by 1 neurosurgeon. Patients were assessed for VOD, defined as the presence of more than 1 subjective vestibular and oculomotor complaint (dizziness, diplopia, blurred vision, etc.) and more than 1 objective physical examination finding (abnormal near point of convergence, smooth pursuits, saccades, or vestibulo-ocular reflex testing). Poisson regression analysis was used to identify factors that increased the risk of VOD at initial presentation and the development of PCS.



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**RESULTS** Three hundred ninety-nine children, including 306 patients with acute SRC and 93 with PCS, were included. Of these patients, 30.1% of those with acute SRC (65.0% male, mean age 13.9 years) and 43.0% of those with PCS (41.9% male, mean age 15.4 years) met the criteria for VOD at initial consultation. Independent predictors of VOD at initial consultation included female sex, preinjury history of depression, posttraumatic amnesia, and presence of dizziness, blurred vision, or difficulty focusing at the time of injury. Independent predictors of PCS among patients with acute SRC included the presence of VOD at initial consultation, preinjury history of depression, and posttraumatic amnesia at the time of injury.

**CONCLUSIONS** This study identified important potential risk factors for the development of VOD following pediatric SRC. These results provide confirmatory evidence that VOD at initial consultation is associated with prolonged recovery and is an independent predictor for the development of PCS. Future studies examining clinical prediction rules in pediatric concussion should include VOD. Additional research is needed to elucidate the natural history of VOD following SRC and establish evidence-based indications for targeted vestibular rehabilitation.

PMID: 27689244

**No 459: February 6, 2019**

Storey EP, Wiebe DJ, D'Alonzo BA, Nixon-Cave K, Jackson-Coty J, Goodman AM, Grady MF, Master CL. **Vestibular Rehabilitation Is Associated With Visuovestibular Improvement in Pediatric Concussion.** J Neurol Phys Ther. 2018 Jul;42(3):134-141.

**BACKGROUND AND PURPOSE:** Vision and vestibular-related deficits are common after concussion and are associated with prolonged recovery times, substantially impacting the quality of life for children. The utility of targeted vestibular rehabilitation for these deficits in children after concussion is unknown. The purpose of this study was to determine whether active vestibular rehabilitation is associated with an improvement in visuovestibular signs and symptoms in children with concussion.

**METHODS:** A retrospective cohort study of children diagnosed with concussion and referred to vestibular rehabilitation between 2012 and 2014 was conducted. Patient-reported symptoms and visuovestibular performance measures were assessed in the medical practice and physical therapy settings.

**RESULTS:** One hundred nine children were included in the study with a mean age of 11.8 (3.4) years. Among this group, 59 (54%) were male and 48 (44%) had a sports-related concussion. Children presented to a pediatric sports medicine office and physical therapy a median of 24 (interquartile range [IQR], 14-42) and 55 (IQR, 39-94) days after injury, respectively. Concussion symptoms decreased from a median of 9 (IQR, 5-13) symptoms at initial evaluation to a median of 0 (IQR, 0-2) symptoms at final assessment. Performance on all visuovestibular tasks improved significantly over the course of therapy



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except for near point of convergence. For the 45 children who completed the Balance Error Scoring System at both initial and final therapy visits, there was a significant improvement in mean level of performance ( $P < 0.0001$ ). Characteristics between those who completed a full versus partial course of physical therapy were similar.

**DISCUSSION AND CONCLUSIONS:** Vestibular rehabilitation in children with concussion is associated with improvement in symptoms as well as visuovestibular performance. This active intervention may benefit children with persistent symptoms after concussion. Future prospective studies are needed to determine the efficacy and optimal postinjury timing of vestibular rehabilitation.

Video Abstract available for more insights from the authors (see Supplemental Digital Content 1, available at: <http://links.lww.com/JNPT/A208>).

PMID: 29912034

**Summary of January 2019 Topic: Complementary therapies for balance disorders and management of anxiety**

**No 458: January 30, 2019**

Bubela D, Sacharko L, Chan J, Brady M. **Balance and Functional Outcomes for Older Community-Dwelling Adults Who Practice Tai Chi and Those Who Do Not: A Comparative Study.** J Geriatr Phys Ther. 2017 Nov 9. doi: 10.1519/JPT.000000000000153.

**BACKGROUND AND PURPOSE:** A growing body of literature substantiates that Tai Chi is a form of exercise that may help older adults increase strength, improve balance, lower fall rates, and experience less fear of falling. Few studies, however, offer controlled experimental design and simultaneously investigate multiple factors known to contribute to fall risk. The purpose of this study was to compare performance on measures relating to fall risk (strength, balance, functional mobility, and fear of falling) in older community-dwelling adults who participated in a community-based Tai Chi program with a control group of their peers who had no Tai Chi training over the same time period.

**METHODS:** A quasi-experimental comparative pre- and posttest design was used to compare an experimental group of 16 community-dwelling older adults, mean (SD) age = 80.4 (6.8) years, participating in a 16-week Tai Chi training program with a group of 13 adults, mean (SD) age = 71.2 (6.1) years, who had no Tai Chi experience in the areas of knee extension strength (measured by handheld dynamometry), functional strength (by five-time sit to stand), mobility (by Timed Up and Go [TUG] test and Fifty-Foot Walk Test), balance (by Functional Reach and Berg Balance Scale), and fear of falling (by Activity-specific Balance Confidence scale). Within-group and between-groups comparisons were made





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using 2x2 mixed analysis of variance.

**RESULTS:** Tai Chi participants improved in nearly all measures, whereas controls did not. Tai Chi participants experienced significant improvement in the TUG test during the training period ( $P = .003$ ), with significant difference when compared with controls ( $P = .049$ ) and moderate effect size and observed power ( $\eta^2 = 0.165$ ; observed power = 0.512). Significant knee extension strength improvement occurred ( $P = .042$ ) with moderate effect size and observed power ( $\eta^2 = 0.183$ ; observed power = 0.543). While the total balance confidence scale score did not change significantly, responses on many individual items did reach a level of significant change for persons participating in the Tai Chi training.

**CONCLUSION:** Older adults' participation in a community-based Tai Chi program may lead to improvement in strength, mobility, and confidence in performing functional tasks. Incorporation of elements of Tai Chi into therapy programs for older adults at risk for fall and referral to community-based Tai Chi programs may be viable options in the continuum of health-related care for older adults.

PMID: 29135600

**No 457: January 16, 2019**

Huang ZG, Feng YH, Li YH, Lv CS. **Systematic review and meta-analysis: Tai Chi for preventing falls in older adults.** *BMJ Open.* 2017 Feb 6;7(2):e013661. doi: 10.1136/bmjopen-2016-013661

**OBJECTIVE:** It remains unclear whether Tai Chi is effective for preventing falls in older adults. We undertook this systematic review to evaluate the preventive effect of Tai Chi by updating the latest trial evidence.

**DESIGN:** Systematic review and meta-analysis.

**METHODS:** The Cochrane Library, MEDLINE and EMBASE were searched up to February 2016 to identify randomised trials evaluating Tai Chi for preventing falls in older adults. We evaluated the risk of bias of included trials using the Cochrane Collaboration's tool. Results were combined using random effects meta-analysis.

**OUTCOME MEASURES:** Number of fallers and rate of falls.

**RESULTS:** 18 trials with 3824 participants were included. The Tai Chi group was associated with significantly lower chance of falling at least once (risk ratio (RR) 0.80, 95% CI 0.72 to 0.88) and rate of falls (incidence rate ratio (IRR) 0.69, 95% CI 0.60 to 0.80) than the control group. Subgroup analyses



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suggested that the preventive effect was likely to increase with exercise frequency (number of fallers:  $p=0.001$ ; rate of falls:  $p=0.007$ ) and Yang style Tai Chi was likely to be more effective than Sun style Tai Chi (number of fallers:  $p=0.01$ ; rate of falls:  $p=0.001$ ). The results might be influenced by publication bias as the funnel plots showed asymmetry. Sensitivity analyses by sample size, risk of bias and comorbidity showed no major influence on the primary results.

**CONCLUSIONS:** Tai Chi is effective for preventing falls in older adults. The preventive effect is likely to increase with exercise frequency and Yang style Tai Chi seems to be more effective than Sun style Tai Chi.

PMID: 28167744

Free PMC Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293999/>

**No 456: January 9, 2019**

Pascoe MC, Thompson DR, Ski CF. **Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis.** *Psychoneuroendocrinology*. 2017 Dec;86:152-168. doi: 10.1016/j.psyneuen.2017.08.008. Epub 2017 Aug 30.

**BACKGROUND AND OBJECTIVES:** Practices that include yoga asanas and mindfulness-based stress reduction for the management of stress are increasingly popular; however, the neurobiological effects of these practices on stress reactivity are not well understood. Many studies investigating the effects of such practices fail to include an active control group. Given the frequency with which people are selecting such interventions as a form of self-management, it is important to determine their effectiveness. Thus, this review investigates the effects of practices that include yoga asanas, with and without mindfulness-based stress reduction, compared to an active control, on physiological markers of stress.

**MATERIALS AND METHODS:** A systematic review and meta-analysis of randomised controlled trials published in English compared practices that included yoga asanas, with and without mindfulness-based stress reduction, to an active control, on stress-related physiological measures. The review focused on studies that measured physiological parameters such as blood pressure, heart rate, cortisol and peripheral cytokine expression. MEDLINE, AMED, CINAHL, PsycINFO, SocINDEX, PubMed, and Scopus were searched in May 2016 and updated in December 2016. Randomised controlled trials were included if they assessed at least one of the following outcomes: heart rate, blood pressure, heart rate variability, mean arterial pressure, C-reactive protein, interleukins or cortisol. Risk of bias assessments included sequence generation, allocation concealment, blinding of assessors, incomplete outcome data, selective outcome reporting and other sources of bias. Meta-analysis was undertaken using Comprehensive Meta-Analysis Software Version 3. Sensitivity analyses were performed using 'one-study-removed' analysis. Subgroup analysis was conducted for different yoga and control group types, including mindfulness-based stress reduction versus non-mindfulness-based stress reduction based interventions, different populations, length of intervention, and method of data analysis. A random-effects model was used in all analyses.



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**RESULTS:** Forty two studies were included in the meta-analysis. Interventions that included yoga asanas were associated with reduced evening cortisol, waking cortisol, ambulatory systolic blood pressure, resting heart rate, high frequency heart rate variability, fasting blood glucose, cholesterol and low density lipoprotein, compared to active control. However, the reported interventions were heterogeneous.

**CONCLUSIONS:** Practices that include yoga asanas appear to be associated with improved regulation of the sympathetic nervous system and hypothalamic-pituitary-adrenal system in various populations.

PMID:28963884

**No 455: January 2, 2019**

Nick N, Petramfar P, Ghodsbin F, Keshavarzi S, Jahanbin I. **The Effect of Yoga on Balance and Fear of Falling in Older Adults.** PM R. 2016 Feb;8(2):145-51. doi: 10.1016/j.pmrj.2015.06.442. Epub 2015 Jul 8.

**OBJECTIVE:** To determine the effect of yoga on balance and fear of falling in older adults.

**DESIGN:** Randomized controlled trial.

**SETTING:** Jahandidegan Center in Shiraz, southern Iran.

**PARTICIPANTS:** Forty persons (17 men and 23 women) between the ages of 60-74 years with a Modified Falls Efficacy Scale (MFES) score <8 and a Berg Balance Scale (BBS) score <45. After completing the MFES questionnaire and BBS measurement, the participants were divided into intervention and control groups. BBS measurement and the MFES questionnaire were completed again immediately after the intervention.

**INTERVENTION:** The intervention group participated in 2 yoga practice sessions per week for 8 weeks. The control group received no intervention.

**MAIN OUTCOME MEASUREMENTS:** Fear of falling was measured with the MFES and balance was measured with the BBS.

**RESULTS:** We found significant changes in both variables ( $P < .0001$ ). Mean differences before and after the intervention for the BBS for yoga and control groups were 10.19 and -1.16, respectively. Mean differences before and after the intervention for the MFES for yoga and control groups were 1.62 and -0.21, respectively.

**CONCLUSION:** Yoga is a potential intervention to reduce fear of falling and improve balance in older adults.

PMID: 26164350