



**Vestibular Rehabilitation SIG
Archived Abstract of the Week
for the year 2020**

January Topic: BPPV Recurrence

January 9, 2020

Kim HJ, Kim JS. **The Patterns of Recurrences in Idiopathic Benign Paroxysmal Positional Vertigo and Self-treatment Evaluation.** *Front Neurol.* 2017 Dec 15;8:690. doi: 10.3389/fneur.2017.00690. eCollection 2017.

BACKGROUND AND OBJECTIVES: Benign paroxysmal positional vertigo (BPPV) recurs frequently. This study aims to determine that each patient with BPPV has a predilection for a specific canal and the type of recurred BPPV can be predicted from that observed during the previous attack.

METHODS: The involved side (right, left, and bilateral) and affected canal (posterior, geotropic horizontal, apogeotropic horizontal, anterior, and mixed) were analyzed in 224 pairs of consecutive attacks of BPPV confirmed in 167 patients at the Dizziness Clinic of Seoul National Bundang Hospital from 2003 to 2017. We defined the recurrence when patients had the redevelopment of BPPV at least 1 week after resolution of the previous one.

RESULTS: During the initial attack, the involved canals were posterior in 134 (59.8%), geotropic horizontal in 53 (23.7%), apogeotropic horizontal in 27 (12.1%), anterior in 5 (2.2%), and mixed in 5 (2.2%). The right ear was more commonly affected than the left ear [132 (58.9%) vs. 90 (40.2%)]. Two patients (0.9%) showed bilateral involvements. During the recurrences, the proportions of involved canals and affected side were similar irrespective of those during the former event. Only 24% of the patients showed the recurrence in the same canal on the same side.

CONCLUSION: The patterns of recurrences are usually discordant in patients with BPPV. Instruction for self-administration of a specific canalith repositioning procedure based on the previous type of BPPV may have a limited efficacy in this frequently recurrent disorder.

PMID: 29326650

January 15, 2020

Wang YQ, Li JR, Zou SZ, Ding YL. **Clinical features and recurrence rate on benign paroxysmal positional vertigo.** 2019 Dec;33(12):1185-1188. doi: 10.13201/j.issn.1001-1781.2019.12.017.

OBJECTIVE: To study the characteristics and the recurrence rate of manual reduction of BPPV.

METHOD: The clinical characteristics of 735 patients with BPPV were analyzed retrospectively. The posterior semicircular canal BPPV (PC-BPPV) was treated with the Epley maneuver therapy; the horizontal semicircular canal BPPV (HC-BPPV) was treated with the Barbecue therapy; the anterior semicircular canal BPPV (AC-BPPV) was treated with the Yacovino therapy; the combined semicircular canal was treated with the Epley and the Barbecue therapy; and for the bilateral lesions, first treat the



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more severe side with manual reduction then the lighter side was treated with manual reduction after the more severe side nystagmus or vertigo completely disappears.

RESULT: 1. Of the 735 patients with BPPV, 455 (61.90%) were PC-BPPV, 272 (37.01%) were HC-BPPV, 3 (0.41%) were AC-BPPV, and 5 (0.68%) were combined BPPV. 2: A total of 455 patients with BPPV were followed up by telephone. 51 patients recurred within 3 years, the recurrence rate was 11.21%; the male recurrence rate was 25.68% (38/148), and the female recurrence rate was 28.66% (88/307). The recurrence rate was the highest in 51-60 years old, and the recurrence rate was 29.67%. 3. 300 patients with PC-BPPV were followed up by telephone, 81 cases (27.00%) recurred, and the recurrence rates of one month, six months, one year, two years, and three years were 0.67% (2/300), 3.33% (10/300), 6.67% (20/300), 9.33% (28/300) and 11.67% (35/300) respectively; 155 patients with HC-BPPV were followed up by telephone, 45 cases (29.03%) recurred, the recurrence rates of one months, six months, one year, two years, and three years were 0 (0/155), 2.58% (4/155), 3.23% (5/155), 7.10% (11/155) and 9.68% (15/155) respectively.

CONCLUSION: PC-BPPV is the most common disease in BPPV patients. Manual recurrence can effectively treat the recurrence rate of BPPV, female patients is slightly higher than that of male patients. The long-term recurrence rate of PC-BPPV is consistent with that of HC-BPPV. The BPPV were most common in posterior semicircular canal. Manual reduction is effective to treat BPPV cases. BPPV recurrence was not correlated with age and gender. The long-term recurrence rate of PC-BPPV and HC-BPPV is consistent. PMID: 31914271

January 22, 2020

Amor-Dorado JC, Barreira-Fernández MP, Aran-Gonzalez I, Casariego-Vales E, Llorca J, González-Gay MA. **Particle repositioning maneuver versus Brandt-Daroff exercise for treatment of unilateral idiopathic BPPV of the posterior semicircular canal: a randomized prospective clinical trial with short- and long-term outcome.** *Otol Neurotol.* 2012 Oct;33(8):1401-7. doi: 10.1097/MAO.0b013e318268d50a.

OBJECTIVE: To compare the outcome and probability of recurrence in a series of patients with unilateral idiopathic benign paroxysmal positional vertigo of the posterior canal (PC-BPPV) that were randomly treated by Brandt-Daroff exercise (B-D exercise) or by particle repositioning maneuver (PRM).

STUDY DESIGN: Randomized prospective clinical trial.

SETTING: Tertiary referral center.

PATIENTS: Patients were included in this study if they complained of vertigo and had been diagnosed as having unilateral idiopathic PC-BPPV for at least 1 week before Dix-Hallpike maneuver (DHM), remained for 30 days in the randomly assigned treatment, and had at least 48 months' follow-up.

INTERVENTION: Forty-one patients were treated with a single PRM and 40 patients by B-D exercise.

MAIN OUTCOME MEASURE: Resolution of benign paroxysmal positional nystagmus on the DHM. The probability of recurrence was also studied.

RESULTS: At Day 7, DHM was negative in 80.5% of the PRM-treated patients and in 25% of those treated by B-D exercise ($p < 0.001$). At Month 1, the differences between both treatment groups remained



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statistically significant (92.7% in PRM versus 42.5% in the B-D exercise had a negative DHM; $p < 0.001$). The variable that influenced that DHM became negative was the PRM (RR = 4.8; 95% confidence interval, 2.5-9.2; $p < 0.001$). The number of recurrences in PRM and B-D exercise were 0.56 ± 0.8 and 0.48 ± 0.8 , respectively ($p = 0.48$). The recurrence rate at 48 months was 35.5% (15/41) in B-D exercise and 36.6% (9/31) in the PRM group ($p = 0.62$). Although the time interval until the first recurrence was similar ($p = 0.44$), patients included in the PRM group showed a significantly longer time interval between the first and second recurrence ($p = 0.04$).

CONCLUSION: PRM is more effective treatment and as safe as B-D exercise in the short term for unilateral and idiopathic PC-BPPV, and although it does not reduce the probability of recurrence in the 4-year follow-up period compared with B-D exercise, it may delay the second recurrence's onset in those patients who had already experienced a single recurrence. Our study supports the use of PRM as the treatment of choice in unilateral and idiopathic PC-BPPV, although exercise may be also considered as an alternative treatment in selected cases.

PMID: 22935812

January 29, 2020

Helminski JO, Janssen I, Hain TC. **Daily exercise does not prevent recurrence of benign paroxysmal positional vertigo.** *Otol Neurotol.* 2008 Oct;29(7):976-81. doi: 10.1097/MAO.0b013e318184586d.

OBJECTIVE: The purpose of this study was to analyze if a daily routine of self-canalith repositioning procedure (CRP) will increase the time to recurrence and reduce the rate of recurrence of benign paroxysmal positional vertigo (BPPV).

STUDY DESIGN: Prospective study, nonrandomized control group.

SETTING: Outpatient clinic.

PATIENTS: Thirty-nine patients diagnosed with posterior canal BPPV successfully treated with the CRP. Based on a convenience sample, 17 (44%) patients were assigned to the treatment group, whereas 22 (56%) were assigned to the no-treatment group. The number of subjects lost at the time of follow-up were 5 (29.4%) of the treatment group and 2 (9%) of the no-treatment group.

INTERVENTIONS: Patients assigned to the treatment group performed the self-CRP daily, whereas those assigned to the no-treatment group performed no exercises. Patients were followed for up to 2 years.

MAIN OUTCOME MEASURES: The main outcome measures were the rate of recurrence of BPPV and the time for BPPV to recur.

RESULTS: Of the 39 subjects, symptoms recurred in 16 (41%) of the total population, 6 (35%) of 17 of the treatment group, and 10 (46%) of 22 of the no-treatment group. There was no difference in the frequency of recurrence (Pearson chi; $p = 0.522$) or the time to recurrence (survival analysis; log-rank test; $p = 0.242$).

CONCLUSION: Our results suggest that a daily routine of the self-CRP does not affect the time to recurrence and the rate of recurrence of posterior canal-BPPV.

PMID: 18698271



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February Topic: Vestibular Migraine

February 7, 2020

Teggi R, Colombo B, Albera R, Asprella Libonati G, Balzanelli C, Batuecas Caletrio A, Casani AP, Espinosa-Sanchez JM, Gamba P, Lopez-Escamez JA, Lucisano S, Mandalà M, Neri G, Nuti D, Pecci R, Russo A, Martin-Sanz E, Sanz R, Tedeschi G, Torelli P, Vannucchi P, Comi G, Bussi M. **Clinical Features of Headache in Patients With Diagnosis of Definite Vestibular Migraine: The VM-Phenotypes Projects.** Front Neurol. 2018 Jun 5;9:395. doi: 10.3389/fneur.2018.00395. eCollection 2018.

Migraine is a common neurological disorder characterized by episodic headaches with specific features, presenting familial aggregation. Migraine is associated with episodic vertigo, named Vestibular Migraine (VM) whose diagnosis mainly rely on clinical history showing a temporary association of symptoms. Some patient refers symptoms occurring in pediatric age, defined "episodic symptoms which may be associated with migraine." The aim of this cross sectional observational study was to assess migraine-related clinical features in VM subjects. For the purpose, 279 patients were recruited in different centers in Europe; data were collected by a senior neurologist or ENT specialist through a structured questionnaire. The age of onset of migraine was 21.8 ± 9 . The duration of headaches was lower than 24 h in 79.1% of cases. Symptoms accompanying migrainous headaches were, in order of frequency, nausea (79.9%), phonophobia (54.5%), photophobia (53.8%), vomiting (29%), lightheadedness (21.1%). Visual or other auras were reported by 25.4% of subjects. A familial aggregation was referred by 67.4%, while migraine precursors were reported by 52.3% of subjects. Patients reporting nausea and vomiting during headaches more frequently experienced the same symptoms during vertigo. Comparing our results in VM subjects with previously published papers in migraine sufferers, our patients presented a lower duration of headaches and a higher rate of familial aggregation; moreover some common characters were observed in headache and vertigo attacks for accompanying symptoms like nausea and vomiting and clustering of attacks.

PMID: 29922214

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5996089/>

February 12, 2020

Beh SC. Vestibular Migraine: **How to Sort it Out and What to Do About it.** J Neuroophthalmol. 2019 Jun;39(2):208-219. doi: 10.1097/WNO.0000000000000791.

BACKGROUND: Vestibular migraine (VM) is the most common neurologic cause of vertigo in adults and results in significant utilization of health care resources, but remains under-recognized and underdiagnosed.



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EVIDENCE ACQUISITION: Review of literature in PubMed using the following terms: vestibular migraine, migraine-associated vertigo, vertiginous migraine, benign recurrent vertigo, migraine-associated dizziness, migraine, migraine treatment, Meniere disease (MD), vertebrobasilar ischemia (VBI), posterior circulation stroke, benign paroxysmal positional vertigo, and episodic-ataxia Type 2 (EA2).

RESULTS: VM can manifest with a variety of vestibular symptoms, including spontaneous vertigo, triggered vertigo, positional vertigo, and head-motion dizziness. Patients may report more than 1 vestibular symptom. Episodes of vertigo are often, but not always, accompanied by headache. Auditory symptoms are frequently associated with VM attacks and may mimic the manifestations of MD. Other migrainous features that accompany VM attacks include photophobia, phonophobia, osmophobia, and visual aura. Interictally, patients may suffer from persistent dizziness or isolated paroxysmal vestibular symptoms. Mood disorders (particularly anxiety) are often found in VM. Abnormal neuro-otologic findings are not uncommon in patients with VM. Differential diagnoses for VM include MD, VBI, EA2, and migraine with brainstem aura. For rescue treatment, triptans, vestibular suppressants, and/or antiemetic agents may be considered. Pharmacologic migraine preventives (antiepileptics, beta-blockers, and antidepressants) are often useful.

CONCLUSIONS: The keys to correctly diagnosing VM is identifying a relationship between vestibular symptoms and migrainous features and being aware of the heterogeneity of manifestations of this enigmatic, but treatable, condition. The principles of treatment of VM include rescue therapy, lifestyle modification, nonpharmacologic migraine preventives, pharmacologic migraine prophylaxis, and treatment of comorbidities.

PMID 31094996

February 20, 2020

Teggi R, Colombo B, Albera R, Asprella Libonati G, Balzanelli C, Batuecas Caletrio A, Casani A, Espinoza-Sanchez JM, Gamba P, Lopez-Escamez JA, Lucisano S, Mandalà M, Neri G, Nuti D, Pecci R, Russo A, Martin-Sanz E, Sanz R, Tedeschi G, Torelli P, Vannucchi P, Comi G, Bussi M. **Clinical Features, Familial History, and Migraine Precursors in Patients With Definite Vestibular Migraine: The VM-Phenotypes Projects.** *Headache.* 2018 Apr;58(4):534-544. doi: 10.1111/head.13240. Epub 2017 Dec 4.

OBJECTIVE: The aim of this work was to assess through a questionnaire the features of vertiginous episodes, accompanying symptoms, familial history, and migraine precursors in a sample of 252 subjects with a diagnosis of definite vestibular migraine.

BACKGROUND: Migraine is a common neurological disorder characterized by episodic headaches with specific features. About two-thirds of cases run in families, and patients may refer symptoms occurring in infancy and childhood, defined as episodic syndromes that may be associated with migraine. Migraine is associated with episodic vertigo, called vestibular migraine, whose diagnosis mainly relies on clinical history showing a temporary association of symptoms.



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METHODS: In this cross-sectional multicentric study, 252 subjects were recruited in different centers; a senior specialist through a structured questionnaire assessed features of vestibular symptoms and accompanying symptoms.

RESULTS: The age of onset of migraine was 23 years, while onset of vertigo was at 38 years. One hundred and eighty-four subjects reported internal vertigo (73%), while 63 subjects (25%) reported external vertigo. The duration of vertigo attacks was less than 5 minutes in 58 subjects (23%), between 6 and 60 minutes in 55 (21.8%), between 1 and 4 hours in 29 (11.5%), 5 and 24 hours in 44 (17.5%), up to 3 days in 14 (5.5%), and more than 3 days in seven (2.8%); 14 subjects (5.5%) referred attacks lasting from less than 5 minutes and up to 1 hour, nine (3.6%) referred attacks lasting from less than 5 minutes and up to 1 to 4 hours, six (2.4%) referred attacks lasting from less than 5 minutes and up to 5 to 24 hours, and five (2%) cases referred attacks lasting from less than 5 minutes and up to days. Among accompanying symptoms, patients referred the following usually occurring, in order of frequency: nausea (59.9%), photophobia (44.4%), phonophobia (38.9%), vomiting (17.8%), palpitations (11.5%), tinnitus (10.7%), fullness of the ear (8.7%), and hearing loss (4%). In total, 177 subjects referred a positive family history of migraine (70.2%), while 167 (66.3%) reported a positive family history of vertigo. In the sample, 69% of patients referred at least one of the pediatric precursors, in particular, 42.8% of subjects referred motion sickness. The age of onset of the first headache was lower in the subsample with a familial history of migraine than in the total sample. Among the pediatric precursors, benign paroxysmal vertigo - BPV, benign paroxysmal torticollis, and motion sickness were predictive of a lower age of onset of vertigo in adulthood; cyclic vomiting was predictive for vomiting during vertigo attacks in adults.

CONCLUSIONS: Our results may indicate that vestibular symptoms in pediatric patients may act as a predisposing factor to develop vestibular migraine at an earlier age in adulthood.

PMID: 29205326

February 26, 2020

Alghadir AH, Anwer S. **Effects of Vestibular Rehabilitation in the Management of a Vestibular Migraine: A Review.** *Front Neurol.* 2018;9:440. Published 2018 Jun 12. doi:10.3389/fneur.2018.00440

Vestibular rehabilitation (VR) has been shown to be effective for many vestibular disorders. This review focuses on the current evidence on the effects of physical therapy in the management of vestibular symptoms in individuals with a vestibular migraine (VM). The individuals with a history of a migraine tend to have a high incidence of vestibular symptoms with some or all of their headaches. A total of six included studies investigated the effects of VR in the management of VM. The critical review form for quantitative studies was used to appraise quality assessment and risk of bias in the selected studies. Previous studies validated the use of VR in the treatment of vestibular symptoms for individuals with a VM to include improved headache and migraine-related disability in patients with a VM. From the current evidence, it is difficult to provide conclusive evidence regarding the efficacy of VR to minimize vestibular symptoms in patients with VM. Therefore, more randomized controlled studies are required



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to make firm evidence on the effect of VR in reducing vestibular symptoms in patients with VM. The future prospective, blinded, randomized controlled studies may help to isolate possible therapeutic effects of VR and other general effects.

PMID: 29946294

March Topic: CSM Recap

March 6, 2020

Schubert MC, Helminski J, Zee DS, et al. **Horizontal semicircular canal jam: Two new cases and possible mechanisms.** *Laryngoscope Investig Otolaryngol.* 2020;5(1):163–167. Published 2020 Jan 16. doi:10.1002/liv.2.352

INTRODUCTION: Benign paroxysmal positional vertigo (BPPV) of the horizontal semicircular canal (hSCC) can present with otoconia blocking its lumen (canalith jam), with signs and symptoms that make it difficult to distinguish from central nervous system pathology.

OBJECTIVE: Here we report two cases of canalith jam affecting the hSCC and offer a theoretical mechanism based on known vestibular neurophysiology.

METHODS: We use video-oculography to document the canalith jam and show the moment the otoconia loosen.

RESULTS: Canalith jam is a rare form of BPPV remedied with repositioning maneuvers.

CONCLUSION: Clinicians should consider canalith jam as a mechanism for BPPV when the nystagmus is (a) Direction fixed with fixation removed and during positional testing; (b) Velocity dependent on supine head position; (c) Converts to geotropic directional changing nystagmus.

PMID: 32128444

March 11, 2020

Scocco DH, García IE, Barreiro MA. **Sitting Up Vertigo. Proposed Variant of Posterior Canal Benign Paroxysmal Positional Vertigo.** *Otol Neurotol.* 2019 Apr;40(4):497-503. doi: 10.1097/MAO.0000000000002157.

OBJECTIVE: To describe a variant of posterior canal benign paroxysmal positional vertigo (BPPV).

STUDY DESIGN: Retrospective case review.

SETTING: Tertiary referral center.

PATIENTS: Fifteen patients with symptoms of BPPV and oculomotor evidence of activation of posterior semicircular canal (P-SCC) cupula that arises when sitting up from Dix-Hallpike maneuver (DH).

INTERVENTION: All patients were examined with videonystagmography and underwent brain magnetic resonance imaging (MRI).



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RESULTS: All patients showed up-beating nystagmus with ipsilateral torsional component when coming up from right or left side DH. Most patients described vertiginous symptoms when sitting up from bed and many described severe non-positional disequilibrium. Eight patients had been treated with Epley canalith repositioning maneuver (CRM) at our clinic for posterior canal BPPV. Four of them were re-tested within an hour for CRM effectiveness and the rest, a week later. Three patients had been diagnosed with BPPV and were being treated with CRM in other institutions. Four patients showed these findings but they had not previously undergone CRM. All patients were treated with CRM without success, but they resolved their positional vertigo by means of Brandt Daroff exercises. No patient showed evidence of central vestibular disorder.

CONCLUSION: We propose a P-SCC canalolithiasis limited to the periampullar portion by means of an anatomical restriction of distal movement of the otoconial debris. This syndrome seems to be more frequent early after CRM of classical P-SCC canalolithiasis. Close attention to ocular movement on sitting up after DH on patients is warranted.

PMID: 30870365

March 21, 2020

van Vugt VA, van der Wouden JC, Essery R, Yardley L, Twisk JWR, van der Horst HE, Maarsingh OR.

Internet based vestibular rehabilitation with and without physiotherapy support for adults aged 50 and older with a chronic vestibular syndrome in general practice: three armed randomised controlled trial. BMJ. 2019 Nov 5;367:l5922. doi: 10.1136/bmj.l5922.

OBJECTIVE: To investigate the clinical effectiveness and safety of stand alone and blended internet based vestibular rehabilitation (VR) in the management of chronic vestibular syndromes in general practice.

DESIGN: Pragmatic, three armed, parallel group, individually randomised controlled trial.

SETTING: 59 general practices in the Netherlands.

PARTICIPANTS: 322 adults aged 50 and older with a chronic vestibular syndrome.

INTERVENTIONS: Stand alone VR comprising a six week, internet based intervention with weekly online sessions and daily exercises (10-20 minutes a day). In the blended VR group, the same internet based intervention was supplemented by face-to-face physiotherapy support (home visits in weeks 1 and 3). Participants in the usual care group received standard care from a general practitioner, without any restrictions.

MAIN OUTCOME MEASURES: The primary outcome was vestibular symptoms after six months as measured by the vertigo symptom scale-short form (VSS-SF range 0-60, clinically relevant difference ≥ 3 points). Secondary outcomes were dizziness related impairment, anxiety, depressive symptoms, subjective improvement of vestibular symptoms after three and six months, and adverse events.

RESULTS: In the intention-to-treat analysis, participants in the stand alone and blended VR groups had lower VSS-SF scores at six months than participants in the usual care group (adjusted mean difference -4.1 points, 95% confidence interval -5.8 to -2.5; and -3.5 points, -5.1 to -1.9, respectively). Similar



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differences in VSS-SF scores were seen at three months follow-up. Participants in the stand alone and blended VR groups also experienced less dizziness related impairment, less anxiety, and more subjective improvement of vestibular symptoms at three and six months. No serious adverse events related to online VR occurred during the trial.

CONCLUSION: Stand alone and blended internet based VR are clinically effective and safe interventions to treat adults aged 50 and older with a chronic vestibular syndrome. Online VR is an easily accessible form of treatment, with the potential to improve care for an undertreated group of patients in general practice.

PMID: 31690561

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6829201/>

March 29, 2020

Ellis MJ, Boles S, Derksen V, Dawyduk B, Amadu A, Stelmack K, Kowalchuk M, Russell K. **Evaluation of a pilot paediatric concussion telemedicine programme for northern communities in Manitoba.** Int J Circumpolar Health. 2019 Dec;78(1):1573163. doi: 10.1080/22423982.2019.1573163.

Pediatric concussion patients living in northern communities in Canada can face unique challenges accessing primary and specialized healthcare. In this study we report the clinical characteristics, healthcare utilization, outcomes and estimated cost avoidance associated with a pilot pediatric concussion telemedicine program established between a multi-disciplinary pediatric concussion program in Winnipeg, Manitoba and a hospital in Thompson, Manitoba. From October 1st- July 1st, 2018, 20 patients were evaluated; mean age 13.1 years, 15 (75%) males and 14 (70%) self-identified as Indigenous. Injury mechanisms included hockey (50%), falls (35%) and assaults (15%). Median time from referral to initial consultation was 2.0 days. After screening by the neurosurgeon, 90% of patients underwent initial consultation via real-time videoconferencing with 80% managed exclusively through telemedicine. At the end of the study, 90% met the criteria for clinical recovery, one remained in treatment and one was discharged to a headache neurologist. Sixty-six telemedicine encounters were completed including 57 videoconferencing appointments and 9 telephone follow-ups representing an estimated cost avoidance of \$40,972.94. This study suggests telemedicine may be a useful approach to assist pediatric concussion programs with delivering timely, safe and cost-effective care to patients living in medically underserved remote and northern communities in Canada.

PMID: 30714513

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6366439/>

April Topic: Telehealth and Vestibular Rehab

April 3, 2020



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Muller I, Kirby S, Yardley L. **The therapeutic relationship in telephone-delivered support for people undertaking rehabilitation: a mixed-methods interaction analysis.** Disabil Rehabil. 2015;37(12):1060-5. doi: 10.3109/09638288.2014.955134. Epub 2014 Aug 26.

PURPOSE: The aim of this study was to identify communication features that may affect the development of the therapeutic relationship during telephone support sessions for people undertaking self-directed therapy.

METHODS: Recorded telephone support sessions of 61 people with chronic dizziness were analysed for communication behaviour using the Roter Interaction Analysis System (RIAS). Working alliance was assessed and was correlated with the RIAS to determine whether communication behaviour affected the therapeutic relationship. Thematic qualitative analysis of support sessions was then carried out to explore the content of sessions with high or low levels of person-centredness.

RESULTS: The level of person-centredness was related to the therapeutic relationship. High person-centred sessions were more likely to address concerns and include therapist reassurances about the safety of the treatment and its side effects.

CONCLUSION: It is possible for rehabilitation therapists to build a strong therapeutic relationship very quickly and over the telephone. Person-centred communication is important for the development of the therapeutic relationship during telephone-delivered support. This research suggests how person-centred communicative behaviours, such as reassurance, encouragement and approval could be incorporated into practice.

IMPLICATIONS FOR REHABILITATION: Person-centred communication is important for the development of a strong therapeutic relationship during support for self-directed rehabilitation. It is possible for rehabilitation therapists to build a strong therapeutic relationship very quickly and over the telephone. Positive communication behaviours such as encouragement, approval, reassurance of safety, and responsiveness to participant cues aid the therapeutic relationship.

KEYWORDS: Dizziness; person-centred; roter interaction analysis system; telephone support; therapeutic relationship; vestibular rehabilitation; working alliance

PMID: 25564084

April 9, 2020

Yue JK, Upadhyayula PS, Avalos LN, Phelps RRL Suen CG, Cage TA. **Concussion and Mild-Traumatic Brain Injury in Rural Settings: Epidemiology and Specific Health Care Considerations.** J Neurosci Rural Pract. 2020 Jan;11(1):23-33. doi: 10.1055/s-0039-3402581. Epub 2020 Mar 3.

Background: Mild-traumatic brain injury (mTBI) and concussions cause significant morbidity. To date, synthesis of specific health care disparities and gaps in care for rural mTBI/concussion patients remains needed.

Methods: A comprehensive literature search was performed using PubMed database for English articles with keywords "rural" and ("concussion" or "mild traumatic brain injury") from 1991 to 2019. Eighteen



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articles focusing on rural epidemiology (n = 5), management/cost (n = 5), military (n = 2), and concussion prevention/return to play (n = 6) were included.

Results: mTBI/concussion incidence was higher in rural compared with urban areas. Compared with urban patients, rural patients were at increased risk for vehicular injuries, lifetime number of concussions, admissions for observation without neuroimaging, and injury-related costs. Rural patients were less likely to utilize ambulatory and mental health services following mTBI/concussion. Rural secondary schools had decreased access to certified personnel for concussion evaluation, and decreased use of standardized assessment instruments/neurocognitive testing. While school coaches were aware of return-to-play laws, mTBI/concussion education rates for athletes and parents were suboptimal in both settings. Rural veterans were at increased risk for postconcussive symptoms and posttraumatic stress. Telemedicine in rural/low-resource areas is an emerging tool for rapid evaluation, triage, and follow-up.

Conclusions: Rural patients are at unique risk for mTBI/concussions and health care costs. Barriers to care include lower socioeconomic status, longer distances to regional medical center, and decreased availability of neuroimaging and consultants. Due to socioeconomic and distance barriers, rural schools are less able to recruit personnel certified for concussion evaluation. Telemedicine is an emerging tool for remote triage and evaluation.

PMID: 32214697

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7092729/>

April 17, 2020

Shah MU1, Lotterman S, Roberts D, Eisen M. **Smartphone telemedical emergency department consults for screening of nonacute dizziness.** *Laryngoscope.* 2019 Feb;129(2):466-469. doi: 10.1002/lary.27424. Epub 2018 Nov 26.

OBJECTIVES/HYPOTHESIS: Each year, the United States spends over \$4 billion on emergency department visits for evaluation of dizziness. Benign paroxysmal positional vertigo (BPPV) is a common cause of dizziness that can easily be diagnosed by observing characteristic eye movements during the Dix-Hallpike test (DHT). The DHT is easily performed; however, interpretation requires more advanced training. This may be part of the reason it is not commonly performed in emergency departments, and instead, patients undergo costly imaging tests. We evaluated whether smartphone-based video recordings of DHT could be assessed telemedically for screening of nonacute dizziness.

STUDY DESIGN: Feasibility study.

METHODS: Dizzy patients underwent objective vestibular testing, but also had videos of their eye movements recorded via a smartphone during the DHT. The videos were remotely reviewed by two neuro-otologists for BPPV screening and were compared to objective and in-person exam findings.

RESULTS: Overall, 30 dizzy patients were evaluated with seven cases of BPPV. The sensitivity for diagnosing BPPV via a smartphone-recording of eye movements of the DHT was 92.86%, with a specificity of 100% and a negative predictive value of 97.87%.



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CONCLUSIONS: Our initial proof-of-concept study shows that remote screening of BPPV is possible with high specificity. Because the DHT is easily taught, having a remote otolaryngologist interpret the resulting eye movements may increase usage of the test and may lead to cost savings.

PMID: 30478898

April 23, 2020

Bernocchi P, Giordano A, Pintavalle G, Galli T, Ballini Spoglia E, Baratti D, Scalvini S. **Feasibility and Clinical Efficacy of a Multidisciplinary Home-Telehealth Program to Prevent Falls in Older Adults: A Randomized Controlled Trial.** J Am Med Dir Assoc. 2019 Mar;20(3):340-346. doi: 10.1016/j.jamda.2018.09.003. Epub 2018 Oct 23.

OBJECTIVES: The aim of this study was to determine the feasibility and efficacy of a 6-month tele-rehabilitation home-based program, designed to prevent falls in older adults with 1 or more chronic diseases (cardiac, respiratory, neuromuscular or neurologic) returning home after in-hospital rehabilitation for their chronic condition. Patients were eligible for selection if they had experienced a fall during the previous year or were at high risk of falling.

DESIGN: Randomized controlled trial. Tele-rehabilitation consisted of a falls prevention program run by the physiotherapist involving individual home exercise (strength, balance, and walking) and a weekly structured phone-call by the nurse inquiring about the disease status and symptoms and providing patient support.

SETTING AND PARTICIPANTS: Two hundred eighty-three patients (age 79 ± 6.6 years; F = 59%) with high risk of falls and discharged home after in-hospital rehabilitation were randomized to receive home-based program (intervention group, n = 141) or conventional care (control group, n = 142).

MEASURES: Incidence of falls at home in the 6-month period (primary outcome); time free to the first fall and proportion of patients sustaining ≥ 2 falls (secondary outcomes).

RESULTS: During the 6 months, 85 patients fell at least once: 29 (20.6%) in the Intervention Group versus 56 (39.4%) in the control group ($P < .001$). The risk of falls was significantly reduced in the intervention group (relative risk = 0.60, 95% confidence interval: 0.44-0.83; $P < .001$). The mean \pm standard deviation time to first fall was significantly longer in intervention group than control group (152 ± 58 vs 134 ± 62 days; $P = .001$). Significantly, fewer patients experienced ≥ 2 falls in the intervention group than in the control group: 11 (8%) versus 24 (17%), $P = .020$.

CONCLUSIONS: A 6-month tele-rehabilitation home-based program integrated with medical/nursing telesurveillance is feasible and effective in preventing falls in older chronic disease patients with a high risk of falling.

PMID: 30366759

May Topic: Bilateral Vestibular Deficit and Cochlear Implants



**Vestibular Rehabilitation SIG
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May 6, 2020

Lerchundi F, Laffue AH, Olivier M, Gualtieri FJ. **Bilateral posterior semicircular canal dysfunction: a new finding with video head impulse test.** J Neurol. 2020 Apr 28. doi: 10.1007/s00415-020-09793-5. [Epub ahead of print]

Development of the video head impulse test (vHIT) assessing all three semicircular canals in both labyrinths has uncovered the existence of new vestibular failure patterns and made bilateral posterior canal dysfunction detection possible. We conducted a retrospective analysis of 41 patients with bilateral posterior semicircular canal failure and compared results to 37 controls, with normal posterior semicircular canal function. Mean calculated gain showed significant difference between patients and controls in right [0.54 (SD 0.016)] and left [0.57 (SD 0.014)] posterior semicircular canals. There was a peak in prevalence between 71 and 80 years. Presentation was chronic in 78% of patients, and gait instability was the most common complaint. Sixty eight percent of cases were classified as idiopathic. Significant difference between groups was seen regarding the presence of Meniere's disease, presbycusis, and positional down-beat nystagmus (posDBN). This new vHIT pattern is most often seen in elderly patients, mainly of idiopathic etiology and presents together with sensorineural hearing loss and posDBN. Our findings suggest idiopathic cases may well contribute to the so-called "presbyastasis". PMID: 32347336

May 13, 2020

Murray D, Viani L, Garvan J, Murphy A, Vance R, Simoes-Franklin C, Smith J, Meldrum D. **Balance, gait and dizziness in adult cochlear implant users: A cross sectional study.** Cochlear Implants Int. 2020 Jan;21(1):46-52. doi: 10.1080/14670100.2019.1662978. Epub 2019 Sep 18.

Objective: Cochlear implantation is associated with vestibular impairment due to the close proximity of the structures. The aim of the study was to quantify dizziness/vertigo, gaze instability, balance and gait problems in a sample of adult cochlear implant (CI) users.

Methods: An observational, cross sectional study evaluated subjective dizziness (Vestibular Rehabilitation Benefit Questionnaire (VRBQ)), balance confidence (Activities Specific Balance Questionnaire (ABC)), gait (Functional Gait Assessment (FGA) and 10m walk test), balance (Equitest Sensory Organisation Test (SOT)), and computerised dynamic visual acuity (DVA). The Dix Hallpike test was performed to test for benign paroxysmal positional vertigo (BPPV).

Results: Twenty participants (n=10F), 2.8(±2.7) years post implantation, with mean age 59.3(±15.8) years were assessed. Subjective dizziness (VRBQ) was low (15.0% (±15.5)) and balance confidence was high (ABC: 82.1%±14.9). FGA scores (25.1 ± 4.4) and gait speed (1.8 (±0.3) m/sec) were below normal. Dx Hallpike was positive in 3. Gaze instability was found in 50% (DVA loss, 0.29 (± 0.16) LogMAR), while 79% demonstrated balance impairment (mean SOT score, 57.8%±14.5), with 42% falling on SOT condition 5.

Discussion: Evidence of vestibular dysfunction was identified in these adult CI users.



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Conclusion: Access to vestibular function assessment and rehabilitation is required in adult CI users.
PMID: 31530102

May 20, 2020

Wolter NE, Gordon KA, Campos JL, Vilchez Madrigal LD, Pothier DD, Hughes CO, Papsin BC, Cushing SL.
BalanCI: Head-Referenced Cochlear Implant Stimulation Improves Balance in Children with Bilateral Cochleovestibular Loss. *Audiol Neurootol.* 2020;25(1-2):60-71. doi: 10.1159/000503135. Epub 2019 Nov 1.

INTRODUCTION: To determine the impact of a head-referenced cochlear implant (CI) stimulation system, BalanCI, on balance and postural control in children with bilateral cochleovestibular loss (BCVL) who use bilateral CI.

METHODS: Prospective, blinded case-control study. Balance and postural control testing occurred in two settings: (1) quiet clinical setting and (2) immersive realistic virtual environment (Challenging Environment Assessment Laboratory [CEAL], Toronto Rehabilitation Institute). Postural control was assessed in 16 and balance in 10 children with BCVL who use bilateral CI, along with 10 typically developing children. Children with neuromotor, cognitive, or visual deficits that would prevent them from performing the tests were excluded. Children wore the BalanCI, which is a head-mounted device that couples with their CIs through the audio port and provides head-referenced spatial information delivered via the intracochlear electrode array. Postural control was measured by center of pressure (COP) and time to fall using the WiiTM (Nintendo, WA, USA) Balance Board for feet and the BalanCI for head, during the administration of the Modified Clinical Test of Sensory Interaction in Balance (CTSIB-M). The COP of the head and feet were assessed for change by deviation, measured as root mean square around the COP (COP-RMS), rate of deviation (COP-RMS/duration), and rate of path length change from center (COP-velocity). Balance was assessed by the Bruininks-Oseretsky Test of Motor Proficiency 2, balance subtest (BOT-2), specifically, BOT-2 score as well as time to fall/fault.

RESULTS: In the virtual environment, children demonstrated more stable balance when using BalanCI as measured by an improvement in BOT-2 scores. In a quiet clinical setting, the use of BalanCI led to improved postural control as demonstrated by significant reductions in COP-RMS and COP-velocity. With the use of BalanCI, the number of falls/faults was significantly reduced and time to fall increased.

CONCLUSIONS: BalanCI is a simple and effective means of improving postural control and balance in children with BCVL who use bilateral CI. BalanCI could potentially improve the safety of these children, reduce the effort they expend maintaining balance and allow them to take part in more complex balance tasks where sensory information may be limited and/or noisy.

PMID: 31678979

May 28, 2020



**Vestibular Rehabilitation SIG
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Dobbels B, Lucieer F, Mertens G, Gilles A, Moyaert J, van de Heyning P, Guinand N, Pérez Fornos A, Herssens N, Halleman A, Vereeck L, Vanderveken O, Van Rompaey V, van de Berg R. **Prospective cohort study on the predictors of fall risk in 119 patients with bilateral vestibulopathy.** PLoS One. 2020 Mar 9;15(3):e0228768. doi: 10.1371/journal.pone.0228768. eCollection 2020.

OBJECTIVES: To identify predictive factors for falls in patients with bilateral vestibulopathy (BV). Specific variables contributing to the general work-up of a vestibular patient were compared between BV patients experiencing falls and those who did not.

DESIGN: Prospective multi-centric cohort study.

SETTING: Department of Otorhinolaryngology & Head and Neck Surgery at two tertiary referral centers: Antwerp University Hospital and Maastricht University Medical Center.

PARTICIPANTS: In total, 119 BV patients were included. BV diagnosis was defined in accordance with the diagnostic BV criteria, established by the Bárány Society in 2017.

MAIN OUTCOME MEASURES: Patients were divided into fallers and non-fallers, depending on the experience of one or more falls in the preceding 12 months. Residual vestibular function on caloric testing, rotatory chair testing, video head impulse test (vHIT) and cervical vestibular evoked myogenic potentials (cVEMP) was evaluated as a predictive factor for falls. Furthermore, hearing function (speech perception in noise (SPIN)), sound localization performance, etiology, disease duration, sport practice, scores on the Dizziness Handicap Inventory (DHI) and the Oscillopsia Severity Questionnaire (OSQ) were compared between fallers and non-fallers.

RESULTS: Forty-five (39%) patients reported falls. In a sub-analysis in the patients recruited at UZA (n = 69), 20% experienced three or more falls and three patients (4%) suffered from severe fall-related injuries. The DHI score and the OSQ score were significantly higher in fallers. Residual vestibular function, SPIN, sound localization performance, etiology, disease duration, age and sport practice did not differ between fallers and non-fallers.

CONCLUSIONS: Falls and (severe) fall-related injuries are frequent among BV patients. A DHI score > 47 and an OSQ score > 27.5 might be indicative for BV patients at risk for falls, with a sensitivity of 70% and specificity of 60%. Residual vestibular function captured by single vestibular tests (vHIT, calorics, rotatory chair, cVEMP) or by overall vestibular function defined as the number of impaired vestibular sensors are not suitable to distinguish fallers and non-fallers in a BV population.

PMID: 32150553

PMCID: PMC7062241

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7062241/>

June Topic: Meniere's Disease

June 5, 2020



**Vestibular Rehabilitation SIG
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for the year 2020**

Ward B, Wettstein V, Golding J, et al. **Patient Perceptions of Effectiveness in Treatments for Menière's Disease: a National Survey in Italy.** J Int Adv Otol. 2019;15(1):112-117. doi:10.5152/iao.2019.5758

Objectives: The aim of the present study was to investigate current treatment practices and self-reported effectiveness in Ménière's disease.

Materials and methods: Members of two Italian Ménière's disease support (n=170) with ≥6-month history of Ménière's disease were administered an online survey about recent treatments. Vertigo episode count, work absenteeism, and limitations in family life, social life, work, or travel as included in the Social Life and Work Impact of Dizziness Questionnaire before and after recent treatments were queried.

Results: Twenty-four different treatments were reported for Ménière's disease, with dietary modifications (55%), diuretics (47%), and betahistine (41%) being the most common. The majority (71%) received multiple simultaneous treatments. Prior to the most recent treatments, 78%-89% of respondents indicated limitations in family or social life, work, or traveling. After their most recent treatment, respondents reported improvements in mean vertigo episode counts (5.7±7.6 vs. 2.6±4.6, p<0.001), days off work per month (10.1±9.2 vs. 4.2±6.7, p<0.001), and proportions indicating limitations in any functional measure assessed (p<0.05). These findings were consistent regardless of treatment approach (p<0.05 for all). Intratympanic gentamicin provided the greatest reductions in vertigo count, functional limitations, and work absenteeism (p<0.01 for all), as well as the fewest respondents reporting post-treatment functional limitations (16%-37%).

Conclusion: Despite many treatment approaches targeting different proposed pathophysiology for Ménière's disease in this cross-sectional survey, all treatments are reported as effective by patients. These findings support a prominent placebo effect in Ménière's disease and highlight challenges in studying treatment outcomes; there is a critical need to better understand Ménière's disease.

PMID: 28538472

PMCID: PMC6483453

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6483453/>

June 10, 2020

Liu YF, Renk E, Rauch SD, Xu HX. **Efficacy of Intratympanic Gentamicin in Menière's Disease With and Without Migraine.** Otol Neurotol. 2017;38(7):1005-1009. doi:10.1097/MAO.0000000000001460

Objective: To compare the efficacy of intratympanic gentamicin injection (ITG) on vertigo control, drop attacks, and functional level in Menière's disease patients with and without a history of migraine.

Patients: Menière's disease patients (patients with migraine and age- and sex-matched control patients without migraine) treated from 2002 to 2012 who failed medical management and received ITG, with a minimum 2-year follow up.

Intervention: ITG.

Main outcome measures: Vertigo control, drop attack prevalence, and change in functional level.



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Results: Twenty-eight Menière's disease patients were included in this study (14 with migraine and 14 matched patients without migraine). There were three men and 11 women in each group, with a mean age of 53 ± 8.9 years. Baseline characteristics (Menière's stage, vertigo frequency, drop attack prevalence, and functional level) before ITG were not significantly different between the two groups. Two years after ITG, 71% of Menière's disease with migraine patients and 78% of Menière's disease without migraine patients had class A, B, or C vertigo control ($p > 0.999$). Change in prevalence of drop attacks (43-7% versus 50-0%, respectively) was also similar ($p > 0.999$). However, significantly fewer vertigo control class A, B, and C migraine patients achieved functional level 1 or 2 (40%) compared with non-migraine patients (91%) ($p = 0.007$).

Conclusions: Although ITG appears equally effective in treating vertigo and drop attacks in Menière's disease with and without migraine, patients with migraine derive significantly less benefit in terms of functional improvement.

PMID: 28538472

June 17, 2020

Ghavami Y, Haidar YM, Moshtaghi O, Lin HW, Djalilian HR. **Evaluating Quality of Life in Patients With Meniere's Disease Treated as Migraine.** *Ann Otol Rhinol Laryngol.* 2018;127(12):877-887.

Objective: To evaluate the change in quality of life (QOL) of patients with Meniere's disease (MD) after treatment with migraine prophylaxis therapy.

Methods: Patients with definite MD were given the Meniere's Disease Outcomes Questionnaire-Retrospective (MDOQ-R) after migraine prophylactic therapy to assess QOL. Changes in physical, emotional, and social parameters affected by MD were calculated, along with a global pre- and posttreatment QOL scores.

Results: The MDOQ-R was given to 27 consecutive patients with definite MD. Patients who had at least an 18-month follow-up were included, resulting in 25 questionnaires. The mean change in QOL score was 25 ± 16 (range, -3 to 55), $P = .02$. Quality of life was improved in 23 (92%) of the respondents in every metric measured, unchanged in 1 (4%), and poorer in 1 (4%) of patients after migraine prophylaxis treatment.

Conclusions: Majority of MD patients who had all failed diuretic therapy responded positively to medications used for migraine prophylaxis, as indicated by a significant improvement in QOL. This study may further suggest a correlation between the pathophysiologic basis of disease in MD and vestibular migraine. Patients with MD may be successfully managed with medications intended to treat migraine.

PMID: 30198300

Link to Free Article:

<https://escholarship.org/uc/item/1hx0n33d>

June 25, 2020



**Vestibular Rehabilitation SIG
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Sarna B, Abouzari M, Lin HW, Djalilian HR. **A hypothetical proposal for association between migraine and Meniere's disease.** Med Hypotheses. 2020;134:109430.

Meniere's disease (MD) is a chronic condition affecting the inner ear whose precise etiology is currently unknown. We propose the hypothesis that MD is a migraine-related phenomenon which may have implications for future treatment options for both diseases. The association between MD and migraine is both an epidemiological and a mechanistic one, with up to 51% of individuals with MD experiencing migraine compared to 12% in the general population. The presence of endolymphatic hydrops in those with MD may be the factor that unites the two conditions, as hydropic inner ears have an impaired ability to maintain homeostasis. Migraine headaches are theorized to cause aura and symptoms via spreading cortical depression that ultimately results in substance P release, alterations in blood flow, and neurogenic inflammation. Chronically hydropic inner ears are less able to auto-regulate against the changes induced by active migraine attacks and may ultimately manifest as MD. This same vulnerability to derangements in homeostasis may also explain the common triggering factors of both MD attacks and migraine headaches, including stress, weather, and diet. Similarly, it may explain the efficacy of common treatments for both diseases: current migraine treatments such as anti-hypertensives and anti-convulsants have shown promise in managing MD. Though the etiology of both MD and migraine is likely multifactorial, further exploration of the association between the two conditions may illuminate how to best manage them in the future. MD is likely a manifestation of cochleovestibular migraine, which occurs as a result of migraine related changes in both the cochlea and vestibule.

PMID: 31629154

July Topic: Suppression Head Impulse Paradigm (SHIMP)

July 8, 2020

Manzari L, Tramontano M. **Suppression Head Impulse Paradigm (SHIMP) in evaluating the vestibulo-saccadic interaction in patients with vestibular neuritis.** Eur Arch Otorhinolaryngol. 2020;10.1007/s00405-020-06085-6.

Purpose: Evaluate the potential clinical application of the Suppression Head Impulse Paradigm (SHIMP) in evaluating the vestibulo-saccadic interaction in patients with vestibular neuritis (VN).

Methods: A retrospective study was performed. Fifteen patients diagnosed with unilateral VN were identified from a database of ENT vestibular clinic from January 2011 to February 2020. Medical records were reviewed to determine clinical presentation, vestibular testing results, treatment, and recovery.

Results: Fifteen patients (7 left ear, 8 right ear, mean age 58.73 ± 10.73 , six female) met the inclusion criteria and were enrolled in the study. Significant differences were found in the within-subjects analysis at T1 in DHI score ($p = 0.001$), VOR gain ($p < 0.005$), and in the percentages of impulses containing a SHIMPs saccade when the head is passively turned toward the affected side ($p = 0.001$).



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Conclusions: SHIMPs paradigm provides useful information about the value of vestibulo-saccadic interaction as new recovery strategies in patients with VN.

PMID: 32472160

July 15, 2020

Devantier L, Hoskison E, Ovesen T, Henriksen JM. **Suppression head impulse paradigm in healthy adolescents - A novel variant of the head impulse test.** J Vestib Res. 2018;28(3-4):311-317.

Background: Suppression Head Impulse Paradigm (SHIMP), a novel variant of the Head Impulse Test has been introduced. At the same time, the Head Impulse Test was renamed to the Head Impulse Paradigm (HIMP). Contrary to HIMP saccades, SHIMP saccades are a sign of vestibular function.

Objective: 1) To compare SHIMP and HIMP feasibility, vestibular-ocular reflex (VOR) gain value and the saccadic pattern in healthy adolescents. 2) To compare SHIMP and HIMP feasibility in the hands of an experienced and an inexperienced HIMP examiner.

Method: A total of 29 adolescents from Skåde Municipal School, Denmark were tested with HIMP and then with SHIMP.

Results: Neither covert nor overt saccades were observed in the HIMP, whereas SHIMP saccades were observed in all SHIMP reports. SHIMP gain values were statistically lower than HIMP gain values. A statistically significant difference was observed between the two examiners' right SHIMP gain values, but not for the left SHIMP gain values or the HIMP gain values.

Conclusions: We found that HIMP and SHIMP tests are feasible in healthy adolescents for experienced as well as inexperienced examiners. However, one must be aware of potential pitfalls in the execution and interpretation of both tests. This is a well-known fact for the HIMP test, but additional considerations are needed to obtain reliable results from the SHIMP test.

PMID: 30373968

July 22, 2020

Chen FY, Zhang YZ, Wu CQ, et al. **[The application value of suppression head impulse paradigm in vestibular neuritis].** 2018;32(18):1374-1377. doi:10.13201/j.issn.1001-1781.2018.18.003

Objective: To study the parameters of the suppression head impulse paradigm of vestibular neuritis and explore the application value of suppression head impulse paradigm in vestibular neuritis.

Method: Twenty patients with vestibular neuritis in our outpatient clinic were selected. The HIMP and SHIMP gain of unilateral vestibular neuritis patients were detected by video pulse detector.

Result: All patients with HIMP examination in the affected side can elicit compensatory saccade, the healthy side with no compensatory saccade; SHIMP examination in the healthy side can elicit anti-compensatory saccade, the affected side without compensatory saccade or weak saccades. The HIMP gain of affected side and healthy side of patients with vestibular neuritis were 0.56 ± 0.15 and 0.99 ± 0.13



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respectively, and the SHIMP gain of affected side and healthy side of patients with vestibular neuritis were 0.45 ± 0.13 and 0.9 ± 0.13 respectively. The gain of the affected side and the healthy side of HIMP was larger than those of SHIMP, and the difference was statistically significant ($P < 0.05$). The differences of HIMP and SHIMP gain between the affected side and the healthy side were statistically significant ($P < 0.01$).

Conclusion: Video head impulse test combined with suppression head impulse paradigm can evaluate vestibular function injury and residual retention in vestibular neuritis, and can also dynamically monitor vestibular compensation in patients.

PMID: 30550165

July 29, 2020

Park JS, Lee JY, Nam W, Noh S, Chang SO, Kim MB. **Comparing the Suppression Head Impulse Paradigm and the Head Impulse Paradigm in Vestibular Neuritis.** *Otol Neurotol.* 2020;41(1):e76-e82.

Objective: To compare the results of suppression head impulse paradigm (SHIMP) and head impulse paradigm (HIMP) in acute vestibular neuritis (AVN).

Study design: Retrospective study.

Setting: Tertiary otology clinic.

Patients and interventions: We tested 21 patients with AVN with the HIMP, SHIMP, and caloric tests, and we analyzed the relationships between the tests' results.

Main outcome measures: For this study, we adopted vestibulo-ocular reflex (VOR) gains in the SHIMP and HIMP, peak saccade velocity (PSV) of SHIMP which is another indicator of residual vestibular function, and canal paresis of caloric test.

Results: VOR gains showed significant correlation ($R = 0.926$, $p < 0.001$) between the SHIMP and HIMP, but VOR gains were slightly lower in the SHIMP than in the HIMP (mean difference 0.07 ± 0.09 , $p < 0.001$). The difference between the HIMP and SHIMP gains was slightly larger on the affected side (0.10 ± 0.09) than on the healthy side (0.03 ± 0.09). The PSV of SHIMP had significant correlation with HIMP gain and canal paresis. Sixteen of 21 patients showed 100% ipsilesional caloric canal paresis, and eight (50%) of them showed no anti-compensatory saccade (direction toward head rotation) in the SHIMP. However, they showed not extremely low VOR gain but variable VOR gain.

Conclusion: The new parameters of SHIMP might be used as complement for evaluating vestibular function in AVN. However, the clinical impact of the saccades of SHIMP in AVN has not been revealed clearly yet. This question should be investigated in further studies

PMID: 31789804

August Topic: Postural Threat Influences in Vestibular Function

August 7, 2020



**Vestibular Rehabilitation SIG
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Naranjo EN, Cleworth TW, Allum JHJ, Inglis JT, Lea J, Westerberg BD, Carpenter MG. **Vestibulo-spinal and vestibulo-ocular reflexes are modulated when standing with increased postural threat.** J Neurophysiol. 2016 Feb 1;115(2):833-42. doi: 10.1152/jn.00626.2015. Epub 2015 Dec 2.

We investigated how vestibulo-spinal reflexes (VSRs) and vestibulo-ocular reflexes (VORs) measured through vestibular evoked myogenic potentials (VEMPs) and video head impulse test (vHIT) outcomes, respectively, are modulated during standing under conditions of increased postural threat. Twenty-five healthy young adults stood quietly at low (0.8 m from the ground) and high (3.2 m) surface height conditions in two experiments. For the first experiment (n = 25) VEMPs were recorded with surface EMG from inferior oblique (IO), sternocleidomastoid (SCM), trapezius (TRP), and soleus (SOL) muscles in response to 256 air-conducted short tone bursts (125 dB SPL, 500 Hz, 4 ms) delivered via headphones. A subset of subjects (n = 19) also received horizontal and vertical head thrusts (~150°/s) at each height in a separate session, comparing eye and head velocities by using a vHIT system for calculating the functional VOR gains. VEMP amplitudes (IO, TRP, SOL) and horizontal and vertical vHIT gains all increased with high surface height conditions (P < 0.05). Changes in IO and SCM VEMP amplitudes as well as horizontal vHIT gains were correlated with changes in electrodermal activity ($\rho = 0.44-0.59$, P < 0.05). VEMP amplitude for the IO also positively correlated with fear ($\rho = 0.43$, P = 0.03). Threat-induced anxiety, fear, and arousal have significant effects on VSR and VOR gains that can be observed in both physiological and functional outcome measures. These findings provide support for a potential central modulation of the vestibular nucleus complex through excitatory inputs from neural centers involved in processing fear, anxiety, arousal, and vigilance.

PMID: 26631147

Link to free text:

https://journals.physiology.org/doi/full/10.1152/jn.00626.2015?rfr_dat=cr_pub++0pubmed&url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org

August 12, 2020

Lim SB, Cleworth TW, Horslen BC, Blouin JS, Inglis JT, Carpenter MG. **Postural threat influences vestibular-evoked muscular responses.** J Neurophysiol. 2017 Feb 1;117(2):604-611. doi: 10.1152/jn.00712.2016. Epub 2016 Nov 9.

Standing balance is significantly influenced by postural threat. While this effect has been well established, the underlying mechanisms of the effect are less understood. The involvement of the vestibular system is under current debate, and recent studies that investigated the effects of height-induced postural threat on vestibular-evoked responses provide conflicting results based on kinetic (Horslen BC, Dakin CJ, Inglis JT, Blouin JS, Carpenter MG. J Physiol 592: 3671-3685, 2014) and kinematic (Osler CJ, Tersteeg MC, Reynolds RF, Loram ID. Eur J Neurosci 38: 3239-3247, 2013) data. We examined the effect of threat of perturbation, a different form of postural threat, on coupling (cross-correlation,



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coherence, and gain) of the vestibulo-muscular relationship in 25 participants who maintained standing balance. In the "No-Threat" conditions, participants stood quietly on a stable surface. In the "Threat" condition, participants' balance was threatened with unpredictable mediolateral support surface tilts. Quiet standing immediately before the surface tilts was compared to an equivalent time from the No-Threat conditions. Surface EMG was recorded from bilateral trunk, hip, and leg muscles. Hip and leg muscles exhibited significant increases in peak cross-correlation amplitudes, coherence, and gain (1.23-2.66 \times) in the Threat condition compared with No-Threat conditions, and significant correlations were observed between threat-related changes in physiological arousal and medium-latency peak cross-correlation amplitude in medial gastrocnemius ($r = 0.408$) muscles. These findings show a clear threat effect on vestibular-evoked responses in muscles in the lower body, with less robust effects of threat on trunk muscles. Combined with previous work, the present results can provide insight into observed changes during balance control in threatening situations.

New & noteworthy: This is the first study to show increases in vestibular-evoked responses of the lower body muscles under conditions of increased threat of postural perturbation. While robust findings were observed in hip and leg muscles, less consistent results were found in muscles of the trunk. The present findings provide further support in the ongoing debate for arguments that vestibular-evoked balance responses are influenced by fear and anxiety and explain previous threat-related changes in balance

PMID: 26631147

Link to free text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5288487/>

August 19, 2020

Zaback M, Adkin AL, Carpenter MG. **Adaptation of emotional state and standing balance parameters following repeated exposure to height-induced postural threat.** Sci Rep. 2019 Aug 28;9(1):12449. doi: 10.1038/s41598-019-48722-z.

Height-induced postural threat influences standing balance control. However, it is unknown if minimizing individuals' emotional response to threat moderates this relationship. This study repeatedly exposed individuals to height-induced postural threat to determine if reducing the emotional response to threat influences standing balance control. Sixty-eight young adults completed a series of standing trials at LOW (0.8 m above ground, away from edge) and HIGH (3.2 m above ground, at edge) postural threat conditions. Emotional state was assessed using self-report and electrodermal measures. Standing balance was assessed through analysis of centre of pressure (COP) movement and lower leg electromyographic activity. Individuals' emotional response to threat was attenuated following repeated threat exposure. However, threat-induced changes in standing balance were largely preserved. When initially threatened, individuals leaned backward and demonstrated smaller amplitude and higher frequency of COP adjustments; these balance outcomes did not change following repeated threat exposure. Only high frequency COP oscillations (>1.8 Hz) and ankle muscle co-contraction showed any adaptation; regression analyses showed that these behavioural adaptations were accounted for by a combination of emotional and cognitive state changes. This suggests that some threat-induced standing



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balance changes are more closely linked with the emotional response to threat than others, and are therefore amendable to intervention.

PMID: 31462652

Link to free text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6713771/>

August 26, 2020

Cleworth TW, Allum JHJ, Luu MJ, Lea J, Westerberg BW, Carpenter MG. **The Effect of Unilateral Vestibular Loss on Standing Balance During Postural Threat.** *Otol Neurotol.* 2020 Aug;41(7):e945-e951. doi: 10.1097/MAO.0000000000002485.

Objective: Vestibular deficit patients have an increased fall risk and fear of falling. Postural threat, known to increase balance-related fear and anxiety, influences vestibular gains during quiet standing in young healthy adults. The current study examined whether there is a similar relationship for peripheral unilateral vestibular loss (UVL) patients in comparison to age-matched healthy controls (HC).

Setting: University laboratory.

Study design: Prospective laboratory study.

Patients and controls: Eleven UVL patients, nine with vestibular neurectomy. Eleven aged-matched HCs.

Main outcome measures: Subjects stood on a hydraulic lift placed at two heights: low (0.8 m, away from the edge) and high (3.2 m, at the edge). Amplitude (root mean square), mean power frequency (MPF), and mean position were analyzed for center of foot pressure (COP) and 90% ranges for angle amplitude and velocity for trunk sway.

Results: Group interactions were strongest for anterior-posterior (AP) COP and trunk pitch angle. AP lean away from the edge was greater in HCs than UVLs. HCs, but not UVLs had a decrease in root mean square AP COP with height. Trunk pitch sway was changed similarly. Both groups had increased trunk pitch velocity at height. Changes with height were less for roll: MPF of lateral COP increased with height for UVLs with no changes for HCs, and trunk roll amplitude decreased for both groups.

Conclusions: This report provides evidence for a differential effect of height induced postural threat on balance control between UVLs and HCs presumably due to the reduced vestibular-spinal gain in UVL subjects.

PMID: 32658112

September Topic: COVID-19 Neurologic Implications

September 3, 2020

Di Carlo DT, Montemurro N, Petrella G, Siciliano G, Ceravolo R, Perrini P. **Exploring the clinical association between neurological symptoms and COVID-19 pandemic outbreak: a systematic review**



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of current literature [published online ahead of print, 2020 Aug 1]. J Neurol. 2020;1-9.
doi:10.1007/s00415-020-09978-y

Object: The novel severe acute respiratory syndrome (SARS)-CoV-2 outbreak has been declared a pandemic in March, 2020. An increasing body of evidence suggests that patients with the coronavirus disease (COVID-19) might have a heterogeneous spectrum of neurological symptoms

Methods: A systematic search of two databases was performed for studies published up to May 29th, 2020. PRISMA guidelines were followed.

Results: We included 19 studies evaluating 12,157 patients with laboratory-confirmed COVID-19 infections. The median age of patients was 50.3 (IQR 11.9), and the rate of male patients was 50.6% (95% CI 49.2-51.6%). The most common reported comorbidities were hypertension and diabetes (31.1%, 95% CI 30-32.3% and 13.5%, 95% CI 12.3-14.8%, respectively). Headache was reported in 7.5% of patients (95% CI 6.6-8.4%), and dizziness in 6.1% (95% CI 5.1-7.1%). Hypo/anosmia, and gustatory dysfunction were reported in 46.8 and 52.3%, of patients, respectively. Symptoms related to muscular injury ranged between 15 and 30%. Three studies reported radiological confirmed acute cerebrovascular disease in 2% of patients (95% CI 1.6-2.4%).

Conclusions: These data support accumulating evidence that a significant proportion of patients with COVID-19 infection develop neurological manifestations, especially olfactory, and gustatory dysfunction. The pathophysiology of this association is under investigation and warrants additional studies, Physicians should be aware of this possible association because during the epidemic period of COVID-19, early recognition of neurologic manifestations otherwise not explained would raise the suspect of acute respiratory syndrome coronavirus 2 infection.

PMID: 32740766

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7395578/>

September 9, 2020

Abdullahi A, Candan SA, Abba MA, et al. **Neurological and Musculoskeletal Features of COVID-19: A Systematic Review and Meta-Analysis.** Front Neurol. 2020;11:687. Published 2020 Jun 26.
doi:10.3389/fneur.2020.00687

Importance: Some of the symptoms of COVID-19 are fever, cough, and breathing difficulty. However, the mechanism of the disease, including some of the symptoms such as the neurological and musculoskeletal symptoms, is still poorly understood.

Objective: The aim of this review is to summarize the evidence on the neurological and musculoskeletal symptoms of the disease. This may help with early diagnosis, prevention of disease spread, and treatment planning.

Data Sources: MEDLINE, EMBASE, Web of Science, and Google Scholar (first 100 hits) were searched until April 17, 2020. The key search terms used were "coronavirus" and "signs and symptoms." Only studies written in English were included.



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Study Selection: The selection was performed by two independent reviewers using EndNote and Rayyan software. Any disagreement was resolved by consensus or by a third reviewer.

Data Extraction and Synthesis: PRISMA guidelines were followed for abstracting data and assessing the quality of the studies. These were carried out by two and three independent reviewers, respectively. Any disagreement was resolved by consensus or by a third reviewer. The data were analyzed using qualitative synthesis and pooled using a random-effect model. **Main Outcome(s) and Measure(s):** The outcomes in the study include country, study design, participant details (sex, age, sample size), and neurological and musculoskeletal features.

Result: Sixty studies (n = 11, 069) were included in the review, and 51 studies were used in the meta-analysis. The median or mean age ranged from 24 to 95 years. The prevalence of neurological and musculoskeletal manifestations was 35% for smell impairment (95% CI 0-94%; I 2 99.63%), 33% for taste impairment (95% CI 0-91%; I 2 99.58%), 19% for myalgia (95% CI 16-23; I 2 95%), 12% for headache (95% CI 9-15; I 2 93.12%), 10% for back pain (95% CI 1-23%; I 2 80.20%), 10% for dizziness (95% CI 3-19%; I 2 86.74%), 3% for acute cerebrovascular disease (95% CI 1-5%; I 2 0%), and 2% for impaired consciousness (95% CI 1-2%; I 2 0%).

Conclusion and Relevance: Patients with COVID-19 present with neurological and musculoskeletal symptoms. Therefore, clinicians need to be vigilant in the diagnosis and treatment of these patients
PMID: 32676052

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7333777/>

September 17, 2020

Krajewska J, Krajewski W, Zub K, Zatoński T. **COVID-19 in otolaryngologist practice: a review of current knowledge.** Eur Arch Otorhinolaryngol. 2020;277(7):1885-1897. doi:10.1007/s00405-020-05968-y

Purpose: Otorhinolaryngological manifestations are common symptoms of COVID-19. This study provides a brief and precise review of the current knowledge regarding COVID-19, including disease transmission, clinical characteristics, diagnosis, and potential treatment. The article focused on COVID-19-related information useful in otolaryngologist practice.

Methods: The Medline and Web of Science databases were searched without a time limit using terms “COVID-19”, “SARS-CoV-2” in conjunction with “otorhinolaryngological manifestation”, “ENT”, and “olfaction”.

Results: The most common otolaryngological dysfunctions of COVID-19 were cough, sore throat, and dyspnea. Rhinorrhea, nasal congestion and dizziness were also present. COVID-19 could manifest as an isolated sudden hyposmia/anosmia. Upper respiratory tract (URT) symptoms were commonly observed in younger patients and usually appeared initially. They could be present even before the molecular confirmation of SARS-CoV-2. Otolaryngologists are of great risk of becoming infected with SARS-CoV-2 as they cope with URT. ENT surgeons could be easily infected by SARS-CoV-2 during performing surgery in COVID-19 patients.



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Conclusion: Ear, nose and throat (ENT) symptoms may precede the development of severe COVID-19. During COVID-19 pandemic, patients with cough, sore throat, dyspnea, hyposmia/anosmia and a history of travel to the region with confirmed COVID-19 patients, should be considered as potential COVID-19 cases. An otolaryngologist should wear FFP3/N95 mask, glasses, disposable and fluid resistant gloves and gown while examining such individuals. Not urgent ENT surgeries should be postponed. Additional studies analyzing why some patients develop ENT symptoms during COVID-19 and others do not are needed. Further research is needed to determine the mechanism leading to anosmia.

PMID: 32306118

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7166003/>

September 23, 2020

Gklinos P. **Neurological manifestations of COVID-19: a review of what we know so far.** J Neurol. 2020;267(9):2485-2489. doi:10.1007/s00415-020-09939-5

Coronavirus disease 2019 (COVID-19) has become a pandemic disease globally. While it mostly presents with respiratory symptoms, it has already been found that it could manifest with a series of neurological symptoms as well, either at presentation or during the course of the disease. Symptoms vary from non-specific such as headache or dizziness to more specific such as convulsions and cerebrovascular disease (CVD). This study aims to give an overview of the neurological manifestations of COVID-19 and discuss the potential pathogenetic mechanisms of central nervous system (CNS) involvement. Clinicians and especially internists, neurologists, and infectious disease specialists should be aware of these symptoms and able to recognize them early. Prompt diagnosis and immediate management of the neurological manifestations of the novel coronavirus will not only improve the prognosis of COVID-19 patients but will also prevent the dissemination of the disease due to misdiagnosed cases.

PMID: 32458197

Link to Free Article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7250266/>

September 30, 2020

Tenforde AS, Borgstrom H, Polich G, et al. **Outpatient Physical, Occupational, and Speech Therapy Synchronous Telemedicine: A Survey Study of Patient Satisfaction with Virtual Visits During the COVID-19 Pandemic** [published online ahead of print, 2020 Aug 14]. Am J Phys Med Rehabil. 2020;10.1097/PHM.0000000000001571. doi:10.1097/PHM.0000000000001571

The COVID-19 pandemic transformed healthcare delivery, including rapid expansion of telehealth. Telerehabilitation, defined as therapy provided by physical therapy, occupational therapy and speech and language pathology, was rapidly adopted with goals to provide access to care and limit contagion. The purpose of this brief report was to describe feasibility of and satisfaction with telerehabilitation. Two-hundred five participants completed online surveys following a telerehabilitation visit. Most



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commonly, participants were women (53.7%), 35-64 years old, and completed PT (53.7%) for established visits of 30-44 minutes in duration for primary impairments in sports, lower limb injuries, and pediatric neurology. Overall high ratings ("excellent" or "very good" responses) were observed for all patient-centered outcome metrics (ranging 93.7-99%) and value in future telehealth visit (86.8%) across telerehabilitation visits. Women participated more frequently and provided higher ratings than men participants. Other benefits included eliminating travel time, incorporating other healthcare advocates, and convenience delivering care in familiar environment to pediatric patients. Technology and elements of hands-on aspects of care were observed limitations. Recognizing reduced indirect costs of care that telerehabilitation may provide along with high patient satisfaction are reasons policy makers should adopt these services into future healthcare delivery models.

PMID: 32804713

October Topic: Gait

October 14, 2020

Dietrich H, Wuehr M. **Strategies for Gaze Stabilization Critically Depend on Locomotor Speed.** Neuroscience. 2019 Jun 1;408:418-429. doi: 10.1016/j.neuroscience.2019.01.025. Epub 2019 Jan 29.

Locomotion involves complex combinations of translational and rotational head movements. For gaze stability, this necessitates the interplay of angular and linear vestibulo-ocular reflexes (VOR) as well as the integration of visual feedback about the desired viewing distance. Furthermore, gaze stabilizing systems must be able to cope with vast differences in head motion brought about by changing locomotor speeds and patterns (walking vs. running). The present study investigated horizontal and vertical angular VOR (aVOR) and linear gaze stabilization (IGS) as well as compensation for linear head movements by angular counter rotation of the head during treadmill walking and running at different velocities (0.4 to 2.4 m/s) while fixating either a close (0.5 m) or distant (2.0 m) target. In the horizontal plane, the aVOR predominated throughout all locomotor speeds, whereas the compensation of linear translations was highly variable and generally insufficient. In contrast, in the vertical plane, eye and angular head motion steadily became more in phase with increasing locomotor speed, which served to optimize linear motion compensation. Furthermore, the timing of the vertical aVOR became more automated and independent of visual feedback during faster locomotion. Thus, horizontal and vertical gaze stabilization strategies appear to be considerably different. Whereas horizontal gaze control is likely governed by passive sensorimotor reflexes throughout all locomotor speeds, vertical gaze stabilization switches to an automated feed-forward control at faster locomotion. This switch is presumably driven by efference copies from spinal locomotor commands that were previously shown to govern gaze stabilization in animal models during stereotypic locomotion.

PMID: 30703510



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October 21, 2020

Dietrich H, Wuehr M. **Selective suppression of the vestibulo-ocular reflex during human locomotion.** J Neurol. 2019 Sep;266(Suppl 1):101-107. doi: 10.1007/s00415-019-09352-7. Epub 2019 May 9

Introduction: In lower vertebrates, gaze stabilization during locomotion is at least partially driven by a direct coupling of spinal locomotor commands with extraocular motor signals. To what extent locomotor feed-forward mechanisms contribute to gaze stabilization during human locomotion is yet unknown. In principle, the feasibility of a feed-forward regulation of gaze during locomotion should critically depend on the spatiotemporal coupling between body and head kinematics and hence the internal predictability of head movements (HMP). The present study thus investigated whether changes in eye-head coordination during human locomotion can be explained by concurrent changes in HMP. **Methods:** Eye and head movements were recorded at different locomotor speeds in light and darkness to obtain the gain and phase of the horizontal and vertical angular VOR (aVOR). Potential correlations between aVOR performance and HMP were analyzed in dependence of locomotor speed and gait cycle phase.

Results: Horizontal aVOR responses persisted independent of locomotor speed. In contrast, with increasing locomotor speed vertical eye-head coordination switched from a VOR-driven compensatory mode to a synergistic behavior where head and eyes move in phase. Concurrently, vertical HMP increased with faster locomotion. Furthermore, modulations in vertical aVOR gain across the gait cycle corresponded to simultaneous alterations in vertical HMP.

Conclusion: The vertical aVOR appears to be suppressed during faster walking and running, whereas at the same time, the predictability of resultant head movements increases. This suggests that during stereotyped human locomotion, internal feed-forward commands supplement or even suppress sensory feedback to mediate gaze stabilization in the vertical plane.

PMID: 31073715

October 28, 2020

Chen PY, Chou LW, Jheng YC, et al. **Development of a Computerized Device for Evaluating Vestibular Function in Locomotion: A New Evaluation Tool of Vestibular Hypofunction.** Front Neurol. 2020;11:485. Published 2020 Jun 12. doi:10.3389/fneur.2020.00485

To evaluate vestibular function in the clinic, current assessments are applied under static conditions, such as with the subject in a sitting or supine position. Considering the complexities of daily activities, the combination of dynamic activities, dynamic visual acuity (DVA) and postural control could produce an evaluation that better reflects vestibular function in daily activities.

Objective: To develop a novel sensor-based system to investigate DVA, walking trajectory, head and trunk movements and the chest-pelvis rotation ratio during forward and backward overground walking in both healthy individuals and patients with vestibular hypofunction.



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Methods: Fifteen healthy subjects and 7 patients with bilateral vestibular hypofunction (BVH) were recruited for this study. Inertial measurement units were placed on each subject's head and torso. Each subject walked forward and backward for 5 m twice with 2 Hz head yaw. Our experiment comprised 2 stages. In stage 1, we measured forward (FW), backward (BW), and medial-lateral (MLW) walking trajectories; head and trunk movements; and the chest-pelvis rotation ratio. In stage 2, we measured standing and locomotion DVA (IoDVA). Using Mann–Whitney U-test, we compared the abovementioned parameters between the 2 groups.

Results: Patients exhibited an in-phase chest/pelvis reciprocal rotation ratio only in FW. The walking trajectory deviation, calculated by normalizing the summation of medial-lateral swaying with 1/2 body height (%), was significantly larger (FW mean \pm standard deviation: $20.4 \pm 7.1\%$ (median (M)/interquartile range (IQR): 19.3/14.4–25.2) in healthy vs. $43.9 \pm 27.3\%$ (M/IQR: 36.9/21.3–56.9) in patients, $p = 0.020$)/(BW mean \pm standard deviation: $19.2 \pm 11.5\%$ (M/IQR: 13.6/10.4–25.3) in healthy vs. $29.3 \pm 6.4\%$ (M/IQR: 27.7/26.5–34.4) in patients, $p = 0.026$), and the walking DVA was also significantly higher (LogMAR score in the patient group [FW LogMAR: rightDVA: mean \pm standard deviation: 0.127 ± 0.081 (M/IQR: 0.127/0.036–0.159) in healthy vs. 0.243 ± 0.101 (M/IQR: 0.247/0.143–0.337) in patients ($p = 0.013$) and leftDVA: 0.136 ± 0.096 (M/IQR: 0.127/0.036–0.176) in healthy vs. 0.258 ± 0.092 (M/IQR: 0.247/0.176–0.301) in patients ($p = 0.016$); BW LogMAR: rightDVA: mean \pm standard deviation: 0.162 ± 0.097 (M/IQR: 0.159/0.097–0.273) in healthy vs. 0.281 ± 0.130 (M/IQR: 0.273/0.176–0.418) in patients ($p = 0.047$) and leftDVA: 0.156 ± 0.101 (M/IQR: 0.159/0.097–0.198) in healthy vs. 0.298 ± 0.153 (M/IQR: 0.273/0.159–0.484) in patients ($p = 0.038$)]).

Conclusions: Our sensor-based vestibular evaluation system provided a more functionally relevant assessment for the identification of BVH patients.

PMID: 32595589

Link to free article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7303327/>

November Topic: Current Concepts in Concussion

November 5, 2020

Howell DR, Bonnette S, Diekfuss JA, Grooms DR, Myer GD, Meehan WP 3rd. **Youth With Concussion Have Less Adaptable Gait Patterns Than Their Uninjured Peers: Implications for Concussion Management.** J Orthop Sports Phys Ther. 2020 Aug;50(8):438-446. doi: 10.2519/jospt.2020.9133. Epub 2020 May 22. 32441192.

Objective: To compare cross-recurrence quantification analysis measurements obtained during gait between adolescents who sustained a diagnosed concussion within 14 days of assessment and healthy adolescents.

Design: Cross-sectional study.



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Methods: Youth athletes with concussion ($n = 43$; mean \pm SD age, 14.4 ± 2.3 years; 56% female; tested median, 7 days post concussion) and healthy controls ($n = 38$; age, 14.9 ± 2.0 years; 55% female) completed a single-task and dual-task gait protocol while wearing a set of inertial sensors. We used cross-recurrence quantification analysis techniques to quantify the similarity between accelerations obtained from the sensor on the dorsum of each foot. Four outcome variables were compared between groups: percent determinism, average diagonal-line length, laminarity, and trapping time.

Results: Athletes with concussion had significantly higher percent determinism, laminarity, and trapping time than the control group in single-task and dual-task conditions ($P < .05$). Gait patterns, when simultaneously completing a secondary cognitive task (dual task), were no different from gait patterns under a single-task condition.

Conclusion: Higher percent determinism, laminarity, and trapping time among athletes with concussion suggest that concussion may be associated with a more stuck and predictable gait pattern. These altered movement patterns may be one reason for underlying slower gait speeds that have been observed following concussion.

PMID: 32441192

November 11, 2020

Bonnette S, Diekfuss JA, Grooms D, Myer GD, Meehan WP 3rd, Howell DR. **Integrated linear and nonlinear trunk dynamics identify residual concussion deficits.** *Neurosci Lett.* 2020 Jun 11;729:134975. doi: 10.1016/j.neulet.2020.134975. Epub 2020 Apr 13. PMID: 32298725.

Postural sway is significantly affected by a mild traumatic brain injury, or concussion, and myriad methods have been developed to quantify the severity of concussion symptoms. The current manuscript quantifies postural sway—as measured by an inertial sensor—in youth athletes with concussion ($n = 43$, age = 14.4 ± 2.3 years, 56% female, tested median 7 days post-concussion) and healthy controls ($n = 38$, age = 14.9 ± 2.0 years, 55% female) during single-task and dual-task postural sway. A nonlinear analysis (i.e., recurrence quantification analysis [RQA]) and several common linear measures were used to quantify postural sway. Respectively, the two complementary types of analyses describe the structure and magnitude of postural sway. We hypothesized that participants who recently experienced a concussion would display differing postural sway dynamics (i.e., different in structure and magnitude) than control participants who had not experienced a concussion. Additionally, a logistic regression was performed to determine which combination of variables (nonlinear and linear) and task (single and dual) would best differentiate concussion and control participants. Significant differences between concussion and control participants were found in percent determinism, laminarity, and standard deviation of postural sway acceleration in both the single and the dual task. In the single task alone, mean diagonal line length and trapping time were additionally significantly different between groups. Moreover, the logistic regression model revealed that a mixture of linear and nonlinear measures across both single and dual tasks best classified concussed and non-concussed participants. Additionally, history of concussion was found to be a significant covariate in the model. These results extend past observations



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by demonstrating that a combination of posture sway tasks and measurements best differentiate participants with a concussion. These results highlight the need for future studies to replicate the findings in different populations and further determine which combinations of postural sway tasks and measurements best classify participants with concussions.

PMID: 32298725

November 18, 2020

Bonnette S, Diekfuss JA, Grooms D, Myer GD, Meehan WP 3rd, Howell DR. **Integrated linear and nonlinear trunk dynamics identify residual concussion deficits.** *Neurosci Lett.* 2020 Jun 11;729:134975. doi: 10.1016/j.neulet.2020.134975. Epub 2020 Apr 13.

Postural sway is significantly affected by a mild traumatic brain injury, or concussion, and myriad methods have been developed to quantify the severity of concussion symptoms. The current manuscript quantifies postural sway-as measured by an inertial sensor-in youth athletes with concussion ($n = 43$, age = 14.4 ± 2.3 years, 56% female, tested median 7 days post-concussion) and healthy controls ($n = 38$, age = 14.9 ± 2.0 years, 55% female) during single-task and dual-task postural sway. A nonlinear analysis (i.e., recurrence quantification analysis [RQA]) and several common linear measures were used to quantify postural sway. Respectively, the two complementary types of analyses describe the structure and magnitude of postural sway. We hypothesized that participants who recently experienced a concussion would display differing postural sway dynamics (i.e., different in structure and magnitude) than control participants who had not experienced a concussion. Additionally, a logistic regression was performed to determine which combination of variables (nonlinear and linear) and task (single and dual) would best differentiate concussion and control participants. Significant differences between concussion and control participants were found in percent determinism, laminarity, and standard deviation of postural sway acceleration in both the single and the dual task. In the single task alone, mean diagonal line length and trapping time were additionally significantly different between groups. Moreover, the logistic regression model revealed that a mixture of linear and nonlinear measures across both single and dual tasks best classified concussed and non-concussed participants. Additionally, history of concussion was found to be a significant covariate in the model. These results extend past observations by demonstrating that a combination of posture sway tasks and measurements best differentiate participants with a concussion. These results highlight the need for future studies to replicate the findings in different populations and further determine which combinations of postural sway tasks and measurements best classify participants with concussions.

PMID: 32298725

November 25, 2020



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Howell DR, Wilson JC, Brilliant AN, Gardner AJ, Iverson GL, Meehan WP 3rd. **Objective clinical tests of dual-task dynamic postural control in youth athletes with concussion.** J Sci Med Sport. 2019 May;22(5):521-525. doi: 10.1016/j.jsams.2018.11.014. Epub 2018 Nov 22.

Objectives: To prospectively evaluate single/dual-task timed-up-and-go (TUG) and tandem gait performance among children and adolescents with concussion and healthy controls.

Design: Repeated measures.

Methods: Participants with concussion (n=23; age=14.1±2.5years; 52% female) completed single/dual-task TUG, tandem gait, and symptom assessments 6.7±2.6 and 23.3±6.1days post injury. The control group (n=27; age=14.1±2.3years; 48% female) completed the same protocol initially and 10.7±16.1days later. All participants completed single-task (undivided attention) and dual-task (divided attention) tests. The primary outcome variable was test completion time.

Results: The concussion group completed single-task (concussion group mean=11.1±1.9 vs. control group mean 9.9±1.4s, p=0.027) and dual-task (concussion group mean=14.4±3.3 vs. control group mean 12.7±1.9s, p=0.047) TUG tests slower than the control group across both time points. The concussion group completed dual-task tandem gait tests slower than the control group at both time points (21.3±6.3 vs. 16.8±5.5s, p=0.006), and were slower in the single-task condition at the first test (19.8±5.4 vs. 13.8±4.4s, p=0.003). Symptoms were significantly worse for the concussion group compared to the control group at the first (34.1±21.4 vs. 3.9±9.1, p<0.001), but not the second test (9.1±12.0 vs. 2.2±6.8; p=0.08).

Conclusions: Slower dual-task TUG and tandem gait times were detected across both time points for the concussion group relative to the control group. In contrast, single-task tandem gait deficits appeared to improve in a similar fashion as symptoms, suggesting increased complexity from the addition of a cognitive task allows for the detection of persistent post-concussion deficits that might take longer to resolve.

PMID: 30509865

December Topic: Cognitive behavioral therapy + Vestibular Therapy for persistent dizziness

December 3, 2020

Kuwabara, J., Kondo, M., Kabaya, K., Watanabe, W., Shiraiishi, N., Sakai, M., Toshishige, Y., Ino, K., Nakayama, M., Iwasaki, S., & Akechi, T. **Acceptance and commitment therapy combined with vestibular rehabilitation for persistent postural-perceptual dizziness: A pilot study.** American journal of otolaryngology, (2020) 41(6), 102609

Purpose: This study investigated the feasibility of acceptance and commitment therapy for persistent postural-perceptual dizziness and preliminarily verified the long-term effectiveness of the therapy.



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Materials and methods: This study implemented the within-group pre-post comparison design. We enrolled 27 adult patients who met the criteria of persistent postural-perceptual dizziness. They underwent a treatment program including acceptance and commitment therapy combined with vestibular rehabilitation once a week for a total of six sessions. The primary outcome was changes in the Dizziness Handicap Inventory score 6 months posttreatment.

Results: All 27 patients completed the acceptance and commitment therapy + vestibular rehabilitation program, and 25 patients (92.6%) could be followed for 6 months posttreatment. For 27 participants, the scores from pretreatment to 6 months posttreatment significantly declined ($P < .001$), and the Dizziness Handicap Inventory effect size was 1.11 (95% confidence interval = 0.80-1.42). At 6 months posttreatment, 11 patients (40.7%) achieved remission (the score ≤ 14), 16 (59.3%) achieved treatment response (reduction in the score ≥ 18), and 20 (74.1%) achieved remission and/or treatment response.

Conclusions: Acceptance and commitment therapy is feasible for persistent postural-perceptual dizziness and might have long-term effectiveness. However, a randomized controlled trial is warranted.
PMID: 32615473

December 9, 2020

Axer, H., Finn, S., Wassermann, A., Guntinas-Lichius, O., Klingner, C. M., & Witte, O. W. (2020). **Multimodal treatment of persistent postural-perceptual dizziness.** *Brain and behavior*, e01864. Advance online publication.

Background: Persistent postural-perceptual dizziness (PPPD) is a chronic disorder with fluctuating symptoms of dizziness, unsteadiness, or vertigo for at least three months. Its pathophysiological mechanisms give theoretical support for the use of multimodal treatment. However, there are different therapeutic programs and principles available, and their clinical effectiveness remains elusive.

Methods: A database of patients who participated in a day care multimodal treatment program was analyzed regarding the therapeutic effects on PPPD. Vertigo Severity Scale (VSS) and Hospital Anxiety and Depression Scale (HADS) were assessed before and 6 months after therapy.

Results: Of a total of 657 patients treated with a tertiary care multimodal treatment program, 46.4% met the criteria for PPPD. PPPD patients were younger than patients with somatic diagnoses and complained more distress due to dizziness. 63.6% completed the follow-up questionnaire. All patients showed significant changes in VSS and HADS anxiety, but the PPPD patients generally showed a tendency to improve more than the patients with somatic diagnoses. The change in the autonomic-anxiety subscore of VSS only reached statistical significance when comparing PPPD with somatic diagnoses ($p = .002$).

Conclusions: Therapeutic principles comprise cognitive-behavioral therapy, vestibular rehabilitation exercises, and serotonergic medication. However, large-scale, randomized, controlled trials are still missing. Follow-up observations after multimodal interdisciplinary therapy reveal an improvement in symptoms in most patients with chronic dizziness. The study was not designed to detect diagnosis-



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specific effects, but patients with PPPD and patients with other vestibular disorders benefit from multimodal therapies.

PMID: 32989916

Link to free text: <https://onlinelibrary.wiley.com/doi/10.1002/brb3.1864>

December 16, 2020

Kristiansen, L., Magnussen, L. H., Wilhelmsen, K. T., Mæland, S., Nordahl, S., Clendaniel, R., Hovland, A., & Juul-Kristensen, B. (2019). Efficacy of intergrating vestibular rehabilitation and cognitive behaviour therapy in persons with persistent dizziness in primary care- a study protocol for a randomised controlled trial. *Trials*, 20(1), 575.

Background: Dizziness is a common complaint, and the symptom often persists, together with additional complaints. A treatment combining Vestibular Rehabilitation (VR) and Cognitive Behaviour Therapy (CBT) is suggested. However, further research is necessary to evaluate the efficacy of such an intervention. The objective of this paper is to present the design of a randomised controlled trial aiming at evaluating the efficacy of an integrated treatment of VR and CBT on dizziness, physical function, psychological complaints and quality of life in persons with persistent dizziness.

Methods/design: The randomised controlled trial is an assessor-blinded, block-randomised, parallel-group design, with a 6- and 12-month follow-up. The study includes 125 participants from Bergen (Norway) and surrounding areas. Included participants present with persistent dizziness lasting for at least 3 months, triggered or exacerbated by movement. All participants receive a one-session treatment (Brief Intervention Vestibular Rehabilitation; BI-VR) with VR before being randomised into a control group or an intervention group. The intervention group will further be offered an eight-session treatment integrating VR and CBT. The primary outcomes in the study are the Dizziness Handicap Inventory and preferred gait velocity.

Discussion: Previous studies combining these treatments have been of varying methodological quality, with small samples, and long-term effects have not been maintained. In addition, only the CBT has been administered in supervised sessions, with VR offered as home exercises. The current study focusses on the integrated treatment, a sufficiently powered sample size, and a standardised treatment programme evaluated by validated outcomes using a standardised assessment protocol.

PMID: 31590692

Link to free text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6781377/>

December 23, 2020

Schmid, D. A., Allum, J., Sleptsova, M., Gross, S., Gaab, J., Welge-Lüssen, A., Schaefer, R., & Langewitz, W. (2018). **Effects of a program of cognitive-behavioural group therapy, vestibular rehabilitation, and psychoeducational explanations on patients with dizziness and no quantified balance deficit,**



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compared to patients with dizziness and a quantified balance deficit. Journal of psychosomatic research, 105, 21–30.

Background: We examined whether a program combining cognitive-behavioural therapy (CBT), vestibular rehabilitation (VR) and psychoeducation is equally effective in improving psychometric measures in patients with dizziness independent of a balance deficit. Measures of patients with dizziness only (DO) were compared to those of patients also having a quantified balance deficit (QBD). **Methods:** 32 patients (23 female, 9 male) with persistent dizziness were analysed as 2 groups based on stance and gait balance control: those with QBD (pathological balance) or DO (normal balance). Dizziness Handicap Inventory (DHI) and Brief Symptom Inventory (BSI) questionnaires were used pre- and post-therapy to assess psychometric measures. Patients then received the same combination therapy in a group setting.

Results: The QBD group mean age was 60.6, SD 8.3, and DO group mean age 44.8, SD 12.1, years. Pre-therapy, questionnaire scores were pathological but not different between groups. Balance improved significantly for the QBD group ($p=0.003$) but not for the DO group. DHI and BSI scores improved significantly in the DO group ($0.001 < p < 0.045$), some BSI sub-scores reaching normal levels. These scores were unchanged for the QBD group. Phobic anxiety scores changed most for both groups, being significantly correlated with DHI scores, higher ($R=0.71$ vs. 0.57) for the DO group.

Conclusions: A combination of CBT, VR, and psychoeducation improves psychological measures in DO patients but not significantly in QBD patients, despite their balance control improving to near normal. Possibly, greater focus on phobic anxiety during the group therapy program would have improved psychological measures of QBD patient.

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