VESTIBULAR REHABILITATION SIG

APTA & Academy of Neurologic Physical Therapy

IN THIS ISSUE:

Message from the Chair

Anne K. Galgon, PT, PhD, NCS
Vestibular Rehab SIG Chair

It has been a great privilege serving the Academy of Neurologic Physical Therapy and the Vestibular Rehabilitation Special Interest Group (VR SIG) over the past 10 years, 3 years as the vice chair and 7 years as the chair. I want to thank the VR SIG leadership for the surprise recognition at our business meeting at CSM in February. Once I got over the initial embarrassment of the moment, I was extremely honored to be recognized for contributing to the VR SIG. Over 100 people showed up to our early morning business meeting, enjoyed breakfast, heard about what the SIG is up to, and networked and won raffle items. A new VR SIG activity at CSM this year was to recognize quality vestibular poster presentations. Some of those CSM poster awardees are featured in this newsletter. Thank you Lisa Heusel-Gillig and the other judges for reviewing poster abstracts, visiting posters, and selecting the poster awardees. Serving the VR SIG has been a highlight of my career. I never would have guessed this is what I would end up doing at the start of my PT career in 1987, when I was barely aware of how the vestibular system and pathologies affected human movement, activities and experiences. I have gained much more personally in my service than I could possibly have given. I want to thank Sue Whitney, who recruited me to run for Vice Chair in 2010 and gave me the opportunity to step up into the Chair position, and to the members that voted for me to stay in this role. This opportunity has been fulfilling in so many ways. Through my involvement with the VR SIG, I have met so many therapists from all over the nation and made lifelong friends. The personal interactions with students, early career, and old-time vestibular rehab therapists and researchers have been the best part of my service. Clinicians have increased my awareness, knowledge, and motivated my research in clinical decision making in vestibular rehabilitation. This experience has propelled my career and I am a better physical therapist, educator, and researcher for it. I have been so happy to be part of a group that just gets things done.

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Message from the Chair cont.

So many changes have occurred in the practice of VR in the last 30 years. Clinicians specializing in vestibular rehabilitation are constantly expanding their scope of practice and effectiveness as new evidence and knowledge in the management of vestibular and vestibular related disorders become available. The VR SIG strives to keep our members informed and educated on new evidence that enhances practice. This issue of the newsletter highlights articles on Central Vestibular Disorders. This topic is just one example of the tremendous growth of knowledge that vestibular rehabilitation therapists should be integrating into their diagnostic and intervention skills. I want to thank the editors, Debbie Struiksma and Jasmine Edwards, for putting this together and all the authors that contributed articles.

Before my tenure, past chairs and leaders set a strong foundation for the work we have done under my charge and what the SIG will do in the future. In many of my previous messages, I have praised the accomplishments and efforts of the VR SIG leaders that have met the changing needs of our members. There are really too many to account for in this short message, but I would like to highlight a few recent ones. Our Telehealth Committee members, Sarah Gallagher, Linda D'Silva, Karen Skop, and Sara Oxborough, were on the cutting edge of this area of PT practice before the COVID-19 health crisis and have stepped up to be a resource for clinicians struggling to adapt to a new way of managing patients. A recent video on how to examine a vestibular patient using telehealth was created by committee members, Sarah G. and Sara O., and is located on our news and noteworthy page of our website, http://www.neuropt.org/special-interest-groups/vestibular-rehabilitation/new-and-noteworthy.

If you haven't seen them, take a look as our updated Patient Factsheets, Lisa Heusel-Gillig and crew, have worked to revise content to an 8th grade reading level and re-translate the factsheets into multiple languages, https://www.neuropt.org/special-interest-groups/vestibular-rehabilitation/patient-education-fact-sheets. Thanks to Chuck Plishka and the International Vestibular Rehabilitation Special Interest Group for also contributing to this effort. If you haven't heard them, you have to listen to our Podcasts. Our podcast team, lead by Maureen Clancy, continues to develop some exceptional educational offerings. The most recent podcast includes a discussion about the new Concussion CPG with Karen McCullough, one of the co-authors. All of our podcasts are now available through the ANPT Synapse Education Center and our webpage, https://www.neuropt.org/special-interest-groups/vestibular-rehabilitation/podcasts.

With my departure at the end of June the leadership team will be changing a bit. The biggest change will be that Rachel Wellons is stepping into my shoes as Chair. She has been doing a great job as chair elect and since March has been taking over much of the responsibility in overseeing the SIG activities. One initiative Rachel has taken is to survey membership satisfaction with our resources and educational offerings. We hope the membership feedback will let us know how we've been doing and help direct our efforts over the next 5 years. It is not too late to give your feedback. Look for links to the survey in social media and the Abstract of the Week (AOW).

Message from the Chair cont.

I would like to recognize Linda D'Silva who is coming off the nominating committee. She is our current chair and has served three years on the committee. Additionally, Linda has been involved in so many other SIG initiatives, including being an ICVR poster abstract reviewer and the telehealth committee member. Linda, thank you so much for your contributions to the SIG. Ryan Shock will be stepping up in to her shoes as Nominating Committee chair.

We are welcoming new members to our leadership team. Heidi Roth PT, DHS, who was elected to the nominating committee and Lynn Johnson, a DPT student at the University of South Carolina, became our new student representative. Lynn is replacing Emma Vansickle who just graduated from University of Pittsburgh and passed her licensing exam this spring. Congratulations Emma! Emma will be stay on working on several the VR SIG committees. Emma, Lynn and others are working to start an "early career VR therapist" group. Look for posting on social media and AOW for events in the future. It is a pleasure to have students and young therapists in our group, because they bring new innovation and vitality to our initiatives.

Cheers to Rachel, Carrie, Chuck, Ryan and all the committee leaders and members. The SIG is your hands! Just remember that the VR SIG is known for getting things done. It is a big task, but I am confident that you will do great things for our members. Also remember to have fun and just "love being vestibular rehabilitation therapists!"

On a personal note, despite the COVID stay at home, I am not getting lonely yet. I have named my two Louisiana gators Rachel and Chuck after two excellent Louisiana vestibular rehab therapists I know.

FOR MORE INFORMATION GO TO:
HTTP://WWW.NEUROPT.ORG/GO/SPECIAL-INTEREST-GROUPS/VESTIBULAR-REHABILITATION

VR SIG Service Award

Anne Galgon PT PhD was awarded the Vestibular Special Interest Group's Service Award.

Dr. Galgon is a Board Certified Neurological Clinical Specialist of the American Board of Physical Therapy Specialists and has led the Vestibular Rehabilitation Special Interest Group for the last seven years as Chair. Prior to that, she served the SIG as Vice Chair for 3 years. After 10 years of leadership service, Dr. Galgon, Anne to those who know her, has completed her current role in the VR SIG.

Under Anne's leadership, the membership of the VR SIG has grown from about 1000 members to 1536 members! She has represented the VR SIG in Paris, France at the invitation of the French Society of Vestibular Physiotherapy (SFKV) along with another member of the VR SIG where she presented the topic, 'Multisensory Vestibular Therapy in the United States of America - A Report from the American Physical Therapy Association.' The first International Vestibular Rehab Conference was held during Anne's tenure as Chair and she was part of the Conference organization team that drew to Chicago over 500 therapists, physicians and researchers from around the world.

Over the last several years, Anne has published numerous studies regarding vestibular rehab issues. Most recently, along with other vestibular rehab therapists, conducted a survey of physical therapy schools in the United States to investigate vestibular rehab education practices.

Due to Anne's longstanding leadership, dedication to the VR SIG, interest in furthering our understanding of vestibular rehab issues through research, as well as her friendship to those in the organization, Anne was chosen to receive this award. We love you Anne!

Triage of Vestibular Patients: Screening for Central Vestibular Disorders

By: Dale Walton, PT, DPT

The need to screen for central disorders is well known among vestibular-trained Physical Therapists. What are the central disorders we are screening for? What symptoms might make a clinician suspicious of a central disorder? Exactly what signs should a clinician look for? What are the essential examination procedures that are both sensitive and specific in identifying central abnormalities? I intend to answer these questions for use by Physical Therapists in evaluating the patient that presents with vertigo or episodic dizziness.

Vertigo and dizziness are some of the most common complaints in medicine (Feil K, 2019). At least 10% of patients that present with vertigo and dizziness end up having a neurological cause of dizziness. (Feil K, 2019) (Toker N H. Y., 2008) Identification of central cerebellar disorders can be easy when severe limb and/or gait ataxia present and deficits in postural control are severe. (Furman J, 2020) However, assessment can be challenging when neurological signs are subtle, and a careful examination is indispensable. (Feil K, 2019) The PCP presented with these complaints during a brief office visit will often refer these patients to PT for further assessment and treatment. The PT therefore plays a critical role in the assessment of these patients.

Conditions involving the cerebellum are the most common central conditions that present with the primary complaint of dizziness or vertigo (Feil K, 2019), but other conditions of the central nervous system can present this way as well. Infarcts or lesions anywhere along the vestibular pathways can present with symptoms of vertigo including lesions in the medulla, pons, midbrain and thalamus. (Dieterich M, 2015) (Kim S, 2015) Ischemia or infarction involving the posterior cerebral circulation i.e.: posterior inferior cerebellar artery (PICA) and the anterior inferior cerebellar artery (AICA) usually present with the complaints of vertigo or dizziness. Particularly with AICA lesions, vertigo and dizziness may be the primary complaint due to the fact that the labyrinthian artery that supplies the inner ear branches off of the AICA. Lesions of the parieto-insular vestibular cortex (PIVC) involving the middle cerebral artery (MCA) have also been reported to present with a primary symptom of vertigo. (Yeo S, 2017) (Dieterich M, 2015)

A recent study looked at 5400 consecutive patients that presented with complaints of vertigo and dizziness at a specialty clinic at the University Hospital of Munich (Germany). 8.5% of the patients were diagnosed with cerebellar disorders. The disorders identified were either focal, degenerative, hereditary or acquired. (Feil K, 2019) (Figure 1) Unfortunately, it took up to 12.4 years for these patients to receive a diagnosis with a mean time of 5.5 years. (Feil K, 2019) Cerebellar dysfunction can lead to severe functional impairment in the daily life of those affected. The time to diagnosis hopefully can be shortened If PT's perform a careful examination and make appropriate referrals to specialists for patients seen for dizziness and vertigo.

Symptoms experienced by patients with the aforementioned conditions are variable and few are highly specific to central pathologies. For example, the following symptoms can be present in both peripheral and central conditions:

- Brief bouts of vertigo with changes in head position are usually thought to be related to BPPV, but this symptom is also experienced in the early stages of degenerative cerebellar pathologies (Feil K, 2019), as well as at times with migraine.
- Sudden loss of hearing is a classic symptom of labyrinthitis, as well as of AICA stroke.
- Mild to moderate deviations in gait, posture and balance can be present in both central and peripheral conditions.
- Ataxia and oculomotor deficit findings are fairly specific to central disorders, but the patient may not notice the deficits when they are mild.

On the other hand, some symptoms in combination with vertigo are exclusive to central causes:

- Dysphagia, dysarthria, diplopia, focal weakness or numbness are signs associated with vertebro-basilar strokes.
- Horner's Syndrome and postural leaning with ataxia is often present with PICA syndrome or lateral medullary stroke. (Dieterich M, 2015)

Assessment of symptoms alone is not sufficient to rule out central causes of vertigo. A careful exam is needed to help differentiate peripheral conditions from central ones.

A thorough history is important to help rule out, or in, central causes of vertigo and should include assessment of

Triage of Vestibular Patients: Screening for Central Vestibular Disorders cont.

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cardiovascular risk factors, familial history of degenerative disease, exposure to toxins: (alcohol and Dilantin), (Furman J, 2020), as well as personal and family history of migraines.

A full neurological exam can take time and is by no means indicated for every patient that presents with dizziness. Fortunately, observational studies have helped identify what the critical exam procedures are. In the 2019 article

published in The Cerebellum, saccadic smooth pursuit was the most common oculomotor finding in the group studied. This was noted in over 90% of the patients with cerebellar disorders of the degenerative, hereditary and other acquired (non-focal) disorders. Other findings that were noted in over 50% of patients were (listed in order of

occurrence): Ocular misalignment with near gaze (exophoria most common); Gaze-evoked nystagmus, saccadic dysmetria (equally divided between horizontal and vertical saccades); Impaired fixation suppression, and Ocular misalignment with distant gaze (most common: esophoria).

Other neurological exam findings found in at least 40% of these patients included dysmetria with finger to nose and finger-to-finger tests. Though relatively rare, I think it is prudent to mention that 15% of patients exhibited Central Positioning Nystagmus associated with PPV. Most of these had degenerative disorders. (Feil K, 2019)

Several other studies have documented the utility of noting the direction of spontaneous horizontal nystagmus when present. Horizontal nystagmus that does not change direction with horizontal gaze and increases in intensity with gaze toward the fast phase follows Alexander's Law and is know to be associated with peripheral vestibular imbalance. Horizontal nystagmus that changes direction with gaze is associated with central disorders - particularly of the cerebellum or vestibular nuclei. (Toker N K. J., 2009) (Kim S, 2015)

The most sensitive and specific exam procedures when screening for central disorders in the dizzy patient are as follows:

- Smooth pursuit
- Gaze holding
- Saccades
- Uncover and cross cover tests
- Suppression of nystagmus with fixation
- UE coordination tests – particularly finger-to-finger and finger-to-nose pointing.

More in-depth neurological exam procedures should be followed if abnormalities are noted during the above exam. Figure (2) shows the order recommended for these tests, abnormal findings to look for and what equipment is needed to perform these tests. The technique used to perform these tests is important but beyond the scope of this article and can be found elsewhere.

I hope that you find this information helpful in your practice. Most importantly, I hope that this article has made it clear why we must perform a central screen on all vestibular patients. I also have tried to answer the questions:

- What signs and symptoms are we looking for?
- What disorders can be related to these signs and symptoms?
- And most importantly, what are the most sensitive and specific exam procedures that we should routinely use during our exams?

If you would like more detailed information on this topic, I highly recommend reading the whole article by Feil and Stroble (Feil K, 2019). The Vestibular SIG of the Neuro Section of the APTA has a podcast that is an interview with one of the authors (Dr. Zwergal) (Episode 43) that is also very worthwhile listening to.

Triage of Vestibular Patients: Screening for Central Vestibular Disorders cont.

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Figure 1: **Subtypes of cerebellar disorders identified by Feil and Stroble 2019**

Focal Lesions: (20%)	1. Infarctions 2. Tumors 3. Demyelination
Cerebellar malformation: (2%)	Arnold Chiari
Degenerative: (58%)	1. Multiple System Atrophy – Cerebellar type (MCA-2) 2. Cerebellar Ataxia, Neuropathy, Vestibular Areflexia Syndrome (CANVAS) Idiopathic Down Beat Nystagmus (DBN) syndrome 3. Sporadic Adult Onset Ataxia (SAOA) 4. Mild cerebellar oculomotor disturbances of unknown origin
Hereditary: (11%)	1. Episodic Ataxia (EA-2) 2. Spinocerebellar ataxia
Acquired: (8%)	1. Toxic (other than alcohol) 2. Alcohol 3. Immunological 4. Paraneoplastic

Figure 2: **Recommended exam procedures for screening for central vestibular disorders.**

Test	Finding	Equipment required
Gaze holding	Nystagmus in central, vertical and horizontal gaze; also look for direction changing nystagmus	Focal point
Smooth Pursuit (horizontal and vertical)	Saccadic Intrusions	Focal point
Saccades (horizontal and vertical)	Dysmetria, hypermetric, hypometric or slowed	2 focal points
Cover/Uncover/Cross Cover Tests: both near and far	Eso and Exo tropias or phorias	Occluder
Fixation Suppression of Nystagmus	Nystagmus not suppressed by fixation and may increase	Video IR goggles
Coordination Testing: Finger to nose and finger to (examiners) finger	Ataxia, past pointing	none

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The Evolving Landscape of Vestibular-related Rehabilitation for Patients with Multiple Sclerosis: From Conceptualization to Current Best Evidence

By: Jeffrey R. Hebert, PhD, PT

Introduction

Compared to other therapies routinely prescribed for patients with central nervous system (CNS) involvement, evidence supporting the application of vestibular-related rehabilitation for persons with a CNS-related diagnosis is relatively scant. However, high-level and reproducible evidence to support this type of rehabilitation-based treatment can be found for patients with multiple sclerosis (MS). In this report, Dr. Hebert will describe historical, present and future concepts of his work on this topic in the field of MS research.

MS Background

MS is a progressive, autoimmune-mediated disorder of the CNS, identified as a neurological disease of global concern, resulting in progressive disability and subsequent reduction in quality life years (1). MS is a dual process of inflammatory demyelination and progressive neurodegeneration leading to multi-focal axonal loss within the brain, brainstem and spinal cord, (2) with the hallmark "sclerotic" plaques or lesions in "multiple" locations within the CNS constituting the name of the disease. Due to involvement of these diverse CNS regions, persons with MS often present with a multitude of clinical manifestations and problems. Among common MS-related symptoms, declining mobility and balance control, and chronic fatigue are seminal problems of progressive disability in persons with MS, adversely impacting daily life participation, quality of life and higher degree of burden on self and society. Impaired balance control is also associated with falls, often resulting in injuries (3). Based on what we know, there is no doubt a need to discover and clinically implement the best, evidence-guided treatments specifically designed to remediate these omnipresent problems for persons living with MS.

The Origin

The early days of my physical therapy clinical practice on the University of Colorado School of Medicine campus in the late 1990's began with concurrent work in the Department of Otolaryngology primarily specializing in disorders of the peripheral vestibular system and in the Department of Neurology and the Multiple Sclerosis Clinic. The pathophysiology and pathogenesis among these patient populations are vastly different; nonetheless, what I began to appreciate overtime was that they presented with similar clinical manifestations (e.g., balance control impairment, dizziness). In isolation, even back then those observations were not that novel; however, with ongoing application of an inquisitive clinical view one additional common denominator complaint sealed the deal to begin my career investigating vestibular-related function and rehabilitation in persons with MS and other CNS diagnoses. Unsolicited statements from patients with peripheral disorders of the vestibular end organ following standard vestibular rehabilitation included "I have more energy" and "I feel like doing more now". Since fatigue was not a standard outcome for patients with peripheral vestibular dysfunction at the time, by way of ongoing observation, I qualified that patients with peripheral vestibular disorders had chronic coexisting perceived fatigue.

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Before implementing vestibular-related rehabilitation on a routine basis for patients with MS, the principal first step was to conduct a study to investigate the possibility that perceived fatigue and balance are correlated factors in persons with MS. The results from this study showed statistically significant inverse correlations between computerized dynamic posturography-sensory organization test (CDP-SOT)-based balance and perceived fatigue based on the modified fatigue impact scale; MFIS ($r = -0.78$; $p < 0.001$) (4). Moreover, we determined that the relationships were different across the six CDP-SOT conditions, where strongest correlations between CDP-SOT and MFIS scores were found for the most challenging sensory integration tasks: condition 4 ($r = -0.75$; $p = 0.001$), condition 5 ($r = -0.68$; $p = 0.003$) and condition 6 ($r = -0.71$; $p = 0.001$). The findings from this study supported the conceptualization that balance related to central sensory integration is significantly impaired in persons with MS, and that when implementing a rehabilitation approach (e.g. vestibular-related rehabilitation program) that include multiple diverse tasks that specifically target the processes of central sensory integration, concomitant improvements in balance and symptoms including perceived fatigue are likely to ensue. These efforts and results led to clinically applying vestibular rehabilitation practice procedures for my patients with MS on a more routine basis, and as expected I was finding similar results: improved balance, dizziness and perceived fatigue. Consequently, I formally constructed 5 case reports that served as the foundation of my PhD studies and the conceptual framework of my PhD dissertation lending to our 2011 pilot report.

Putting the Balance and Eye-movement Exercises for Persons with Multiple Sclerosis program (BEEMS) to the test.

My colleagues and I postulated that the BEEMS program would result in improvements in the primary proximal outcome of CDP-SOT-based balance and distal outcomes of perceived fatigue and dizziness. To test this hypothesis, we implemented a 3-arm, 14-week, stratified (based on presence of brainstem and/or cerebellar involvement) block randomized controlled trial (ClinicalTrials.gov NCT01216137) involving participants with MS who had at least moderate levels of impaired balance (CDP-SOT) and perceived fatigue (MFIS) (5). Participants (N = 38) were randomly assigned to one of three groups: Experiment, Exercise Control (to control for attention bias), or delayed-start Control groups. Participants in the Experimental (BEEMS) and Exercise Control (cycling/stretching) groups received supervised treatment 2x/wk, for 6 weeks and assigned daily home-based training. To facilitate analytic control for the possible confounding effects of brainstem and cerebellum lesion involvement, groups were stratified prior to randomization based on those participants with and those without brainstem and/or cerebellar involvement based on most recent magnetic resonance (MR) scan. As postulated, statistically significant improvements in CDP-SOT-based balance, fatigue and dizziness were found for the Experimental Group; more so, these improvements were significantly greater when compared to the Exercise Control (CDP-SOT, $p = 0.001$; fatigue; MFIS, $p = 0.024$; dizziness; Dizziness Handicap Inventory (DHI), $p = 0.018$) and delayed-start Control (CDP-SOT, $p = 0.003$; fatigue, $p = 0.005$; dizziness, $p = 0.009$) groups. We also found that the improvements in balance were significantly correlated with improvements in fatigue ($p = 0.011$) and dizziness ($p = 0.001$), further

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demonstrating that a focused rehabilitation approach specifically targeting balance related to sensory integration was primarily responsible for the improvements in the more distal outcomes of fatigue and dizziness.

Findings from our pilot trial allowed my team and me to design, conduct and complete a 2-arm, 16-week, stratified (based on presence of brainstem and/or cerebellar involvement) block randomized controlled trial for persons with MS (ClinicalTrials.gov NCT01698086), following similar methodology as our pilot trial where participants (N = 88) were randomly assigned to one of two groups: BEEMS or Control group (6). Based on results from our previous pilot trial that showed following 4-weeks of home-based training-only after the completion of 6-weeks of supervised training improvements in outcomes were maintained but had hit a plateau, we decided to test the augmented effects of extending the supervised training beyond 6-weeks. As such, participants in BEEMS received supervised treatment 2x/wk, for 6-weeks, then 1x/wk for an additional 8-weeks, and daily home-based training for a total of 14-weeks. As postulated, from baseline to 6-weeks, BEEMS participants experienced greater improvements compared to Control participants in balance; CDP-SOT composite ($p = 0.006$), dizziness; DHI ($p < 0.0001$), fatigue; MFIS ($p < 0.0001$), and quality of life based on the 36-item Short Form; SF-36, Mental subscale ($p = 0.0006$) and Physical subscale ($p = 0.004$), and from baseline to 14 weeks in balance ($p < 0.0001$), dizziness ($p < 0.0001$), fatigue ($p < 0.0001$), SF-36 Mental ($p = 0.02$), and SF-36 Physical ($p = 0.01$). Lastly, we reported that BEEMS participants with brainstem and/or cerebellar lesion involvement demonstrated greater improvements compared to those without involvement in these brain regions. These findings sparked interest from a variety of experts in clinical and investigational fields of rehabilitation and neurology since it argues the point that regardless of clinical evidence of neurodegenerative pathological involvement of brain regions especially vital to balance, dynamic visual fixation and ocular motor control, benefits can still be realized when a targeted multifaceted rehabilitation program such as the BEEMS is prescribed.

Moreover, results from our two BEEMS trials were included in two recent systematic review, meta-analysis studies. In Garcia-Munoz and colleagues report: Effectiveness of Vestibular Training for Balance and Dizziness Rehabilitation in People with Multiple Sclerosis: A Systematic Review and Meta-Analysis, results from both BEEMS trials (5,6) were the primary findings used for determining meta-analysis level evidence support for improvements in each outcome of balance, fatigue and dizziness; (7) and Moss-Morris and colleagues in the report: Which behavioural and exercise interventions targeting fatigue show the most promise in multiple sclerosis? A systematic review with narrative synthesis and meta-analysis, compared results from trials in five different exercise-based categories (balance, aerobic, general exercise – aquatic, general exercise, combined exercise) where the findings from our BEEMS trials (5,6) were the only two "balance" reports used for analysis with the results further providing meta-analysis level evidence supporting the BEEMS program's positive effect on fatigue (8).

Postulated mechanisms

Relevant to our conceptual framework, brain plasticity is a potential primary mechanism by which the BEEMS

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program positively affects balance and related symptoms (e.g., fatigue, dizziness). In theory, the BEEMS program facilitates functional brain reorganization in response to purposeful variations in the three major sensory feedback systems involved in central sensory integration. The overarching concept is that the postural control-related elements of the BEEMS program forces the CNS to integrate the unaltered sensory system(s) to complete various functional tasks efficiently while simultaneously constraining the remaining system input(s). The mode of visual input alterations or constraints contained in the BEEMS program include: 1) absent: eyes closed; 2) conflicting: head and body movements without gaze fixation; and 3) visual field movement and hand eye coordination: ball tossing and catching with eyes open. The mode of somatosensory input alterations or constraints include: 1) base of support: progressive narrowing; and 2) type of support surface: progressive complexity (i.e., from firm to: compliant: cushion-based, tilted: rocker board-based, and reactive-spring loaded: trampoline- based). The mode of vestibular input alterations or stimulation of the peripheral end organ (vestibule) includes: 1) head movements (yaw, pitch, roll); and 2) body movements in elevation (e.g. squatting) and translation (e.g., walking, lunging).

Brain plasticity involves a complex mix of neurogenesis-related processes at the molecular and cellular levels (9). Initial endogenous neural repair following injury (e.g. MS-related demyelination/axonal degeneration) occurs by way of restorative plasticity processes. However, adaptive plasticity processes are required to further augment neural repair and functional brain organization. Foundational empirical evidence of adaptive brain plasticity in persons with MS supports the application of experience-related, training-induced brain reorganization treatment approaches for persons with MS (10). Conceptually, the BEEMS program imparts balance, ocular motor and gaze fixation challenges and stimuli as external, experience-related, training-induced tasks as necessary elements and central processing load that lead to adaptive plasticity reorganization of the CNS.

Also, the dynamic visual fixation (yaw and pitch: vestibulo-ocular reflex; VOR) and ocular motor (saccades, pursuit) BEEMS exercises provide improved accuracy of visual information, a key component of central sensory integration. Since vision is an integral sensory input for balance control (11,12) and impaired visual input leads to balance instability (13,14) perceived fatigue (15) and dizziness (16) improvement in VOR and ocular motor function provides more accurate visual sensory input, further enhancing orientation and balance control.

Furthermore, the improvements in fatigue and dizziness could be a result of reduced requirements in physical effort and mental attention for task performance that lead to lessening the load on central (cortical, subcortical) processing.

Collectively, these processes may be the key elements of skill acquisition and retention for patients who participate in the BEEMS program.

Main practical & clinical considerations.

The BEEMS program is currently most generalizable to ambulatory (with or without use of assistive device) persons with MS who present with at least moderate:

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1) balance impairment qualified as sensory integration-related balance dysfunction; and 2) perceived fatigue; both requiring quantification using valid clinical measures. Providers must recognize the importance of training-induced "adverse side effects" as positive indicators of program effectiveness and as a guide to program advancement. Additionally, patients require early and often education of this appropriate and transient worsening of symptoms primarily to help with adherence and loss to follow-up problems. Providers should also understand the stages of compensation: compensated, uncompensated and decompensated, and that the latter of which is of further importance when treating persons with a progressive, degenerative neurological disease (e.g. MS). This is because currently there are no curative therapies for MS and adhering to an effective therapy (e.g. BEEMS) long-term is required to maintain benefits gained and prevent or minimize disability advancement.

Bottomline:

1. A well-conceptualized multifaceted vestibular-vision rehabilitation program (BEEMS) is feasible, safe and efficacious for patients with MS, with meta-analysis level of evidence support
2. Clinicians should open the potential benefit aperture to include multiple important related outcomes (e.g., fatigue, quality of life) not routinely considered when implementing vestibular-related therapies
3. Even in the presence of historically recognized negative prognostic factors (e.g, neurodegenerative-related involvement of the brainstem and cerebellum), positive gains in multiple clinical outcomes are possible with targeted rehabilitation therapies such as the BEEMS
4. BEEMS scholarly directives: explore other clinical outcomes (e.g. different domains of cognition, long-term fall prevention); conduct mechanistic trials aimed at determining neural plastic changes; investigate various programmatic enhancements of the BEEMS (e.g. visual vertigo/optokinetic-related progamming (17); and conduct robust BEEMS trials in other patient populations with diverse CNS involvement (e.g. traumatic brain injury, aging).

The Evolving Landscape of Vestibular-related Rehabilitation for Patients with Multiple Sclerosis: From Conceptualization to Current Best Evidence cont.

By: Jeffrey R. Hebert, PhD, PT

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Update on Managing Functional & Psychiatric Vestibular Disorders

By: Pamela Dunlap, PT, DPT, NCS; Jeffrey P. Staab, MD, MS; Janene M. Holmberg, PT, DPT, NCS
Contributed By: Megan Mar, PT, DPT

"Update on Managing Functional & Psychiatric Vestibular Disorders: Developing Successful Strategies" was presented by Drs. Dunlap, Staab, and Holmberg. Dr. Dunlap began the presentation emphasizing the relation between psychiatric comorbidity and dizziness. The prevalence of psychiatric disorders such as depression and generalized anxiety disorder are seen to be higher in persons with vestibular vertigo than the general population. Patient history of having a psychiatric disorder can significantly affect outcomes, such as prolonged recovery time, increased risk for developing secondary psychiatric symptoms, and increased psychological strain. Comorbidity of psychiatric disorders can lead to higher perception of impairment and greater vertigo-related handicap. Additionally, elevated psychiatric symptoms can contribute to increased fear and emotional distress related to dizziness and decreased balance confidence. Thus, it is important for clinicians to recognize and screen for psychiatric comorbidities and symptom severity. Screening tools and objective measurement questionnaires available are listed in the table.

Screening for Psychiatric Comorbidities	Hospital Anxiety and Depression Scale (HADS) Patient Health Questionnaire (PHQ-9) Generalized Anxiety Disorder 7-item (GAD-7) (HADS and GAD-7 at https://www.phqscreeners.com)
Measuring Psychiatric Symptoms	Vertigo Symptoms Scale Anxiety and Autonomic subscale Vestibular Rehabilitation Benefits Questionnaire - Anxiety items Dizziness Handicap Inventory
Measuring Behavioral Factors	Fear of Falling Falls Efficacy Scale Activities-Specific Balance Confidence Scale Negative Affectivity Positive and Negative Affect Schedule Fear Avoidance Dizziness Handicap Inventory Dizziness Catastrophizing Scale Vestibular Activities Avoidance Instrument

The fear avoidance model explained the pathophysiology of psychological factors and vestibular disorders: vestibulopathy causes dizziness, curved by catastrophizing, grows towards fear and avoidance, leading to disability and depression, feeding the maladaptive cycle. This model aids in understanding development of abnormal sensory-motor processing leading to excessive reliance on visual and somatosensory information, as well as avoidance of provoking activities inhibiting the necessary vestibular compensation mechanisms. Fear of falling is a significant component, found to cause changes in postural control and gait, as well as measuring higher among persons with dizziness who report anxiety/depression. In addition to fear avoidance, other behavioral factors found to have a strong relationship in persons with dizziness include neuroticism, negative affect, and catastrophizing. Can vestibular rehabilitation change these factors? Yes, as various studies have shown improvements in dizziness handicap, anxiety and depression symptoms, balance function, and normalization of sway. To summarize, Dr. Dunlap emphasized the importance of recognizing and measuring psychiatric/behavioral factors as common comorbidities, as well as considering these factors in plans of care for improving outcomes.

Dr. Staab discussed the criteria development, diagnosis, and treatment strategies for Persistent Postural Perceptual Dizziness (PPPD). As 21st century neurotology progressed away from the old dichotomy of "structural versus psychogenic" for understanding chronic symptoms after acute vestibulopathy, current knowledge is better explained by a three-factor Venn diagram: structural/metabolic factors, psychological factors, and/or functional changes. One or more of these factors can be present, and each of these factors must be evaluated as a diagnosis of "rule-in" rather

Update on Managing Functional & Psychiatric Vestibular Disorders cont.

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than "rule-out"; noting these factors can interact with and/or induce one another. Reviewing an 1800's medical definition of "functional disorder", it was defined as "a change in the mode of action of the organ", not a breakdown in structure. With this definition, patients with dizziness can understand that the ear is not damaged (or no longer damaged) and isn't causing their symptoms but they've shifted strategies in their actions. Upon further historical review, there were a number of precursors describing PPPD-like diagnoses in the medical literature for centuries. However, more recently the Barany Society sponsored a comparison of 21st century nomenclature describing similar presentations, whose commonality resulted in the diagnostic criteria of PPPD. The ICVD definition of PPPD is described as a dizziness, unsteadiness, or non-spinning vertigo present on most days for 3 months or more, with symptoms present for hours-long periods (1)(2). Symptoms are exacerbated by upright posture, active or passive motion, and exposure to complex visual stimuli; and triggered by events such as vestibular disorders, other neurological or medical illnesses, and psychological distress. Lastly, the symptoms cause significant distress or functional impairment, and are not better accounted for by another disorder. Dr. Staab states PPPD is not a diagnosis of exclusion. Since PPPD is a symptom-based diagnosis, special attention to a patient's subjective report may reveal a PPPD comorbidity in the presence of an active vestibular condition, where the patient's presentation is not better explained by the condition alone. Red flags that a patient's presentation is not PPPD are indistinct onset of symptoms, worsening symptoms over years, falls/near-falls, and non-fluctuating symptoms regardless of provocative factors.

The functional changes in the "mode of action" present with PPPD consist of altered postural control with "walking on ice" gait, altered spatial orientation with visual reliance, and reduced cortical integration of space-motion information. Looking at brain imaging studies in persons with PPPD, there is reduced activity and connectivity in vestibular areas (3). Imaging of visual cortex responses to visual motion displayed activity proportional to their symptoms, and neuroticism modified the connectivity between frontal regulatory regions and visual regions (4). Dr. Staab emphasized these findings were an example of a functional vestibular disorder triggered by structural condition (subjects had neuritis or BPPV as a trigger) in which brain activity/connectivity in response to an environmental stimulus is proportional to symptoms, all of which were modified by psychological factors. He repeats this important concept again! Psychological and behavioral factors cannot be ignored in our patients, as they are closely intertwined in what is happening in the brain.

Cognitive behavioral therapy (CBT) is an important part of treating PPPD. However, Dr. Staab acknowledged a common hurdle for patients seeking treatment for dizziness is that most psychologists will say they "don't do dizziness". He advises patients to "lead with the anxious part" to get their foot in the door, and then talk about their dizziness. Key elements of CBT that complement physical therapy include graded exposure, manage fearful arousal with relaxation techniques, reframing cognitive strategies, and decreasing safety aids. Serotonergic antidepressant medications (SSRI's and SNRI's) can be helpful, but have a slow titration process with low starting doses and patients often quit too early. Dr. Staab concluded his presentation by highlighting PPPD is recognized as part of the 11th edition of the International Classification of Diseases (ICD-11) by the World Health Organization.

Dr. Holmberg dived into vestibular rehabilitation, emphasizing the importance of knowing what is driving a patient's disability. Additionally, she quotes a lesson she learned from an early lecture of Dr. Staab, "Listen, listen, listen", because it is the patient's history that will describe what drives the diagnosis and should guide treatment. The Patient-Specific Functional Scale is helpful as a PPPD Activity Analysis Grid to measure function, degree of avoidance, and limitation of tolerance for activities such as stores, computers, overall motion tolerance, driving, and ADLs/IADLs. For determining whether a patient has PPPD, it is helpful to make a checklist for the diagnostic criteria comparing both migraine and PPPD. Common clinical exam findings for PPPD include normal but symptomatic oculomotor testing, normal head impulse and positional testing, abnormal motion sensitivity, and presence of safety behaviors.

Update on Managing Functional & Psychiatric Vestibular Disorders cont.

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Computerized Dynamic Posturography (CDP) results can vary from normal to visual or vestibular dysfunction patterns to an "across the board" pattern. It is vital to screen for functional movement disorder comorbidities, especially if you see patients who potentially have PPPD. Dr. Holmberg refers to a consensus recommendation by Nielsen et al. 2014 for screening for functional comorbidities, example findings include refusal to perform oculomotor exam but spontaneous evidence of intact function, uneconomical posturing, and tremors absent with distraction (5). She emphasizes that we can educate patients on these findings, and how improving automatic processing pathways can address their condition.

Physical therapy treatment for PPPD is multifactorial, but consists largely of education, which alone can be empowering. Education should review pathophysiology, evidence the triggering event is healed, anxiety as an exacerbative factor, discussion on resources and capacity for healing, and paced exposure. Well-rounded treatment also includes desensitization/oculomotor training against visual vertigo, habituation for motion intolerance, sensory re-weighting, fitness and sleep hygiene for fatigue, core stabilization for high-threat balance reactions, systematic successful exposures for balance confidence, and relaxation techniques for autonomic dysregulation. Priority of intervention should be guided by the patient's subjective report. Referencing the fear avoidance model, these interventions address the maladaptive factors to promote re-adaptation towards recovery. Dr. Holmberg recommends an aggressive aerobic exercise program to address anxiety, as well as setting up a nurturing environment for healing with healthy eating and hydration. She warns to not dive too quickly into visual motion exposure without giving patients the foundational strategies for success, such as grounding and relaxation, or else it can result in failure. It is important for both clinicians and patients to remember high dosage of treatment does not always equate faster healing, and exposure must be graded and dosed appropriately. Dr. Holmberg's bottom line: Differentiating functional disorders is vital for successful interventions, and identifying the factors driving disability are critical to successful treatment.

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Central Vestibular Dysfunction: Current Literature and Where to Go From Here

By: Helena Esmonde, PT, DPT, NCS

The term "central vestibular dysfunction" covers a broad range of pathologies, ranging from a single event such as a cerebellar stroke to chronic and fluctuant conditions such as vestibular migraine (Brown et al., 2006). A central vestibular disorder can be defined as a vestibular condition originating from problems with the brain and brainstem (Shepherd 2009). The challenge faced by clinicians providing assessment and treatment for these conditions centers around the diversity of root causes, severity, and progressive nature of some of the various central vestibular diagnoses, from concussion to multiple sclerosis.

Although patients with concussion can have peripheral vestibular issues as well, Skóra et al. (2018) found that at a 6 month follow-up in patients with mild traumatic brain injury (mTBI), more than half the patients still had abnormal VNG results that were indicative of a central vestibular dysfunction. Concussion Clinical Practice Guidelines, a joint effort between the Orthopedic, Sports, and Pediatric sections of the American Physical Therapy Association, were recently published in the Journal of Orthopaedic and Sports Physical Therapy in April 2020 (Quatman-Yates et al.). These guidelines provide comprehensive recommendations for assessment and treatment of concussion, taking into consideration the oculomotor, vestibular, autonomic, psychiatric, cervical, and cognitive symptoms that can be present in those with mTBI. Each case is unique, so the treatment should be individualized to provide guidance on graded return to aerobic exercise as well as addressing the individual deficits found on examination.

It is critical to provide proper monitoring and screening of those in the acute phase of concussion in particular, since the patients may not be aware of their own deficits. For example, in a 2019 study of 96 patients with acute mTBI (median age 38) by Marcus et al., researchers found that half of the patients had objective gait ataxia upon physical therapy assessment, even though these same patients denied any balance problems. Regarding prognosis, it is important to consider pre-existing conditions such as migraine and motion sensitivity. In one study on athletes with sports related concussion, it was discovered that a history of motion sensitivity was associated with a more prolonged vestibular dysfunction following mTBI (Sufrinko et al., 2019). If an individual already has challenges with increased sensitivity to sensory stimuli, this can result in a longer road to recovery from a central vestibular injury such as a concussion, which is important when determining a reasonable timeline for goal achievement in a course of physical therapy care.

Similar to concussion, a stroke in the brainstem or cerebellum can result with a presentation of central vestibular dysfunction. The good news is that there are at least a few studies that indicate that "a customized physical therapy intervention for stroke patients with brainstem injury who had vestibular symptoms identified significant improvement in postural control and functional activities" (Kwon and Ko, 2017). In addition, during a randomized controlled trial by Dai et al. (2013), researchers were able to train caregivers so that they could provide vestibular rehab exercise guidance and supervision to stroke patients with unilateral neglect. After 1 month of daily vestibular rehabilitation plus standard physical therapy, these patients had more improvements in ADLs and balance along with a reduction in neglect, as compared to standard physical therapy alone.

While it is encouraging that patients with cerebellar and brainstem stroke can improve with vestibular rehabilitation, diagnosis of such strokes can prove challenging at times. Imaging is not always reliable, since early MRI can result in a false negative. A three-step bedside oculomotor exam (H.I.N.T.S.: Head-Impulse—Nystagmus—Test-of-Skew) appears more sensitive for stroke than early MRI in acute vestibular syndrome (Kattah et al., 2009). In addition, the Subjective Visual Vertical bucket test can be useful in these cases where it is unclear whether a patient is having a stroke or a symptomatic vestibular migraine. Indeed, when used in conjunction with a focal neurological exam and clinical assessment for nystagmus, the SVV bucket test had a sensitivity of 92.6% and specificity of 88.9% when differentiating central vestibular dysfunction in stroke from vestibular migraine (Chang et al., 2019).

Like patients with cerebellar or brainstem stroke, those with vestibular migraine can benefit from physical therapy. A recent review by Alghadir and Anwer (2018) found that more randomized controlled trials are needed to confirm the benefits of vestibular rehabilitation for those with vestibular migraine. However, Whitney et al. (2000) and Vitkovic et al. (2013) both found that vestibular rehabilitation improved balance and reduced dizziness in patients with vestibular migraine.

Central Vestibular Dysfunction: Current Literature and Where to Go From Here cont.

By: Helena Esmonde, PT, DPT, NCS

Collaboration between a physician and physical therapy can be beneficial since patient education, trigger management and reduction, and medication can all play important roles in improving the likelihood that a patient with vestibular migraine can tolerate and benefit from common vestibular rehabilitation techniques such as habituation to visual motion or self-movement (Knight, 2017). Interestingly, in children with migraine headaches (not diagnosed with vestibular migraine per se), a study by Baraldi et al. (2020) found evidence of a central alteration of vestibular pathways in these patients that makes balance function more visually dependent than healthy subjects, even between headaches. Key goals of vestibular rehabilitation in both adults and children with vestibular symptoms are often to gradually reduce visual dependence, improve balance, and increase habituation to sensory stimuli (Bogle 2019; Christy 2018). In addition, regular exercise seems to reduce migraine frequency, although ideal frequency and intensity of such exercise is unclear at this point (Amin et al., 2018).

While vestibular migraine is one of the most common central vestibular disorders, there can be malignant sources of central nystagmus seen during a vestibular exam. In fact, according to a study by Power et al. (2019) , in 12% to 20% of cases, positional vertigo is due to CNS pathology, including cerebellar tumors. Power's study followed three patients who required surgery (two for removal of a cerebellar tumor and one to address obstructive hydrocephalus), and in all three cases, the patients showed improvement in motion sensitivity and balance after a postoperative course of vestibular rehabilitation. Further research, particularly randomized controlled trials, would help to increase our understanding of the optimal frequency, duration, and types of activities that are best for rehabilitation in this patient population.

While cerebellar tumors and hydrocephalus can be life threatening, we can try to address them with surgery, but unfortunately degenerative and hereditary cerebellar ataxias are not treatable in this way. Patients with these types of cerebellar dizziness and imbalance benefit from a multimodal approach including physical and occupational therapy as well as medication to reduce presenting symptoms (Zwergal et al., 2020). Even worse, some of these degenerative conditions affect both the central vestibular pathways as well as resulting in bilateral peripheral vestibular loss (Pothier et al., 2012). In these cases, the focus of physical therapy should go beyond vestibular rehabilitation and ensure adequate attention to balance training, safe mobility, assistive equipment and home safety planning, assessment for benefit from balance-based torso weighting, and patient and family education and training, in addition to concurrent medical monitoring and management.

Progressive neurologic diseases beyond cerebellar ataxia can also impact the vestibular system and may benefit from vestibular rehabilitation and assessment. For example, Tramontano et al. (2018) found that a four week course of vestibular rehabilitation in patients with severe multiple sclerosis reduced fatigue and improved balance and activities of daily living. Similarly, a study in patients with Parkinson's disease found that eight weeks of customized vestibular rehabilitation resulted in significant balance improvements (Acarer et al., 2015). This may relate to the fact that there is limited but increasing evidence that VEMPs, in particular, are abnormal in patients with Parkinson's disease (Smith 2018). From an assessment perspective, Nakamagoe et al. (2019) found that in patients with amyotrophic lateral sclerosis (ALS), the reduced ability to use visual fixation to suppress nystagmus (induced by caloric testing) correlates with decreased frontal assessment battery scores (test for executive function). Therefore, a simple vestibular function test could potentially provide a means to objectively monitor cerebral ALS lesions.

The vestibular system connects to the muscles of our eyes, trunk, and limbs via specific brainstem and cerebellar structures, so disruption of these neural pathways can result in vertigo, imbalance, nystagmus, and other neurological signs (Lea and Pothier, 2019). Such an elegant neurological network is vulnerable to trauma, disruptions in blood flow, genetic and progressive disease, and complex impaired functional presentations such as what is seen in patients with migraine. However, with this complexity comes opportunities for new and different neural pathways to form and adaptations to develop. The desire to tap into this neuroplasticity is the driving force for patient and clinician efforts in physical therapy for those with central vestibular dysfunction.

Central Vestibular Dysfunction: Current Literature and Where to Go From Here cont.

By: Helena Esmonde, PT, DPT, NCS

The heterogeneity of presentation even within each central vestibular diagnosis is a challenge to the ability of clinicians to adapt and individualize their treatments, using clinical evidence whenever it is available to improve decision making and optimize patient outcomes. No matter how complex, every patient matters, and so we look forward to further research to support the care of those with central vestibular dysfunctions.

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Establishing a Vestibular Treatment-based Classification System:

FOSTERING EVIDENCE-BASED CARE, QUALITY IMPROVEMENT, AND RESEARCH

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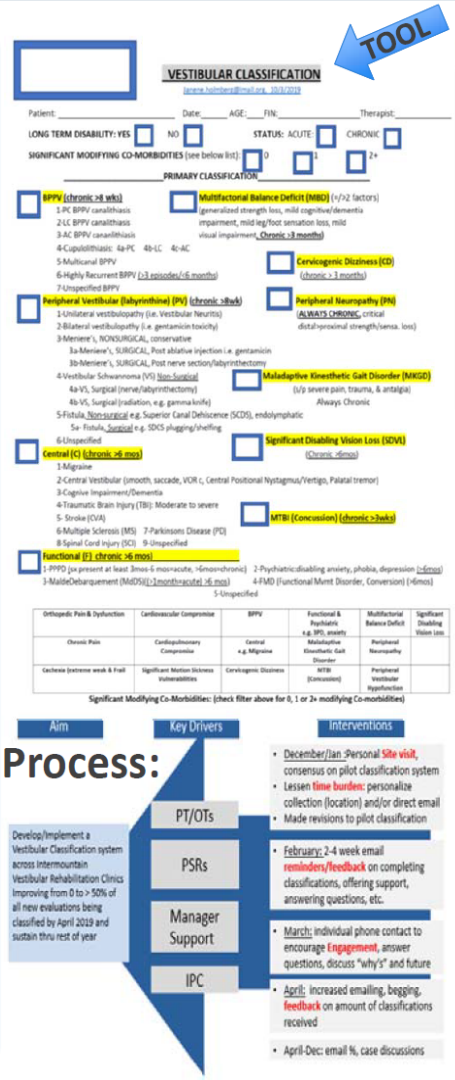
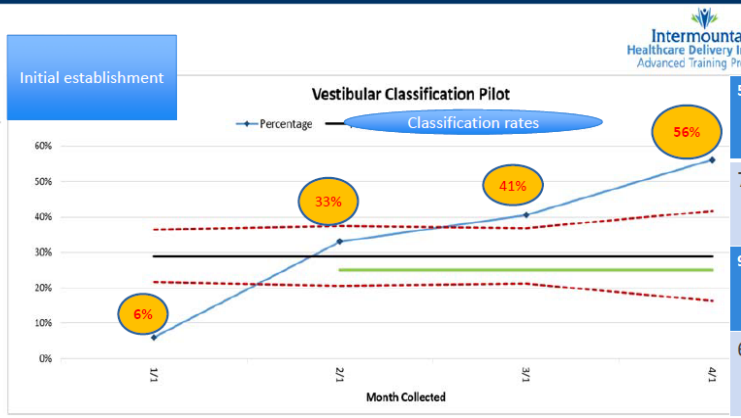
No conflicts of interest to disclose.

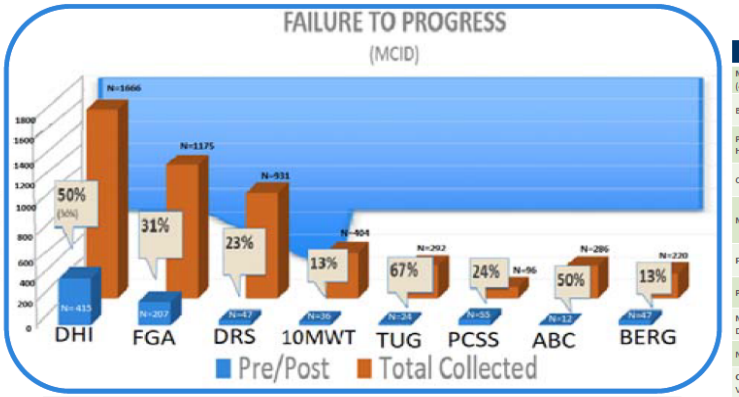
BACKGROUND: Dizziness and Instability are common disabling complaints for which vestibular rehabilitation has been found effective. Increasing clinical outcome measures and clinical practice guidelines are available to help guide treatment, however translating this to best practice and documenting effectiveness remains challenging. Clinically-relevant classification systems in orthopedics have been found useful in driving better documentation of outcomes and advancing best evidence care process models (CPM). The purpose of this study was to develop, implement and evaluate the effectiveness of an outcome-linked treatment-based vestibular classification.

METHODS: A vestibular classification was developed and implemented in large not-for-profit healthcare organization that consisted of 14 vestibular-specialized therapists across 7 sites with total average of 3,000 new evaluations annually. Therapists were supported by initial in-person collaboration, frequent email support, and phone contact at various intervals. Classification and outcome data were collected over a 12 month period. A total of 2,068 classifications were collected.

RESULTS: Prior to starting data collection, an Electronic Health Record query over a 4-month interval revealed a total of 249 different ICD-10 code combinations. Isolated outcome collection policies had been implemented 5 years prior but without connection to a specific classification system and had failed to lead to any meaningful data or clinical impact. Compliance on classification and outcome reporting improved from initial average of only 6% to 80% by 4 months and remained stable for remainder of the trial at average of 72%. Average age was 62 with range of 7-96. Ten major classifications were utilized with only 1% of patients not successfully classified. Acute vs chronic criteria for classifications were collected with 61% patients chronic. Descriptive subcategories were utilized in some of the categories with significant modifying co-morbidities reported in approximately 43% of cases, most commonly orthopedic/pain (22%), central involvement (commonly migraine) (18%), BPPV (14%), psychiatric-anxiety(9%) or peripheral neuropathy (7%). Long term disability was ID in 7% of cases with anticipation for increased visits and potential increased level of failure to progress. Primary classifications were consistent with what would be anticipated for tertiary care presentations with acute presentations accounting for 40% of cases with exception of proper ID/rx of PPPD. Most common outcome measures were the Dizziness Handicap Inventory, Functional Gait Assessment, and the Disability Rating Scale. Post outcome data reporting was limited and varied based on outcome measure utilized at average 21% (range 4-57%). Failure to progress, i.e. failure to meet MCID, was analyzed for the various measures and overall the minimal clinical important difference was met 70%.







CONCLUSION

A treatment-based vestibular classification was able to be successfully implemented and sustained for almost 1 year. There is beginning evidence for potential meaningful clinical data related to treatment efficacy, prevalence, modifying co-morbidities, and identifying quality improvement needs. Study supports the classification's potential for providing a structure to foster further clinical improvement initiatives as well as optimal documentation of care.

CLINCAL RELEVANCE

Healthcare's value-based transformation is demanding physical therapists increase accountability to evidence-based outcomes. Prior outcome measurements in this healthcare system, without a classification system, were not found sustainable or meaningful where current data shows potential for more detailed analysis of effectiveness, better capacity to identify areas for clinical improvement and foundation to foster research

TABLE 1: CLASSIFICATIONS

Description	%	Break Out Analysis
Multifactorial Balance Deficit (453)	22 %	
BPPV (444)	21 %	Posterior=62%, Anterior=3%, Latera SCC=9%, UA+10%
Peripheral Vestibular Hypofunction (308)	15 %	Unilateral hypo=61%, VS=18%, Unspecified=8%, Bilateral & Menieres=6%
Central (383)	19 %	Migraine=39%, CVA=14%, Unspecified=10%, PD=10%
MTBI (concussion) (272)	13 %	Initially 6 subcategories: vestibular, cognitive, migraine, anxiety, cervical, mixed but MOST were mixed, taken out
Functional/Psychiatric (82)	4%	PPPD=38%, Psychiatric=30%, MdDS=16%, FMD=2%
Peripheral Neuropathy (72)	3%	More often a significantly modifying co-morbidity
Mal-Adaptive Kinesthetic Gait Disorder (17)	1%	
Not Classified (20)	1%	
Cervicogenic (6) Sign Disabling Vision(1)	<1 %	

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Treatment Efficacy for Horizontal Semicircular Canal Benign Paroxysmal Positional Vertigo (BPPV): A Systematic Review

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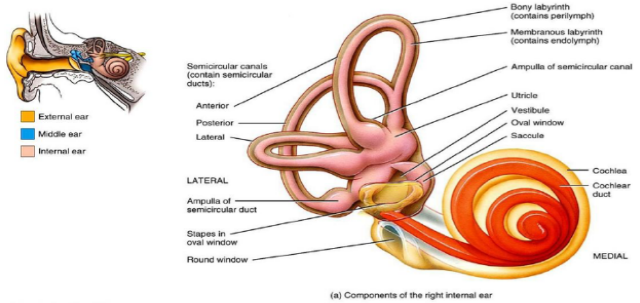
Background

- Benign Positional Paroxysmal Vertigo (BPPV) is characterized by a brief episodes of vertigo elicited by positional changes of the head relative to gravity (Bhattacharyya 2017).
- The horizontal canal (HC) is the second most commonly involved canal in BPPV, and causes horizontal nystagmus in the roll test.
- The canalithiasis variant causes nystagmus beating towards the ground (geotropic), while the cupulolithiasis variant causes nystagmus beating away form the ground (apogeotropic).
- The most commonly performed treatments for HC BPPV are the Gufoni Maneuvers and the Canalith Repositiong Maneuver (CRM) for the horizontal canal (Lempert Maneuver)
- The efficacy of these treatments is not well established.



(a) Components of the right internal ear

Figure 17.20 Tortora - PAP 12/e
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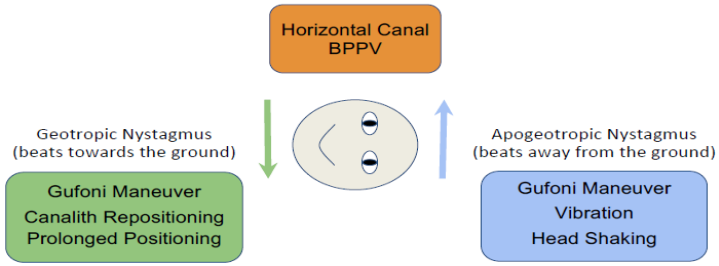
Purpose

- The purpose of this systematic review and meta-analyses was to evaluate current research to determine the efficacy of the different methods for treating the canalithiasis and cupulolithiasis variants of horizontal canal BPPV.

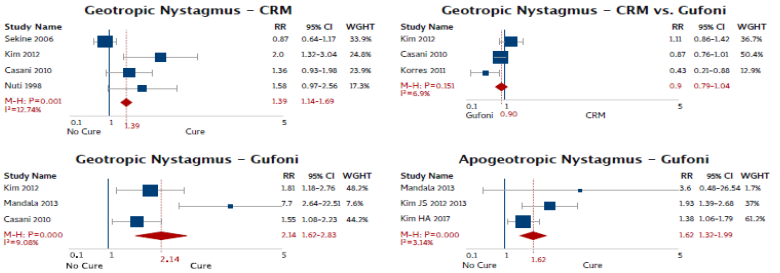
Methods

- Electronic literature search of MEDLINE, CINAHL, and Web of Science.
- Studies were evaluated in a two-part screening process to establish eligibility for inclusion in the study.
- Quality assessment was performed using the PEDro scale and ratings were assigned to each study.
- Data was extracted for canalithiasis and cupulolithiasis of the horizontal canal with the primary outcome of interest being resolution of vertigo and nystagmus, and were compiled into a PICO table.
- When there was sufficient data, fixed-effect meta-analyses (Mantel-Haenszel model) were run to produce summary estimates of the overall efficacy of the individual maneuvers, and, when possible, to compare maneuvers.

Horizontal BPPV Treatment Options



Results



Study	Quality Rating (PEDro Score)	Groups	Comparator(s)	Treatment Success	Comparator Success
Kim (2017)	Good (9)	Gufoni	Sham	57.1%	19.4%
		Gufoni	Mastoid Oscillation	57.1%	47.8%
		Gufoni + Mastoid Oscillation	Sham	47.4%	19.4%
Kim (2012) apogeo	Good (9)	Gufoni	Sham	59.6%	22.4%
		Head-shaking	Sham	47.2%	22.4%
		Gufoni	Head-shaking	59.6%	47.2%
Kim (2012) geo	Good (9)	Lempert Maneuver	Sham	50.9%	35.4%
		Gufoni	Sham	48.4%	35.4%
		Lempert Maneuver	Gufoni	50.9%	48.4%
Mandala (2013)	Good (8)	Gufoni	Sham	83.8%	11.4%
Hwang (2015)	Good (8)	Gufoni Accelerated	Gufoni Decelerated	48.0%	48.0%
Casani (2011)	Good (7)	Gufoni	Lempert + FFP	86.2%	61.0%
Testa (2012)	Good (7)	Gufoni	Modified Gufoni	88.0%	93.0%
Korres (2011)	Fair (5)	Gufoni	Lempert Maneuver	88.9%	38.4%
		Gufoni	FPP	88.9%	75.8%
		Lempert Maneuver	FPP	38.4%	75.8%
Vannucchi (1997)	Fair (5)	FPP	Head-shaking	91.4%	16.7%
		FPP	No Treatment	91.4%	26.7%
		Head-shaking	No Treatment	16.7%	26.7%
Faralli (2008)	Fair (4)	Lempert Maneuver	Mastoid Oscillation + Lempert	22.2%	77.7%
Sekine (2006)	Fair (4)	Lempert Maneuver	No Treatment	21.4%	30.9%
Maranhao (2015)	Fair (4)	Gufoni	N/A	61.1%	N/A
		Lempert Maneuver		50.0%	
Nuti (1998)	Fair (4)	Lempert Maneuver	N/A	63.0%	N/A
		FPP		73.2%	
		Lempert + FPP		71.5%	
Ciniglio Appiani (1997)	Poor (2)	FPP	Lempert Maneuver	100.0%	90.0%
Mosca (2001)	Poor (2)	FPP	Personal Method	83.0%	78.0%

Conclusions

- For the treatment of HC BPPV canalithiasis, based on the results of the meta-analyses, both the Gufoni Maneuver and the CRM for the HC are effective maneuvers. There are a limited number of studies that have compared the two treatments, but the results suggest that there is not a difference in the efficacy of the treatments
- The Prolonged Positioning maneuver is another recommended treatment for HC BPPV canalithiasis. While the initial results are promising, there is insufficient data to draw strong conclusions about this treatment.
- For the treatment of HC BPPV cupulolithiasis, based on the results of the meta-analysis, the Gufoni Maneuver appears to be an effective treatment.
- For the other suggested treatments for HC BPPV cupulolithiasis, such as vibration during the CRM and head shaking maneuvers, there is limited evidence to support these treatments.

Clinical Relevance

- For the treatment of HC BPPV canalithiasis, both the Gufoni Maneuver and the CRM for the HC are appropriate treatments. The Gufoni Maneuver is a simpler maneuver to perform, involves fewer movements, and may be easier for the patient to perform.
- The clinician should consider several factors, including the severity of the symptoms, age, size, past medical history, and musculoskeletal limitations, in selecting the appropriate treatment

Acknowledgements / References

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