

Poster Presentations Abstracts

Friday Poster Session 5:45-7:30pm

1. SYSTEMATIC REVIEW OF OUTCOME MEASURES USED IN VESTIBULAR REHABILITATION IN PATIENTS WITH CONCUSSION

Goldsack K, **HEICK J**, Jain, TK.

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METHOD: A computerized literature research was conducted to include the PubMed, CINAHL, and EMBASE databases. The review was conducted in 3 stages: Stage 1- Search for clinical trials involving vestibular rehabilitation in patients post-concussion and determine the outcome measures used in each trial; Stage 2 - List and classify the scales collected during stage 1 according to the ICF domains, and Stage 3 - Describe the measurement properties of the identified scales in patients after concussion. A computerized literature research of articles was conducted by the authors. The original search included the PubMed, CINAHL, and EMBASE databases. The review was conducted in 3 stages: Stage 1- Search for clinical trials involving vestibular rehabilitation in patients post-concussion and determine the outcome measures used in each trial; Stage 2 - List and classify the scales collected during stage 1 according to the ICF domains, and Stage 3 - Describe the measurement properties of the identified scales in patients after concussion. Studies were included if they were performed on human subjects and published in English. **RESULTS:** A total of 33 scales were identified from 7 studies involving 318 subjects. The most commonly used outcomes measures were: Dizziness Handicap Inventory (5 studies), Activities Specific Balance Confidence Scale (4 studies), Functional Gait Assessment (4 studies), Dizziness Rating (3 studies), and Balance Error Scoring System (3 studies). According to the ICF domains 2 outcome measures were categorized into body function and structure, 2 into Activity, and 1 into Participation. **DISCUSSION AND CONCLUSION:** The most commonly used scales evaluated components of dizziness and balance. Future studies should also include instrumental evaluation. Criteria for scale selection should be based in ICF framework, psychometric properties and patient characteristics. **(RESEARCH)**

2. "GAME CHANGER": NEW DIAGNOSIS OF PPPD ENHANCES OUTCOME EXPECTANCIES.

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BACKGROUND AND PURPOSE: Persistent postural perceptual dizziness (PPPD) is a diagnostic term that provides an accessible description of ongoing dizziness relative to conventional pathoanatomic labels, perhaps contributing to patient insights for resolution. The influence of diagnostic labeling remains underexplored, particularly in the case of PPPD. Our purpose is to examine the effects of PPPD diagnosis on expectancies in two patients who had experienced longstanding dizziness and prior vestibular rehabilitation (VR). **CASE DESCRIPTIONS:** Patient A: 65-year-old woman with dizziness for 19 years, history of Meniere's disease, and vestibular nerve resection more than 10 years prior to diagnosis of PPPD. Baseline Dizziness Handicap Inventory (DHI): 56%. She could not walk alone in community, travel for leisure, or drive on freeways. Medical Intervention: Diagnosis of PPPD by an otolaryngologist, low-dose Effexor, and PT referral. Patient B: 55-year-old woman with dizziness for more than 2 years. She had a history of vestibular neuritis, a fall, and repair of perilymphatic fistula. Baseline DHI: 28%. Patient B noted significant improvement with prior VR but expressed a lack of understanding of symptom persistence. VR interventions for patients A and B emphasized education on PPPD mechanisms and expectations of recovery and development of a home program that consisted of balance training, aerobic exercise, and graded exposure to valued activities coupled with relaxation techniques. **OUTCOMES:** After 10 therapy sessions, DHI improved to 24% and 20% for patients A and B, respectively. Qualitative data were collected via post-intervention interviews. Each patient independently underscored the importance of the diagnosis and explanation of PPPD. Patient A indicated the new diagnosis was a "turning point" that prepared her "attitude" for further VR. Patient B was not formally diagnosed with PPPD. Rather, the PT introduced PPPD as a possible framework to explain persistent symptoms. The patient and PT engaged in a collaborative exploration of the topic. Patient B indicated later that the discussion "was a game changer [that] really set me on the right path to recovery... It was the piece I was missing." Both patients had returned to participation in valued activities by the conclusion of the intervention. **DISCUSSION AND CONCLUSION:** For patients with persistent dizziness, diagnostic labeling when paired with education, explanation, and collaborative discussion can serve as a turning point for enhancing expectancies as it makes recovery both conceivable and credible. Exploration and explanation of diagnosis should therefore be considered not only as a starting point, but as an important component of effective intervention. **(CASE STUDY)**

3. DO PSYCHOGENIC FACTORS CONTRIBUTE TO CONVERGENCE SPASM IN POST-CONCUSSION?

Isanhart E.

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BACKGROUND AND PURPOSE: Convergence spasm is the most commonly reported functional eye movement disorder with both psychogenic and organic etiology. In those who sustain a concussion, it is common to see the existence of anxiety and depression. In those presenting to vestibular rehabilitation post-concussion, convergence spasm has been detected. This case series discusses the occurrence of convergence spasm after concussion and the outcome measures as well as treatments used with these individuals. **METHODS:** Thirty-two patients post-concussion presented with a convergence spasm during examination at an Outpatient Neurologic Rehabilitation Center (14 Males, 18 Females, Age range 12-73 years). Convergence spasm was examined by using infrared goggles which enables fixation to be blocked improving assessment confidence. Twenty-four of the patients were followed by the neuropsychologist which used the GAD-7, PHQ-9, and through interview there were 14 that had a history of anxiety and/or depression. Treatments focused on vestibular habituation including replication of daily functional tasks, sensory organization, dynamic balance, dual tasking, ocular motor training, cardiovascular exercise, and mindfulness training. Treatment focused on feedback with normal movement patterns and balance reactions. Functional movement disorders and postural persistent perceptual dizziness interventions include distractions and positive reinforcement. **RESULTS:** The DHI initial findings demonstrated a mean of 47 points +/- 27.6 (range 0-90). Upon discharge, 1 patient had a decline in score by 8 points, the remainder had improvements ranging from 2-67 points. The FGA initial findings demonstrated a mean 24 points +/- 6.4 (range 10-30). At discharge, the average score was 26 points +/- 3.8 (range 18-30). The 10 MWT initially demonstrated a mean of 1.08 m/s +/- .23 (range .66-1.6). Upon discharge the 10 MWT average was 1.11 m/s +/- .20 (range .72-1.26). Near point convergence initial mean was 6.7 cm +/- 11.5 (range 0-49.5). Improvements ranged from 3-41.5 cm and in 2 cases worsened convergence insufficiency of 17 and 25 cm who were referred to vision therapy. The average convergence at discharge was 7.6 cm +/- 10/8 (range 0-33). Sensory organization was tester specific with results leading to some improvement with each assessment. The use of these interventions led to the decreased presence of convergence spasm for these patients. **DISCUSSION AND CONCLUSION:** Patients with post concussion involve a constellation of factors that are involved with their recovery. It can be said that the combination of vestibular rehabilitation, cardiovascular exercise, and mindfulness meditation can contribute to functional improvements and decreased presence of convergence spasms. It is hypothesized that the presence of convergence spasm found in those presenting with post concussion syndrome is largely attributed to the presence of anxiety and depression.

(CASE SERIES)

4. PERSISTENT POST-CONCUSSIVE SYMPTOMS CAN AFFECT SLEEP, STRESS AND ANXIETY LEVELS.

Fagan M, Lakin J, Mularoni M, D'SILVA L.

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BACKGROUND AND PURPOSE: Between 1.6 and 3.8 million sports-related concussions occur in the US every year. Concussed individuals present with symptoms like irritability, drowsiness, and emotional lability. The purpose of this study was to evaluate if sleep, emotional status, and balance continue to be affected at least one year after a concussion injury. **METHODS:** Adults between 20-30 years of age with a diagnosed concussion at least a year prior, and age and sex matched controls were recruited. Subjects were excluded if they had neurological, inner ear, or musculoskeletal impairments. The Pittsburgh Sleep Quality Index (PSQI) examined sleep quality. Stress, anxiety, and depression were examined using the Depression, Anxiety Stress Scale (DASS-21), The NeuroCom Balance Manager™ was used to assess postural sway in 6 conditions. **RESULTS:** 12 participants, 6 with concussion (mean age 25 ± 3.3) and 6 controls (mean age 23.2 ± 1.8) completed the study. Sleep latency (p=0.09) and sleep efficiency (p=0.08) scores on the PSQI were different between the 2 groups. The stress (p=0.03) and anxiety component (p=0.05) of the DASS-21 were significantly different between groups. Postural sway was not different between the 2 groups in all conditions tested. **DISCUSSION AND CONCLUSION:** Participants with concussions were at least a year post injury, however, many continued to have significant post-concussive symptoms. Concussed individuals had impaired sleep latency and efficiency resulting in more daytime sleepiness and higher levels of anxiety, stress, and perception of stress. Poor sleep quality and higher stress levels can impair learning potential. Future studies examining the role of vestibular rehabilitation to reduce symptoms in this group of young adults are necessary.

(RESEARCH)

5. USE OF POSTUROGRAPHIC DATA AS A CLINICAL EDUCATION TOOL TO DECREASE FEAR-AVOIDANCE BEHAVIORS IN PERSONS WITH DIZZINESS: A CASE STUDY

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BACKGROUND AND PURPOSE: 46% of persons who report having dizziness (DIZ) also endorse anxiety and avoidance of certain movements, which can result in fear-avoidance behaviors (FAB). Computerized posturography (POS) can quantify sensory interactions/reorganization for equilibrium and can be used as feedback to show progress in therapy. In this case study, we hypothesized that POS data could be used as an education tool to demonstrate progress in therapy to decrease FAB and health anxiety in a patient with acute DIZ. **CASE DESCRIPTION:** A 72-year-old male presented to the outpatient physical therapy clinic following a three-day acute onset of dizziness. Patient evaluation revealed a right unilateral vestibular hypofunction. PMH significant for phobias related to hospital procedures. Within two weeks of onset of physical therapy plan of care, the patient started to demonstrate increased disease preoccupation, and self-limitation of exercise and activity. Use of Sensory Organization Test (SOT) results over the course of 10 weeks were used to document progress and were discussed with the patient to minimize his FAB and health anxiety symptoms. **OUTCOMES:** Improvements were seen between SOT test and re-test data from week 3 (n = <5%), week 6 (n = 30%) and week 10 (n = 60%). Following education of progress with posturographic data, patient reported a decline in subjective reports of dizziness from baseline report of 4/5 to visit 4 at 3/5, visit 7 at 2/5, and visit 10 at 0/5. Return to previously avoided activities such as lying down/sitting up, walking for exercise, and walking to/from appointments occurred by discharge. **DISCUSSION AND CONCLUSION:** We propose that the use of posturographic data can be used as a means to educate patients on their progress, and as a way to deescalate arising anxiety symptoms and FAB. In our case, the use of objective posturographic data served as a means to decrease patient subjective reports of dizziness and assisted this patient in returning to previously avoided activities.

(CASE STUDY)

6. VESTIBULAR REHABILITATION IMPACT IN PATIENT SELF-MANAGEMENT STRATEGIES: A QUALITATIVE STUDY.

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BACKGROUND AND PURPOSE: Due to challenging characteristics of the pathology, an incorrect or late diagnosis or even unfamiliarity, often dizzy patients feel misunderstood and emotionally destabilized, when they reach specialized assistance. Vestibular rehabilitation (VR), besides the promotion of specific stimulus for treatment, also promotes enlightenment sessions associated with the exercises. This study goal is to approach how this combination may play a role in patient's development of self-management strategies. **METHODS:** The study used a mixed methods approach. At first a literature review was undertaken to assess the state of art on this subject. Secondly, to better understand the concrete patient's needs, feelings and beliefs in this issue, and to approach some topics that were not addressed in the literature, an exploratory retrospective qualitative study design (semi-structured interview to patients that already had Vestibular Rehabilitation) was performed. Nine patients were interviewed, recruited from a Clinic Vestibular Unit. Four of them have been referred to VR with acute episodes and five with chronic dizziness. The data content analysis followed a thematic analysis with a meaning condensation procedure. **RESULTS:** Little is written in this topic, addressing the patient specific point of view. Studies about health related quality of life (HRQoL) is largely provided with specific scales but few assessing the concrete strategies used by the patient. Regarding the interviews the main themes were: "Initial anxiety"; "Better knowledge and cognitive control of symptoms" "Fear of failure and having symptoms again"; "Understanding mechanisms of balance"; "Acceptance of behavior and meaning of symptoms"; "Fear control"; "Security and credibility in the therapist." These themes address some negative and positive aspects that the patients (and therapist) had to deal with during VR sessions and helped them to develop self-management strategies. Other themes were raised but those were the most influential. **DISCUSSION AND CONCLUSION:** The VR approach seems to have a positive impact on the development of patient self-management strategies. As clinical implications, this topic is important to understand the tools that patients perceive as crucial for better adherence and treatment outcome. It would also be interesting to approach and relate the perspective of caregivers/families, physicians and therapists. Because little is written in the literature, more studies should be further developed.

(RESEARCH)

7. "BPPV RELIEF" - AN EDUCATIONAL APP FOR HEALTH PROFESSIONALS WHO TREAT BPPV.

BURSTON A.

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BACKGROUND AND PURPOSE: I would really like the opportunity to present "BPPV Relief" an App that my son who is an App developer and I have been developing over the last 13 months. We have just launched it on the Google playstore for Android devices and are in the process of submitting it for approval from IOS and Microsoft for use on Apple and Microsoft devices. It is a practice innovation so doesn't fit the research abstract guidelines very well. **DESCRIPTION:** BPPV Relief is an App developed as an educational tool for Health Professionals who treat BPPV, teach other Health Professionals and educate patients about BPPV. The tests and treatments are all commonly used and follow evidence based recommendations by the Clinical Practice Guideline for BPPV updated in 2017 by the American Academy of Otolaryngology- Head and Neck Surgery Foundation. They are presented in easy to follow and interactive animations. Animations show how to perform The Dix-Hallpike, Side Lying and Roll tests to test the posterior and horizontal canals. Each animation shows the correct direction of nystagmus seen with a positive test. Animations show how to perform the common treatment manoeuvres for posterior and horizontal canals. They also show the semicircular canals moving in the same plane as the head with the crystals moving around and out of the canal during each manoeuvre. This App will help Health Professionals improve their diagnostic skills and clinical reasoning when treating BPPV. BPPV Relief has been developed by a New Zealand Physiotherapist with 18 years experience treating BPPV and her son who is an App developer.

(SPECIAL INTEREST-Innovation)

8. DEVELOPING A VIRTUAL REALITY GAME FOR PERIPHERAL VESTIBULAR HYPOFUNCTION.

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BACKGROUND AND PURPOSE: According to the Clinical Practice Guidelines for peripheral hypofunction, the optimal dose for gaze stability exercises is a minimum of 3 times a day. Patients are instructed to look at an X on the wall or their own thumb, which may not keep their attention and could lead to a lack of compliance. The purpose of this project is to develop a virtual reality experience that incorporates gaze stability exercises that could lead to improved compliance. **DESCRIPTION:** The HTC Vive is an interactive virtual reality system. The program was coded in C# using the Unity game engine. A start-up menu with three levels of the game was created. As done with gaze stability exercise progression, the levels correspond with increasing levels of difficulty. The system provides multi-modal feedback to the patient as they use the game consisting of visual and audio cues as they progress and text prompts if they move their head too far out of position. **SUMMARY OF USE:** In the first level, the patient is sitting in a virtual room with no distractions and is taught how to move their head while keeping their eyes focused on a cube in front of them. The second level consists of a virtual room with harsh, flickering lighting. The lighting is designed to distract the user to make the exercise more difficult. The third level introduces a checkerboard wall, which provides another distraction along with harsher lighting. The patient progresses through levels by increasing the number of repetitions and speed of head movements in addition to changing position from sitting, to standing, to Romberg, and finally tandem stance. The patient selects their level of dizziness and the game determines whether they should stop, continue at the same level, or move to the next. The game saves the patient's results so that their compliance and progression in the game is recorded. **IMPORTANCE TO VESTIBULAR REHABILITATION:** In order to improve symptoms resulting from vestibular hypofunction, patients need to perform gaze stability exercises several times a day. By using virtual reality, patients can have an interactive game that they play to make their exercises more exciting than just looking at an X on the wall or their own thumb.

(SPECIAL INTEREST)

9. DEVELOPMENT OF ROCK STEADY 1.0 – A MOBILE, GAMIFIED VESTIBULAR REHABILITATION THERAPY APP

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BACKGROUND AND PURPOSE: Adherence to a home exercise program is a critical component of vestibular rehabilitation. The barrier most strongly associated with reduced adherence is lack of interest. One solution to reduce boredom and improve adherence is through virtual reality games. The goal of this study was to develop and evaluate Rock Steady, a gamified mobile vestibular rehabilitation therapy application (app) for the

assessment and treatment of vestibular/balance impairments in adults with complaints of dizziness. **METHODS:** Structured interviews with expert vestibular clinicians/administrators/researchers (n=11) and participants with dizziness (n=15) were performed and common themes extracted. Participants with complaints of dizziness completed eight common vestibular assessments using standard clinical practice methods (CLIN- verbal instruction, stopwatch, metronome and paper-based questionnaire) and using Rock Steady app (APP). The order of assessments was counterbalanced across participants with half beginning with CLIN and half with APP. Participants were tested on 2 separate occasions with at least three days between sessions. Test-retest and parallel forms reliability were evaluated using ICCs and Bland-Altman analyses. System usability was assessed using the System Usability Scale with >60% considered acceptable. **RESULTS:** Structured interviews revealed a number of features that will add value and increase the likelihood of adoption of Rock Steady. In addition, we obtained feedback on game prototypes of gaze stability exercises. Test-re-test and parallel forms reliability of Rock Steady 1.0 were mostly good to excellent with respect to concurrent validity and test-retest reliability. System usability scores indicated excellent usability (92.5% for Session 1 and 90.2% for Session 2). **DISCUSSION AND CONCLUSION:** Rock Steady 1.0 app demonstrated good reliability and feasibility for assessment of vestibular disorders. In general, clients responded similarly when using paper versus digital form of the assessments and felt that the system was easy to use. Low-cost, commercially available technology platforms, such as gaming technology combined with sensor technology, may enhance adherence to vestibular exercises and thus rehabilitation outcomes.
(RESEARCH)

10. EFFECT OF A NOVEL PALATAL ALTERNATIVE SENSORY FEEDBACK DEVICE ON POSTURAL STABILITY AND DYNAMIC BALANCE: A CASE SERIES

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BACKGROUND & PURPOSE: 85% of 7 million annual clinic visits for dizziness and vertigo are diagnosed with vestibular disorder. Primary role of vestibular system is to allow efficient movement in a dynamic environment. Deficits in system increase fall risk and decrease quality of life. Compensation for deficits can occur with vestibular rehabilitation (VR) and use of alternative sensory feedback, e.g. body weighting, vibration. cases describe use of palatal stimulation to improve postural stability. **CASE DESCRIPTION:** Four patients (ages 18-85) with vestibulopathy and completion of VR were recruited for custom fit with PES (EquiCue). 3/4 patients exhibited residual vestibular symptoms and deficits. Dental retainer had an embedded sealed battery-powered electronic system consisting of an accelerometer and 5 stainless steel stimulators. The PES was calibrated to each patient's sensory sensitivity. Strong comfortable sensations were obtained at intensities of 25-30V. Patients underwent 1-3 90 minute training sessions by a physical therapist. Dynamic balance, gait and symptoms were respectively measured by EquiTest Sensory Organization Test (SOT), Dynamic Gait Index (DGI) and Numerical Pain Rating Scale (NPR) with and without the PES at each visit. **OUTCOMES:** The PES was easy to calibrate and teach how to use the sensory input to provide head position and movement feedback. SOT: 4/4 patients had diminished or significant deficits with falls in visual and vestibular responses without PES; with PES 4/4 patients had immediate increased function in the visual and vestibular areas above normative levels; 3/4 exhibited posterior COG alignment without PES, all 4 showed centralized COG when wearing PES at last session; e.g., patient with significant vestibular deficits initially only able to complete 4/6 conditions with falls on conditions 5 & 6, on last session without PES she was able to complete SOT and scored above her normative range, no falls with Equilibrium Score of 78. DGI and NPR: 3/4 patients exhibited immediate relief of dizziness, nausea and unsteadiness with PES; able to perform pivot turns and stepping over obstacles without staggering; range of scores on DGI before and with PES were 11-21/21 and 19-21/21. **DISCUSSION AND CONCLUSION:** Comfortable perception of the electrical stimulus was possible along with improved COG alignment. Immediate and 2-3 week relief of dizziness and nausea was seen with PES training. Function and symptom improvements persisted when not wearing the PES at subsequent sessions. One patient who had compensated for her vestibulopathy was able to improve SOT scores with PES. Individuals with vestibulopathy experienced relief of vestibular symptoms and improved function during and after PES.
(CASE SERIES)

11. HEAD MOBILITY IN VIRTUAL ENVIRONMENTS: A NOVEL OCULUS RIFT ASSESSMENT FOR PATIENTS WITH VESTIBULAR DYSFUNCTION

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BACKGROUND AND PURPOSE: The contribution of visual information to standing balance in patients with vestibular dysfunction varies between patients. Using the Oculus Rift headset and sensors, we developed a

virtual reality (VR) test of head stability (HST) in response to visual perturbation. During the test, head movements is tracked in six degrees-of-freedom. The purpose of this pilot study was to test the sensitivity of the VR_HST to differences between patients with vestibular dysfunction and age-matched controls. **METHODS:** Seventeen patients and 16 controls performed static balance tasks with eyes closed (standing feet together or tandem on floor and foam) and observing 'moving stars' (amplitude 32mm, frequency 0.2Hz) via the Oculus (standing in a tandem position). On an additional dynamic balance task they were asked to avoid a virtual ball approaching their head when observing a virtual 'park' scene and standing hips-width apart. Directional Path (DP) and Root Mean Square Velocity were calculated for postural and head oscillations during the static conditions. DP, acceleration and primary frequency were calculated for the 'park' scene. **RESULTS:** Postural sway differed significantly between groups when standing on foam with feet together and on floor during the 'moving stars' task. Head oscillations were larger among patients, primarily in pitch, yaw, and roll rotation. During the 'park' scene, significant between-group differences emerged in head DP (patients rotated their head sideways more), head acceleration (controls had higher acceleration, especially on translation movements) and peak frequency (controls peaked around the frequency of the ball whereas patients were variable) but there were no significant differences in postural sway measures. **DISCUSSION AND CONCLUSION:** Sensitive tools to detect kinematic response to visual perturbation are needed to individualize vestibular rehabilitation. The VR_HST was found to be sensitive to differences between small and diverse groups in static and dynamic balance tasks. Its clinical utility should be studied in larger samples of patients with vestibular dysfunction. **(RESEARCH)**

12. IMPLEMENTING TELEHEALTH FOR VESTIBULAR REHABILITATION

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BACKGROUND AND PURPOSE: Most of the research in telerehabilitation (telerehab) has been in orthopedics and has shown that telerehab is effective. Within the field of physical therapy there are relatively few vestibular rehab specialists. Access to these specialists is further limited as they are often clustered in urban areas. Telerehab with patients with dizziness can improve access to this expert therapy they need. Purpose: To describe the implementation of telerehab in two vestibular physical therapy clinics. **DESCRIPTION:** Case study of implementing telerehab in 2 physical therapy clinics tracked over 18 months. Both clinics primarily treat patients with vestibular dysfunction and are based in Colorado, one treats via telehealth only. The many steps necessary prior to implementing telerehab were tracked including: federal legislation, state Physical Therapy (PT) practice act, insurance contracts and plans' inclusivity of coverage for telehealth, technology, HIPAA compliance, patient identity security and safety. Both clinics have been able to implement telehealth treatments. The clinics provide either treatments via telehealth or a hybrid model combining both telehealth and face to face treatments. Reimbursement is private pay or from third party payers. Visit frequency ranged from one visit per week to one visit per month. The diagnoses treated included post concussive syndrome, persistent postural perceptual dizziness, mal de debarquement syndrome and benign paroxysmal positional vertigo. **DISCUSSION AND CONCLUSION:** Treating patients with vestibular dysfunction via telerehab is a feasible delivery model. Most of the patients who received telerehab had barriers to participating in in-person PT, such as living more than 2 hours away. Subjectively, both patients and therapists found the treatments successful. A barrier to widespread implementation is insurance reimbursement. More research is needed to demonstrate efficacy of treatment, cost savings, and satisfaction of telerehab with this patient population. **(CASE STUDY-INNOVATION)**

13. THE HEAD-SHAKE STANDARD AND INERTIAL SENSORS POSTUROGRAPHY TESTS IN PERIPHERAL VESTIBULAR LESIONS.

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BACKGROUND AND PURPOSE: Static posturography aims to measure quiet standing. Adding the head movements to standard static posturography tests make the balancing task more challenging. The inertial sensors posturography based on microelectromechanical systems seems to be alternative for standard platform. The first aim of the study was to assess the usefulness of HS-static posturography for vestibular assessment. The second aim was to compare the results between standard posturography and inertial sensors results. **METHODS:** The study included 155 subjects divided to three groups: 54 (mean age 55.7) patients with unilateral uncompensated canal paresis (uCP), 46 patients (56.1) with compensated CP (cCP) and 55 healthy subjects (control) (49.7 years). The static posturography protocol was performed two times using Neurocom device, first in standard 4 conditions: eyes open/eyes closed; firm surface/foam and next repeated with head movements

(range of 30° peak to peak) controlled by metronome set. The measurements with inertial sensors attached on lumbar level were recorded simultaneously. **RESULTS:** We found statistically significant increase of mean sway velocity in HS posturography tests as compared to standard posturography in all groups tested. The number of patients with abnormal results in posturography tests were compared between the study groups. In standard posturography only 4th test (foam, eyes closed) were worse in cCP group as compared to controls while in HS-posturography all tests were worse. Uncompensated group revealed higher number of abnormal results in all tests. **DISCUSSION AND CONCLUSION:** The addition of head movements to standard static posturography can differentiate patients with compensated and uncompensated vestibular deficit. Posturography based on inertial sensors is the promising tool for vestibular assessment. Acknowledgments: This study was supported by project called “Innovative system for evaluation and rehabilitation of human imbalance”, realized within the STRATEGMED II program, funded by the National Centre for Research and Development, Strategmed 2/266 (RESEARCH)

14. UTILIZATION OF TELEHEALTH VISITS FOR CHRONIC VESTIBULAR DYSFUNCTION TO IMPROVE ACCESS TO CARE AND MEET DEMANDS IN THE FACE OF TIME-CONSTRAINTS: A CASE STUDY BRECEDA EY

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BACKGROUND & PURPOSE: Telehealth has been examined as an alternative delivery of care option in populations such as pediatric and veterans with TBI. The purpose of this study was to explore the use of telehealth as an alternative option for in-clinic treatment for chronic vestibular hypofunction. **CASE**

DESCRIPTION: A 72 y.o. male with a diagnosis of “disequilibrium” was identified with chronic vestibular hypofunction. Symptoms began 2.5 years ago. Symptom onset was preceded by multiple bouts of antibiotics for pneumonia, including azithromycin. At initial onset, the patient reported symptom duration to be a few minutes up to the entire day. Also, reported difficulty with quick turns, unable to ride his bike, difficulty walking straight or while turning head to scan. Symptoms were rated at 8/10 on Likert scale. A Sensory Organization Test (SOT) was completed, vestibular score was 42 and composite score was 60, both below age-predicted normal values. Head Shake SOT score was 0 with variable surface. Patient was seen over the course of 2 months, totaling 5 visits, of which 3 visits were done via telephone. **OUTCOMES:** Post treatment, which included adaptation exercises, habituation, optokinetic stimulation, the patient reported the following improvements: (1) SOT vestibular score improved from 42 to 78; (2) SOT composite score improved from 60 to 70; (3) symptom severity decreased from 8/10 to 4/10; (4) duration of symptoms decreased to less than 15 minutes. Functionally, the patient was able to resume riding a bike outdoors and able to walk without veering. Quick turns remained a challenge. **DISCUSSION AND CONCLUSION:** Improved vestibular and balance scores indicate telehealth was a useful adjunct to in-clinic visits. The findings suggest telehealth may be a useful tool to improve access to care, decrease burden of travel, while still leading to positive outcomes with vestibular rehabilitation in a patient with chronic vestibular hypofunction. Further studies are needed that look at larger sample size.

(CASE STUDY)

15. VALIDATION OF THE STEPWATCH ACTIVITY MONITOR IN ASSESSING PHYSICAL ACTIVITY IN INDIVIDUALS WITH VESTIBULAR DISORDERS

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BACKGROUND & PURPOSE: Physical activity (PA) can be accurately monitored more accurately with device rather than self-report. One such device is the Stepwatch Activity Monitor (SAM). Though proven accurate in individuals with neurologic disorders such a Stroke, Spinal Cord Injury, and Multiple Sclerosis, accuracy in individuals with vestibular disorders is unknown. The purpose of this study is to investigate the accuracy of the SAM in measuring step count for individuals with vestibular disorders. **METHODS:** Subjects were included if they had a diagnosis of a vestibular disorder and were currently experiencing measurable symptoms of dizziness and/or imbalance. Subjects completed the 10 Meter Walk Test to set gait parameters on the SAM. Subjects wore the SAM on their right ankle and took 80 steps for calibration. Subjects then completed a 2 Minute Walk Test (2 MWT). All steps were counted using the SAM and a tally counter (TC). Each subject was videotaped and reviewed to ensure TC accuracy. **RESULTS:** Twenty-Six (N=26) subjects, 9 males and 17 females with an average age of 61.5 ± 12.4 years (36-80), completed the study. The average number of steps counted by the TC during the 2 MWT was 219.1 ± 25.9 (168-251) compared to 217.4 ± 27.3 (153-252) steps counted by SAM. The average difference in step count during the 2 MWT between the SAM and TC was 1.6 ± 4.6 steps. Regression analysis demonstrated that the mean difference in step count was not significantly different from 0 (t = -1.588, sig. = 0.125). A Bland-Altman plot was created to assess agreement between the SAM and TC using the 95%

upper and lower confidence intervals (-0.29-3.44). **DISCUSSION AND CONCLUSION:** The results of this study indicate that the SAM accurately measures step count in individuals with vestibular disorders. Researchers can use the SAM to collect step count data in subjects with vestibular disorders in order to investigate the changes in PA with vestibular rehabilitation (VR). Vestibular therapists can now use the SAM to monitor changes in PA in their patients participating VR.
(RESEARCH)

16. VIRTUAL REALITY-BASED EXERCISE PROGRAM FOR UNILATERAL PERIPHERAL VESTIBULAR DEFICIT.

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BACKGROUND & PURPOSE: Virtual reality (VR) is already used in a variety of medical conditions, ranging from post-stroke disabilities to orthopedic rehabilitation or improvement of cognitive abilities. VR techniques have been successfully applied in vertigo and balance disorders using both medical and commercial systems. Aims. Limited scientific data exists regarding the application of hybrid VR units which combine motion capture technologies with a force plate device. **METHODS:** Prospective, study comparing VR training using a hybrid VR unit (Neuroforma 2016 manuf. Titanis, Poland.) (Group 1) vs. static posturography training (Euroclinic SSS ED 8000) with visual feedback (Group 2) in patients suffering from peripheral vestibular dysfunction was conducted. The peripheral vestibular impairments diagnosis was confirmed by VNG in all patients. The subjects in Group 1 (n=25) underwent 10 sessions over 10 days, lasting 30 minutes under the physiotherapist supervision. The patients in Group 2 (n=25) had 10 training sessions over 10 working days. Both groups additionally performed Cawthorne-Cooksey exercises once daily at home throughout the duration of the study. The participants of the study were examined on a posturography platform on the start day and 1 month after rehabilitation. Patients also filled in the Vertigo Syndrome Scale – Short Form (VSS-SF) clinical questionnaire. Both groups demonstrated improvement in posturographic parameters which were statistically significant. The patients reported improvement in their subjective perception of symptoms on the VSS-SF scale. No statistically significant differences were found when comparing functional improvement between these groups. **RESULTS:** All patients completed a full course of therapy and there were no reports of side effects. To analyze the effectiveness of VR rehabilitation versus the control group, the total change of the center of pressure parameters and VSS-SF score was calculated for each individual. The median values were compared. The comparison of the posturographic test results between groups in eyes open and eyes closed conditions show no statistically significant differences. **DISCUSSION AND CONCLUSION:** Virtual reality-based vestibular rehabilitation with the application of hybrid VR units is an effective, enjoyable and well tolerated method of functional improvement. In comparison with an established form of vestibular rehabilitation, which is static posturography with visual feedback training, both approaches prove equivalent in postural sway improvement. Virtual Reality training yields a better subjective reduction of symptoms.
(RESEARCH)

17. CROSS-COUPLING VESTIBULAR EXERCISES FOR THE TREATMENT OF MOTION SENSITIVITY: A CASE STUDY

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BACKGROUND & PURPOSE: Motion sensitivity presents with dizziness, nausea, headaches, or fatigue and can be due to conflict between the semicircular canals and otoliths. If the semi-circular canals perceive rotation that is not aligned with earth's gravitational axis while otoliths are detecting linear motion that is aligned, motion sickness can occur. This nauseogenic stimulus is known as cross-coupling. This case study will investigate the effectiveness of cross-coupling exercises for treatment of motion sickness. **CASE DESCRIPTION:** Patient A was an 8 year old male with subjective complaints of nausea/vomiting, dizziness, and headaches that had been worsening over 4 months. Symptoms had been increasing in frequency and intensity, limiting him from completing turns in his musical, limiting car rides to 2 miles, and difficulty lying on his left side. Nausea lasted for 30-45 minutes after activity was stopped. Initially the patient scored 27 on the Bruininks-Osteretsky Test of Motor Proficiency. The patient scored 6/100 on the Dizziness Handicap Inventory. Benign Paroxysmal Positional Vertigo testing was negative. On the Sensory Organization Test the patient scored a 55, fell once on condition 5, and reported a medium increase in nausea. The patient scored a 3.17 on the Motion Sensitivity Quotient. The patient was treated with vestibular rehabilitation therapy. Once the patient habituated symptoms to active movements, cross-coupling exercises were utilized to address symptoms with passive transportation. **OUTCOME:** After 10 sessions, the patient reported complete resolution of his symptoms. He was able to complete all dances in his musical, be spun for 12 revolutions on a merry-go-round, and read a book in the car without symptoms. Patient scored a 1.33 on the MSQ and was able to complete the SOT without any increase in his nausea. The patient did have 2 falls on condition 6 of the SOT. BOT-2 now met age norms. The patient was able to tolerate 30 minute car rides without an increase in nausea. **DISCUSSION AND CONCLUSION:** Motion sensitivity can limit a person's ability to participate in daily life activities. Cross-coupling exercises that combine pitch and roll while

rotating were effective for treating motion sensitivity as they habituate the vestibular only conflict that occurs. Additional research of the utilization of cross-coupling exercises for the motion sensitive patient may better support effectiveness of this treatment.

(CASE STUDY)

18. INTEGRATION OF VESTIBULAR REHABILITATION WITH YOGA THERAPY THEORY IN TREATING PSYCHOLOGICAL AND PHYSICAL SYMPTOMS OF VESTIBULAR DISORDERS.

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BACKGROUND & PURPOSE: Patients with vestibular disorders exhibit symptoms of dizziness, imbalance, anxiety, and depression. Evidence based vestibular rehabilitation proved to improve balance and reduce dizziness. Anxiety and depression in vestibular disorders impact the outcomes of both subjective and objective outcome measures. Components of Yoga such as Yoga pose (Asanas), Breathing (Pranayama), and Meditation (Dhyana) produce positive results in psychological and physiological symptoms of anxiety, depression. **THEORY**

DESCRIPTION: Yoga poses (Asanas) have several types - Meditative poses, Cultural Poses and Therapeutic poses. Therapeutic poses which are meant to be for 'balance' are beneficial for people with balance and dizziness. The second component of yoga is breathing (Pranayama) helps to reduce stress, increase endurance, reduce anxiety. The third component of yoga is Meditation, reduce anxiety and helps to calm the mind. The combination of above mentioned three components of yoga (Pose, breathing, and meditation) have evidence in relieving both physiological (imbalance) and psychological symptoms (stress, anxiety, and depression). The human balance system is so complex, that multiple organs and psychology should work in a rhythm to maintain balance and to avoid dizziness. Three components of Vestibular system impact the balance and dizziness are Vestibulo ocular reflex (VOR), VSR (vestibular spinal reflex) and 3 Balance Strategies (ankle, hip, and stepping strategy). Yoga poses done with eyes open with gazing a target, eyes closed, and pose transitions are similar techniques of vestibular rehabilitation in relation with VOR, VSR, and three balance strategies. **DISCUSSION**

AND CONCLUSION: Integrating yoga components of poses, breathing and meditation in vestibular rehabilitation could benefit both psychological and physical symptoms of vestibular disorders.

(THEORY)

19. NONEPILEPTIC SEIZURES WITH VERTIGO AND THE EFFECT OF VESTIBULAR REHABILITATION.

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BACKGROUND & PURPOSE: Nonepileptic seizures (NES) are episodes of altered movement, sensation, or experience distinguished from epileptic seizures by the lack of associated ictal abnormal electrical brain discharges. Physiologic NES (PNES) are caused by a variety of conditions that can be the result of sudden changes in the blood supply to the brain or in the sugar or oxygen levels in the brain. Exercise can reduce seizure frequency in people with epilepsy. Little is known on the effect of vestibular rehabilitation. **CASE**

DESCRIPTION: Patient is a 45 y.o. female with a medical history significant for epilepsy and migraines, fibrous dysplasia of bone in sinus, who presents to VR with episodes of vertigo with nausea and vomiting which last for several minutes. During these episodes she lies down and falls asleep, then wakes feeling as if she had a seizure: fatigued, achy, and spacy. Of note, patient experienced this type of episode during VEEG and did not display epileptiform discharges and no abnormal movements. Patient was referred to VR for complaints of vertigo and imbalance, and migraine specialist for evaluation of possible vestibular migraine. She presented with impaired dynamic balance as evidenced by a score of 12/30 on the Functional Gait Assessment (FGA) and impaired VOR as demonstrated by a 6 line difference on the Dynamic Visual Acuity test. She reported a sensation of falling and demonstrated right torsional upbeating nystagmus in right dix-hallpike. **OUTCOMES:** Her gait speed improved from 0.99 to 1.1m/s and her episodes of PNES with vertigo decreased in frequency from 4-8 per month to 1-2 per month after attending 16 vestibular physical therapy sessions. Her FGA score improved from 12/30 to 23/30 representing reduced risk for falls. She was treated with a canalith repositioning maneuver (CRM) for right posterior canalithiasis to resolution of nystagmus but continued symptoms of falling in the test position. Testing for BPPV did not reproduce her episodes of vertigo and she only demonstrated minimal nystagmus, however with CRM her symptoms improved. The migraine specialist prescribed sumatriptan intranasally for acute abortive treatment, however did not suspect that these episodes were vestibular migraines.

After taking the medication patient reported mild improvement in her symptoms once she woke up from her episodes, however they did not stop the vertigo from progressing to the point where patient needed to fall asleep. **DISCUSSION AND CONCLUSION:** Through progressive habituation and adaptation exercises, and BPPV treatment, this patient reported reduced symptoms of vertigo and dizziness, and decreased frequency of PNES episodes. She learned how to manage her vertiginous symptoms so that she was able to move on to another activity and ultimately become a more active participant in her community, returning to water aerobics. VR can help patients with PNES to return to their prior level of function through exercise and patient education.

(CASE STUDY)

20. SIZE MATTERS FOR VESTIBULAR PERCEPTION OF SPATIAL ORIENTATION

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BACKGROUND & PURPOSE: Chronic dizziness can lead to abnormal self-motion perception. Perceptual training may improve chronic dizziness. In darkness, accurate rotation perception across rotation sizes depends on some intact vestibular function. Prior studies limited rotation numbers to avoid vestibular reflex and perception attenuation, as occurs with repeated constant velocity rotations. We hypothesize that self-motion perceptual accuracy will decrease as rotation size increases, but not degrade with repetition. **METHODS:** Fifteen healthy adults, mean age 31.2 (SD = 7.96) years sat in a motorized rotary chair and experienced 100 position step rotations (10 blocks of 10 rotations) in the dark of 45, 90, 135, and 180 degrees following a trapezoidal velocity profile with peak velocity of 60 degrees/second. Rotation directions alternated right and left. The order of rotation size was randomly determined for each subject. After each rotation, subjects verbally reported the perceived size of the rotation. Perceptual responses were compared to actual rotation size to determine accuracy (Perceptual Gain). Subjects did not receive feedback regarding their accuracy. Repeated measures ANOVAs were used to determine 1) whether average perceptual gain changed with rotation size; 2) whether average perceptual gain decreased across rotation blocks; and 3) whether the number of errors increased across rotation blocks, while accounting for within subject repeated rotations. Alpha was set to 0.05. **RESULTS:** Perceptual accuracy for vestibular spatial orientation significantly declined with increasing rotation amplitude ($F(1,3) = 18.22, p < 0.001$). Average perceptual gain was stable across the 10 blocks of rotations ($F(1,9) = 1.52, p < 0.208$). The number of errors did not change across the 10 blocks of rotations ($F(1,9) = 1.15, p < 0.342$). **DISCUSSION AND CONCLUSION:** These results indicate that larger rotation sizes in fact do reduce the accuracy of vestibular perception of spatial orientation in healthy adults. However, the number of position step rotations does not impact the accuracy between repetitions. This provides the groundwork to develop novel treatments for perceptual impairments in chronic dizziness.
(RESEARCH)

21. SUCCESSFUL VESTIBULAR REHABILITATION OF A PATIENT STATUS POST SICKLE CELL ANEMIA CRISIS WITH RESIDUAL VESTIBULOPATHY

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BACKGROUND AND PURPOSE: Sickle cell anemia (SCA) can result in ischemic crises that effect the labyrinthine and basilar arteries, reducing blood flow to the inner ear. Sensorineural hearing loss (SNHL), tinnitus, vertigo, and disequilibrium are potential symptoms of ischemic events post SCA crisis. Minimal research is available on vestibular physical therapy (VPT) post SCA crisis. The purpose of this case report is to demonstrate successful use of VPT on an individual with vestibulopathy post SCA ischemic crisis. **CASE DESCRIPTION:** Patient (Pt) is a 46-year-old female with PMH of retinopathy and SCA. Pt presents 2 months s/p SCA crisis resulting in diffuse bone pain, sudden onset disequilibrium, vertigo, Left (L) sided SNHL, and tinnitus that lasted over 24 hours. Residual symptoms after 24 hours included tinnitus, mild disequilibrium, and dizziness with head movements. Pts examination revealed first degree Right (R) beating nystagmus, positive head impulse test to the L, and robust R beating nystagmus post horizontal head shaking, which are consistent with a unilateral L peripheral vestibular hypofunction. At onset of care, Pt demonstrated significantly impaired dynamic balance as indicated by a 10/30 on the functional gait assessment (FGA) placing her at an increased risk for falls. In addition, she ambulated at a significantly reduced gait speed compared to age matched norms and reported a severe level of disability due to dizziness and instability (dizziness handicap inventory [DHI] score of 64). **OUTCOMES:** Patient completed 9, 45-minute sessions of VPT focusing on gaze stability x 1 and x2 viewing, habituation, adaptation, and dynamic balance. Pt demonstrated significant improvement in dynamic balance as measured by the (FGA), self-reported disability measured by the DHI, balance self-efficacy via the Activities Specific Balance Confidence Scale (ABC), and habitual gait speed (0.80 m/s to 1.31 m/s). Pt returned to work and all leisure activities without symptoms. **DISCUSSION AND CONCLUSION:** SCA crisis can affect the labyrinthine and basilar arteries thus resulting in reduction in tonic firing rate of CN 8 leading to a vestibular hypofunction. Traditional VPT can address the aforementioned deficits in a patient with a residual hypofunction s/p SCA crises.
(CASE STUDY)

22. THE EFFECT OF BLOOD FLOW RESTRICTION TRAINING IN CONJUNCTION WITH VESTIBULAR REHABILITATION FOR A PATIENT SUFFERING FROM ORTHOSTATIC INTOLERANCE AND MOTION SICKNESS.

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BACKGROUND AND PURPOSE: Studies have shown a connection between the vestibular system (particularly the otoliths) and the cardiovascular reflex in relationship to improving blood flow to the brain depending on head position. The purpose of this study was to see if increased muscle mass in the quadriceps in addition to vestibular rehabilitation would improve symptoms of orthostatic intolerance/dizziness in weight bearing positions. **CASE DESCRIPTION:** 37-year-old female referred to physical therapy with a diagnosis of "severe motion sickness." Past medical history included multiple grand mal seizures in 2013 with negative CT scan and a diagnosis of neurologically-mediated hypotension. The patient's primary complaints were an inability to stand for greater than 30 minutes without feeling dizzy or lightheaded, decreased ability to concentrate, and an inability to ride in cars, trains, planes or even look at things in motion. Outcome measures included severity of dizziness on a 0-10 scale. Quadriceps circumference measurements at 2 inches above patellar pole, cervical ROM, Modified CTSIB, gaze stabilization, smooth pursuit, saccades, VOR cancellation, VOR and a dizziness handicap inventory score. Treatment-1x/week for 6 weeks: 45 minutes of vestibular rehabilitation/cervical stabilization/ visual exercises. Then 1-2x/week for 8 weeks: 45 minutes of progressive blood flow restriction training emphasizing quadriceps. **OUTCOMES:** Dizziness severity rating with 30 minutes of standing: 2/10 (initially 10/10) DHI= 14-point drop Average of 5.1% increased thigh circumference Normal VOR (initially corrective saccades with increased dizziness) Improved VOR cancellation tolerance from 2 reps to 10 No longer demonstrates right beating with right gaze Improved CTSIB: eyes closed/foam-improved sway from severe to mild Ability to travel with independent symptom management strategies. **DISCUSSION AND CONCLUSION:** Outcomes of this case study suggest that the use of blood flow restriction for strengthening quadriceps in addition to vestibular rehabilitation for patients suffering from orthostatic intolerance may be beneficial to improve symptoms which greatly impact quality of life. One theory of why this may be an effective approach to improving orthostatic intolerance is that increased muscle mass in the lower extremity may improve vasoconstriction when standing and assist with blood flow to the brain. **(CASE STUDY)**

23. THE INFLUENCE OF MONOFIXATION SYNDROME ON VESTIBULAR COMPENSATION FOLLOWING TRANSMASTOID LABYRINTHECTOMY.

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BACKGROUND AND PURPOSE: Vestibular physical therapy is a treatment option pre-and post transmastoid labyrinthectomy with the effects and negative prognostic indicators well documented in the literature. The purpose of this report is to describe the possible influence of monofixation syndrome and constant microesophoria on vestibular compensation. Further, this report emphasizes the importance of an ocular motor assessment and the utilization of referrals to promote a team-based approach to achieve optimal outcomes. **CASE DESCRIPTION:** This case study reviews the history, examination, interventions, and outcomes of a 49-year-old male who underwent transmastoid labyrinthectomy in 2012 secondary to Meniere's Disease. He sought physical therapy care with multiple providers over a 3-year span with persistent symptoms of dizziness, imbalance and visual motion sensitivity. He was referred to an additional trial of vestibular therapy in 2016 and participated in 20 weekly visits focusing on gaze stability, sensory organization, gait and balance, and visual motion habituation. Following an improvement in balance outcomes and a plateau in self-report measures, a repeat oculomotor exam revealed visual suppression with convergence and esophoria with cover/uncover test. He was referred to neuro-optometry and received 10 weeks of vision therapy for monofixation syndrome. The patient returned to vestibular therapy for reassessment and received an additional 3 visits over a 6-week time frame with emphasis on gaze stabilization. The initial evaluation consisted of subjective questionnaires, ocular motor examination, and balance testing. Subjective measures included the Activities-specific Balance Confidence Scale (ABC) and the Dizziness Handicap Inventory (DHI). Objective measures included the Dynamic Gait Index (DGI), Functional Gait Assessment (FGA), and the Modified Clinical Test of Sensory Organization (mCTSIB). Initial ABC was 72% and DHI was 56. The DGI and FGA were both 22. His mCTSIB was normal for eyes open conditions and abnormal for eyes closed. **OUTCOMES:** Following completion of his first 20 visits, he demonstrated improvement in objective measures and achieved near perfect scores except for the FGA plateauing at 25/30, however, he continued to report subjective impairment with a DHI of 42. Upon completion of vision therapy, he reported subjective improvement in function with ABC to 99% and DHI to 4 and demonstrated perfect FGA and DGI scores. Following 6 weeks of vestibular therapy his DHI improved to 0. **DISCUSSION AND CONCLUSION:** Early identification and management of ocular misalignment and visual suppression syndromes through a detailed oculomotor exam is key to early identification of potential confounding co-morbidities to vestibular compensation. This case study suggests that utilizing a team-based approach with vision therapy may improve patient outcomes. Vestibular therapy focused on gaze stability after a brief adjustment period post vision therapy resolved this patient's dizziness and improved his function. **(CASE STUDY)**

24. VESTIBULAR REHABILITATION FOR PERSISTENT MAL DE DEBARQUEMENT SYNDROME (MDDS) UTILIZING REVERSE SENSORY RE-WEIGHTING AND COMBINED VOR RE-ADAPTATION.

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BACKGROUND AND PURPOSE: Mal de Debarquement Syndrome (MdDS) is a neuro-vestibular disorder that is characterized by abnormal sensation of motion that arises from exposure to prolonged passive motion, such as a cruise or flight. The purpose of this case series is to discuss the efficacy of reverse sensory re-weighting through vestibular adaptation and substitution exercises using a patient response driven treatment strategy.

CASE DESCRIPTION: Three Women and one Male (age 55-74 years) with history of persistent symptoms of dizziness, imbalance, postural sway and rocking after exposure to prolonged passive motion (E.g. Cruise, flight, car, etc.). Duration of patient symptoms were greater than 6 months. All patients were evaluated by a physical therapist and all presented with symptoms consistent with persistent MdDS after examination. Each patient received physical therapy treatment for vestibular rehabilitation. The method of reverse sensory re-weighting was used to enhance patient recovery. All treatments began at higher levels of instability to accommodate the patient's perception of passive motion. The patients were slowly progressed from compliant surfaces to non-compliant surfaces with concurrent VOR exercises to provoke vestibular and central adaptation in order to reduce symptoms of passive motion. The DHI and ABC scale were used as outcome measures to track patient response to treatment. **OUTCOMES:** The interventions caused no adverse effects. All patients demonstrated improvements with DHI and ABC scale scores. The patients reported reduced or abolished self-perceived motion, dizziness and imbalance. Additional improvements were noted in overall balance scores at the end of rehabilitation. The change in patient outcome measure scores exceeded the minimal detectable change, indicating measurable improvements with Physical Therapy intervention. **DISCUSSION AND CONCLUSIONS:** The results described in this case series suggest that combined reverse sensory re-weighting and VOR re-adaptation were beneficial at increasing balance tolerance and reducing symptoms of persistent MdDS. The present case series may be useful for tailoring rehab interventions to patients with MdDS. Further research is warranted to determine the clinical efficacy and significance of using a reverse sensory re-weighting approach combined with VOR for patients with persistent MdDS.

(CASE SERIES)

25. REHABILITATION OF AN ADOLESCENT EQUESTRIAN ATHLETE WITH A HISTORY OF MULTIPLE CONCUSSIONS: A CASE REPORT DESCRIBING THE DEVELOPMENT OF A RETURN-TO-RIDING PROTOCOL.

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BACKGROUND AND PURPOSE: Currently, the literature guiding rehabilitation for concussion management in equestrian athletes is limited, especially for directing return-to-riding. Being familiar with the demands of the sport is of vital importance because each sport presents with unique tasks that require different physical and cognitive demands. The purpose of this case report was to describe the PT management and development of a return-to-riding protocol for an equestrian athlete with history of multiple concussions. **CASE DESCRIPTION:** The patient was a 14-year-old female competitive equestrian rider with a history of three concussions within a three-year span. The patient was referred by a neurologist to neuropsychology and physical therapy. She experienced post concussive symptoms for 2 weeks before presenting to physical therapy. The initial physical therapy examination included cervical spine screening, vestibular testing, balance assessment, and sub-symptom aerobic testing.

OUTCOMES: Vestibular-ocular function assessed via VOMS, cervical DNF strength assessed using DNF endurance test, cervical proprioception tested with JPE using laser, balance assessed using BESS, and aerobic capacity assessed using modified Balke TM protocol. Patient performed 8 sessions of PT over 4-6 wks. At the final evaluation, the patient reported no symptoms at rest or with exercise, was asymptomatic with VOR testing, and demonstrated improvements to WNL in the DVAT, JPE test, and BESS. The patient completed the return-to-riding protocol in two weeks and returned to equestrian competition without complaints 6 weeks after initiating physical therapy. **DISCUSSION AND CONCLUSION:** This case report describes the successful return-to-sport of an equestrian athlete. The physical therapy program included an impairment-based approach that involved exercises for the C-spine, vestibular system, and balance. A protocol was developed to inform the patient's progression back to competition. This protocol was patterned after existing sport-specific protocols and can be used to inform physical therapy decision making in similar patients.

(CASE STUDY)

26. UNILATERAL INCREMENTAL VESTIBULO-OCULAR REFLEX ADAPTATION (IVA) TRAINING DYNAMICALLY TAILORED FOR EACH SUBJECT.

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BACKGROUND AND PURPOSE: Unilateral VOR adaptation (IVA) increases the VOR gain (=eye/head velocity) for head rotations to one side by ~10%. Prior IVA studies involved setting the initial VOR training gain demand at the subject's starting value (=1 in a normal subject), with the gain pre-set to increment by 0.1 every 90 secs over 15 mins. At some point during training the VOR can no longer match the gain demand. We determined if a dynamically calculated gain demand (=actual gain+0.1) would result in greater adaptation. **METHODS:** Using a hybrid video-oculography and StableEyes training system we measured the active (self-generated head impulse) and passive (imposed, unpredictable, head impulse) VOR gain in 5 normal subjects before and after 15 mins of STATIC (i.e. pre-set) and DYNAMIC IVA training consisting of active, leftward and rightward, horizontal head impulses (peak-amplitude 15deg, peak-velocity 150deg/s and peak-acceleration 3000deg/s²). We also measured the active VOR gain during training. **RESULTS:** In these subjects, the active and passive VOR gains, measured before and after training, respectively, increased towards the adapting side by $6.7 \pm 4.5\%$ and $8.2 \pm 6.6\%$ after STATIC and $12.9 \pm 4.0\%$ and $14.2 \pm 6.0\%$ after DYNAMIC IVA training (paired t test between STATIC and DYNAMIC: active $p=0.02$, passive $p=0.07$). The active VOR gain increase peaked at $12.5 \pm 4.8\%$ during STATIC and $19.6 \pm 4.4\%$ (paired t test, $p=0.06$) during DYNAMIC IVA training. **DISCUSSION AND CONCLUSION:** Our data suggest that DYNAMIC IVA training is optimal for VOR adaptation and has the added benefit that the training demand is dynamically adjusted for each subject. This means the VOR gain demand is always a small amount above the actual gain, as opposed to the situation where there is a steadily increasing gap between actual and training demand gains. It also allows more flexible training, e.g., spread training over several smaller time blocks, without undoing prior adaptation. **(RESEARCH)**

27. VESTIBULAR REHABILITATION DURING THE “WATCH AND WAIT” APPROACH FOR A PATIENT WITH AN ACOUSTIC NEUROMA.

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BACKGROUND AND PURPOSE: To determine if vestibular rehabilitation can make an improvement in quality of life and a lasting change for a patient who is experiencing imbalance and dizziness while involved in the “watch and wait” approach for her acoustic neuroma. **CASE DESCRIPTION:** A case on 52-year-old female with a left acoustic neuroma was referred to vestibular rehabilitation secondary to disequilibrium and imbalance. Her subjective dizziness was assessed using the Dizziness Handicap Inventory (DHI). While her balance and stabilization of gaze were assessed using the Dynamic Visual Acuity (DVA), Gaze Stabilization Test (GST), Sensory Organization Test (SOT) by NeuroCom and the Functional Gait Assessment (FGA). The patient participated in four, one-hour vestibular therapy sessions with a focus on stabilization of gaze and balance activities. Her progress was tracked with the SOT, DHI, FGA, and DVA six weeks after discontinuing rehabilitation and her DHI was tracked again at 3 months post rehabilitation. **OUTCOMES:** Her subjective dizziness made the most significant improvement with a score of 50% prior to starting rehabilitation with a physical component= 57%, functional component =50% and an emotional component=61%. At her 6 week and 3-month post rehabilitation assessment DHI scored 0%. Her DVA log MAR change improved for both her right and left side going from a 0.22logMAR change on the left to a 0.00 change and a 0.2logMAR change on the right down to a 0.04 at her 6-week post rehabilitation scoring. Her balance on the SOT improved from a composite of 66 (6% below average for her age prior to rehabilitation) to an 81 at her 6 weeks post rehabilitation checkup. Her FGA score improved from a 23/30 at her initial evaluation to a 29/30 6 weeks post rehabilitation. The patient returned to driving, school and working with no reports of dizziness or imbalance. **DISCUSSION AND CONCLUSION:** The patient's subjective dizziness decreased, her balance improved and her VOR gain increased thru vestibular rehabilitation. She was able to maintain her improvement in her balance and VOR gain at 6 weeks post rehabilitation and maintain her functional level and no reports of dizziness at 3 months post rehab. The outcome of this case supports the benefit of vestibular rehabilitation for patients with an acoustic neuroma during the watch and wait period. **(CASE STUDY)**

28. MULTIDISCIPLINARY APPROACH FOR MANAGEMENT OF EXTENSIVE COMPLICATIONS FROM ACOUSTIC NEUROMA RESECTION.

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BACKGROUND AND PURPOSE: The treatment of large acoustic neuromas usually involves surgical resection. Post-operative management requires a multidisciplinary approach. The purpose of this case study is to detail the management of a patient who developed Cranial Nerve (CN) palsies, immediate post-op hematoma in the surgical cavity, subsequent pseudo meningocele and hydrocephalus following a suboccipital craniectomy (SOC)

for acoustic neuroma resection. **CASE DESCRIPTION:** 72 YO F with H/O hearing loss, ataxia and HA's for 9 months. MRI revealed a large 3.5 cm mass with chronic compression of the brainstem & cerebellum: consistent with an acoustic neuroma. Pt. underwent a SOC with stereotactic guidance for removal of tumor and decompression of CN's. On POD#2 Pt. developed a hematoma in the surgical cavity, which was resected. Pt. received multidisciplinary intervention during both her acute hospitalization (AH) (3x times) and her acute rehab (ARF) (2x times) stay. Following her initial ARF stay, Pt. was d/ced home ambulating with assistance from family. Within 10 days, Pt. returned to the AH for mental status changes: NCHCT revealed pseudomeningocele which was surgically drained. After a weeklong stay in the acute hospital, Pt. was d/ced to ARF again for 9 days, when she was emergently transferred back to AH for new onset hydrocephalus. Following placement of L VPS and AH stay of 20 days Pt. was d/ced home with homecare services and ambulating with RW. **OUTCOMES:** PT intervention focused on Vestibular Adaptation exs., Oculomotor re-training, balance and gait training. The AM-PAC 6-click data and the TUG was measured at every entry and exit point of acute care. FIM scores were used to record functional changes in inpatient rehab. Overall, the patients TUG score went from 142 secs (POD#2) to 112 secs (POD#87): a drop of 30 secs. The AM-PAC scaled score went from 32.23(POD#2) to 39.67(POD#87): a rise of 7.4 points. **DISCUSSION AND CONCLUSION:** The likelihood of developing complications following resection of acoustic neuromas depends on tumor size & growth past the internal auditory canal. In our case, a multi-disciplinary approach from the Neurosurgery, ENT, GI, Neuro-Ophthalmology, Rehabilitation Medicine, and Optometry service was utilized. Eventually our Pt. returned home to her family. Understanding the complications, timely management and an interdisciplinary approach can greatly improve Pt. outcomes and quality of life. **(CASE STUDY)**

29. THE USE OF VESTIBULAR REHABILITATION TO FACILITATE RETURN TO FUNCTIONAL AND RECREATIONAL ACTIVITIES AFTER RAMSAY HUNT SYNDROME.

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BACKGROUND AND PURPOSE: Ramsay Hunt Syndrome (RHS) is usually caused by varicella zoster virus and affects the seventh and sometimes eighth cranial nerve, resulting in facial paralysis, otalgia, and herpetic eruptions. Patient (pts) with RHS can also experience tinnitus, hearing loss, and vertigo. Exercises used in vestibular rehabilitation (VR) can address imbalance, impaired gaze stability, and dizziness with mobility. The purpose of this case study was to illustrate the use of VR in a patient with a history of RHS. **CASE DESCRIPTION:** Pt is a 24-year-old female who presented to VR after being diagnosed with RHS. She complained of imbalance, dizziness, and vertigo that was provoked by quick head and body movement, visual stimulation, and recreational activities such as running. Upon evaluation, she presented with signs and symptoms (sx) of a unilateral vestibular hypofunction, which is consistent with her diagnosis of RHS. She was seen for 9 sessions of VR with an emphasis on gaze stability, ambulation with head turns (HT), turning, static balance, and optokinetics. She also performed otolithic tasks such as jogging, skipping, shuffling, treadmill training, and jumping to facilitate her return to running. Portions of these exercises performed were also prescribed as part of her Home Exercise Program (HEP) to promote vestibular compensation and habituation to provoking stimuli. **OUTCOMES:** Outcome measures that were used included Functional Gait Assessment (FGA), Dizziness Handicap Inventory (DHI), Dynamic Visual Acuity (DVA), number of HT performed during evaluation of Vestibular Ocular Reflex (VOR), gait speed (meters/second (m/s)), and gait speed with HT (m/s). At discharge, patient increased her FGA score from 23/30 to 30/30, gait speed from 1.21 m/s to 1.50 m/s, and gait speed with HT from 0.97 m/s to 1.29 m/s, suggesting decreased fall risk and improved dynamic balance. She improved her DVA score from an 8 to 6-line difference and increased her number of horizontal and vertical HT per minute during evaluation of VOR from 27.50-41.67% of the expected norm to 100% of the expected norm, indicating enhanced gaze stability. She decreased her score on the DHI from 40/100 to 18/100, reflecting decreased disability from her sx. She returned to her regular running program without restriction from dizziness and completed a half marathon. **DISCUSSION AND CONCLUSION:** RHS is a condition that may result in unilateral vestibular hypofunction and therefore cause dizziness, imbalance, and vertigo. There is limited research that extensively discusses the use of VR for patients with RHS. This case report demonstrates how VR can be used to promote central compensation and habituation in pts with RHS. Additionally, this case shows how otolithic tasks with a focus on running can promote return to prior level of function for higher level pts who have RHS. **(CASE STUDY)**

30. A COMPARISON OF VESTIBULAR REHABILITATION PROGRESSIONS FOR VERTIGO CAUSED BY DIFFERENT DIAGNOSES.

GRAS L., Cherin A, HARRIS M., LiTrenta M, Tarpey C, Tracy A, Warren J, Wolfanger A.

Ithaca College, Ithaca, NY

BACKGROUND AND PURPOSE: Vertigo can be associated with a variety of vestibular disorders from central or peripheral origins. Currently, there is a gap in the scientific literature regarding vestibular rehabilitation for different diagnoses that cause vertigo. The purpose of this study is to examine the effectiveness of physical

therapy interventions for vestibular disorders due to different pathologies. **METHODS:** This study is a retrospective chart review of physical therapy medical records. Patients were included in this study based on a sample of convenience. All patients received vestibular ocular reflex (VOR) adaptation exercises with a progression as tolerated. The same exercise progression was used across all diagnoses allowing comparisons to be made between different conditions. Dizziness intensity was rated on a 0-10 Visual Analog Scale (VAS) at the beginning of each visit, and the number of visits were recorded. Data was analyzed using descriptive statistics. **RESULTS:** The review consisted of 7 physical therapy charts: 2 patients with concussion (1 acute and 1 chronic), 3 with migraine (1 acute and 2 chronic), 1 with Meniere's disease (chronic), and 1 with labyrinthitis (chronic). Patients with concussion had the highest average VAS and highest average number of visits across all diagnoses. The patient with an acute concussion had more visits than the patient with a chronic concussion. Those with chronic migraine had more visits than the patient with an acute migraine. Participants with central diagnoses had a higher average VAS and number of visits than patients with peripheral diagnoses. **DISCUSSION AND CONCLUSION:** Vestibular rehabilitation was beneficial for decreasing vertigo across all diagnoses included in this study. Physical therapist can use the results of this study to base their patient's VOR adaptation exercise progressions on. VOR adaptation exercises were successful in treating patient with both central and peripheral vestibular disorders although they varied on dizziness ratings and recovery time. **(RESEARCH)**

Saturday Poster Session 5:45-7:30pm

31. AMBULATORY CARE PHYSICIAN ADHERENCE TO BPPV CLINICAL PRACTICE GUIDELINES IN THE UNITED STATES.

DUNLAP P,¹ Khoja S,¹ Whitney S,^{1,2} Freburger J.¹

¹ University of Pittsburgh, Department of Physical Therapy. ² University of Pittsburgh, Department of Otolaryngology, Pittsburgh, PA.

(RESEARCH)

32. DECODING DIZZINESS: A CASE REPORT ON DIAGNOSING A PATIENT WITH A RARE BENIGN PAROXYSMAL POSITIONAL VERTIGO.

SABADOSA S.

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BACKGROUND AND PURPOSE: Patients with dizziness attend PT because their symptoms impact their physical, emotional, and functional normalcy. The purpose of this case report was to demonstrate how a differential diagnosis was used to identify and treat a patient with an uncommon type of BPPV. This patient was selected because her examination presented with both central and peripheral signs that required clinical reasoning in order to determine the appropriate treatment plan of care and improve her quality of life. **CASE**

DESCRIPTION: The patient was 74-year-old female who experienced a new onset of dizziness and vertigo the day before presenting in the outpatient PT clinic. She awoke with unsteadiness, nausea, and vomiting. Her symptoms worsened after rolling in bed and lying in a dentist's chair. She required transportation from family to appointments. The patient also reported a headache and diplopia. Her past medical history included a strabismus known as hypertropia exotropia, CAD, and history of DVT and vertigo. The patient reported DHI of 80% disability. The patient's oculomotor exam demonstrated a positive smooth pursuit, VOR cancellation, and saccadic eye movements. The HINTS exam was negative, which has a 100% sensitivity for AVS. She had a positive right Dix-Hallpike with notable down beating nystagmus and reports of nausea. Symptoms lasted less than 60 seconds, and patients again experienced nystagmus and nausea when returning to upright. She was diagnosed with left anterior canalithiasis. **OUTCOMES:** The patient underwent one Epley maneuver to address her anterior canalithiasis with minimal immediate results. A CT scan was advised to her physician. She followed up 3 days later, reporting that she felt 80% better and able to drive independently. Positional tests were reassessed with negative Dix-Hallpike and Roll tests. Her oculomotor tests were negative for central signs. However, she did test positive for multiple unilateral vestibular hypofunction tests, including the CTSIB-M and Fukuda. At discharge, 10 days after initial evaluation, she demonstrated a 60% on DHI and negative positional tests. She also had negative central nervous system oculomotor tests, but positive CTSIB-M, VOR slow, and Head Shake test; she was diagnosed with a right vestibular hypofunction and recommended gaze stabilization exercises. However, her ophthalmologist previously disallowed VOR exercises due to her diagnosis of hypertropia exotropia, thus it was recommended to follow up with her physician. **DISCUSSION AND CONCLUSION:** This patient's subjective data and objective exams allowed for appropriate diagnoses to be made. Central and peripheral signs of vertigo were thoroughly assessed, and a rare anterior BPPV was diagnosed and treated with one Epley maneuver. The central vertigo signs may have been due to her diagnosis of hypertropia exotropia, as it was noted she continuously scanned the room. Further research is warranted on the effectiveness of gaze stabilization exercises for those with strabismus diagnoses.

(CASE STUDY)

33. IDENTIFICATION OF THE AFFECTED EAR IN LATERAL CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO: A SYSTEMATIC REVIEW.

KINNE B, Baker B, Harro C.

Grand Valley State University, Grand Rapids, MI.

BACKGROUND AND PURPOSE: The Supine Roll test is the gold standard for diagnosing lateral canal benign paroxysmal positional vertigo (LC-BPPV). However, in some cases, the elicited nystagmus has a similar intensity when the head is rolled to the right or to the left. Therefore, the purpose of this systematic review was to determine the effectiveness of accessory diagnostic procedures, used in conjunction with the Supine Roll test, at accurately identifying the affected ear in individuals with LC-BPPV. **METHODS:** The following databases were searched: (1) CINAHL Plus with Full Text, (2) ProQuest Medical Library, and (3) MEDLINE. The following search terms were used: (1) "lateral canal" OR "horizontal canal" AND (2) "positional vertigo" OR "positioning vertigo" OR "positional nystagmus" OR "positioning nystagmus". Evidence level was examined with the Oxford Centre for Evidence-Based Medicine 2011 levels of evidence method, and methodological rigor was examined with the QUADAS method. **OUTCOMES:** A database search originally identified 1348 records, and nine studies were ultimately included in the qualitative synthesis. This systematic review revealed four index tests (the Bow and Lean test, the Head Bending test, the Lying Down test, and the Pseudo-Spontaneous test) that, when used in conjunction with the Supine Roll test, were able to accurately identify the affected ear in a majority of individuals with LC-BPPV. **DISCUSSION AND CONCLUSION:** To be considered effective at accurately identifying the affected ear in individuals with LC-BPPV, an index test should be able to elicit nystagmus during its administration and to identify the same affected ear as the Supine Roll test. Although all four index tests met these two criteria to some extent, the Pseudo-Spontaneous test was found to be slightly superior to the other three tests in each category.

(RESEARCH).

34. TWO APPROACHES FOR TREATING LATERAL CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO (BPPV).

GALGON A,¹ Schoenewald W,² Fitzpatrick M,³ Tate A.⁴

¹ University of the Sciences, Philadelphia; ² WWSPT and Vestibular Rehabilitation, Doylestown, PA; ³ Willow Grove PT, Willow Grove, PA; ⁴ Arcadia University, Glenside, PA.

BACKGROUND AND PURPOSE: Outcomes of various repositioning maneuvers for Lateral Canal (LC) BPPV have shown moderate effectiveness. Deciding whether to perform roll or side lying with head rotation maneuvers is a challenge for clinician who treat LC BPPV. The purpose of this research was to determine, if treatment approach affected the number of maneuvers before resolution of LC BPPV. **METHODS:** Fifty-six individuals diagnosed with LC BPPV using video goggles were stratified by nystagmus presentation (28 geotropic, 28 apogeotropic) and randomized into 2 treatment approaches. Individuals assigned to the roll maneuver approach received log roll maneuvers for geotropic presentations and modified roll maneuvers, described by Kim et al (2012), for apogeotropic presentations. Individuals assigned to the sidelying head rotation (SLHR) approach received contralateral sidelying and downward head rotations for geotropic presentations and ipsilateral sidelying and upward head rotations for apogeotropic presentations. A blinded observer verified nystagmus and resolution from video recordings. Percent of individuals who had resolution of nystagmus was calculated after 2, 4 and 6 maneuvers. Odds Ratios (OR) for resolution was used to compare the two approaches. Frequency of conversions and switching of direction of maneuvers was compared. **RESULTS:** Resolution in the geotropic presentation was 64, 79 and 93% after 2, 4, and 6 roll maneuvers and 60, 70 and 80% after 2, 4, and 6 SLHR maneuvers, respectively. OR=1.5, 1.6 and 3.5 favoring the roll approach after 2, 4, and 6 maneuvers, respectively. Conversions to apogeotropic occurred twice in the roll approach and switching direction of maneuvers assisted resolution. One conversion to posterior canal (PC) occurred in the SLHR approach. Resolution in the ageotropic presentation was 33%, 58% and 75% after 2, 4, and 6 roll and 27%, 73% and 82% after 2, 4, and 6 SLHR maneuvers. OR=1.3 favoring the roll approach after 2, and 1.9 and 1.5 favoring the SLHR approach after 4 and 6 maneuvers. Three in the SLHR and 2 in the roll groups converted to a geotropic presentation and 2 from each group converted to PC. Six unresolved individuals, 3 in each group, demonstrated persistent asymptomatic apogeotropic nystagmus. Therapists switch directions of maneuvers more often in the SLHR approach. **DISCUSSION AND CONCLUSION:** In this pragmatic study physical therapists provided one of two approaches after diagnosing individuals with LC BPPV using video goggles. The results do not support that one approach is more effective and outcomes are similar to previous research on managing LC BPPV. However, no previous study has compared the modified roll to the SLHR maneuvers in apogeotropic presentations. The study results are limited by diagnostic issues including initial treatment of incorrect side of pathology and the presence of asymptomatic nystagmus.

(RESEARCH)

35. UTILIZING THE DIZZINESS HANDICAP INVENTORY TO DETERMINE NEED FOR BPPV TESTING IN ALL AGE GROUP POPULATIONS.

MATHIS S, CASSIDY A.

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BACKGROUND AND PURPOSE: Dizziness Handicap Inventory (DHI) is a useful tool for determining BPPV verses other causes of dizziness, specifically using the 5-item subscale. Though BPPV is more likely in the > 60-year population, it can occur at any age and is in most cases easily treatable. The purpose of this case study is to review a young patient who went through multiple medical assessments including MRI/CT scan, chest x-ray, EKG, blood laboratory testing, spinal tap, before being successfully treated for BPPV. **CASE DESCRIPTION:** This case study will review a 33-year-old female patient who was referred to a vestibular physical therapy (PT) office for “disorder of vestibular function”. The patient was admitted to the ED at the start of symptoms, saw a neurologist and ENT without formal diagnoses due to inconclusive testing, sent to vestibular PT approximately 6 weeks post initial onset of symptoms. On initial evaluation, the DHI score was 68/100 and the 5 item DHI subscale was 20/20. Despite a complex presentation, PT focused on the consistency of position change related symptoms as indicated by the DHI scale along with patient report. Patient was successfully treated for left posterior canal BPPV in one treatment, with a small amplitude reoccurrence requiring an additional treatment a few weeks later, followed by 4 appointments for exercise training due to deconditioning from avoiding movement for nearly three months. In 6 sessions, the patient returned to baseline status. **OUTCOMES:** Her DHI score initially was 68/100 on evaluation and improved to 6/100 at discharge. Additionally, on evaluation patient answered “yes” to all 5 items on the DHI subscale indicative of BPPV (20/20). At discharge, all answers were “no” except for “sometimes” with getting out of bed and bending over (4/20). Dizziness scores on initial evaluation were 7/10 and on discharge improved to 0/10. Lastly, his Dix Hallpike test was positive for left posterior canal involvement on initial evaluation and negative at the time of discharge. **DISCUSSION AND CONCLUSION:** Patient had decrease in stress and frustration with treatment of BPPV. She was now able to return to work for the first time in 2 months. She also noted less anxiety with resolution of her dizziness because she had been through a work up for progressive neurological conditions when cause was unknown. The patient had a complicated presentation, however utilizing the 5 item DHI tool allowed the practitioners to focus on treatment of BPPV despite other confusing symptoms and return her to baseline. **(CASE STUDY).**

36. TUMARKIN-LIKE PHENOMENON AS A SIGN OF THERAPEUTIC SUCCESS IN BENIGN PAROXYSMAL POSITIONAL VERTIGO

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BACKGROUND AND PURPOSE: Benign paroxysmal positional vertigo (BPPV) is the leading cause of vertigo in adults. Epley and Semont maneuvers are used to treat posterior semicircular canalolithiasis BPPV bringing the otoconia back into the utricle. We conjecture that a Tumarkin-like phenomenon, which may result from mechanical deformation of the otolithic organs activating the vestibulospinal reflex, and that may also occur immediately after the maneuvers, if seen clinically, it is a marker of good therapeutic prognosis. **METHOD:** Retrospective study consisting of 221 persons with confirmed posterior canal BPPV canalithiasis according to Classification of Vestibular Disorders of the Bárány Society. **RESULTS:** During the Epley or Semont maneuvers, 33 patients felt a sudden and strong feeling of being “thrown to the ground” by a “force” without a loss of consciousness (Tumarkin-like phenomenon). The patients who experienced this sensation included 25 women and 8 men. Ages ranged from 46 to 90 years (mean SD 70.5 ± 10.5 years, median 69 years). The Epley procedure was performed on 21 of the patients with posterior canal BPPV. Throughout the maneuvers, we observed the nystagmus elicited by each positional change with video Frenzel goggles. In one patient, the modified Semont was provided to each posterior canal during the same session. In one patient, the Epley and Semont maneuvers were applied bilaterally during the same session. Of the 33 patients who experienced the Tumarkin-like phenomenon during posterior canal BPPV intervention, the right posterior canal was affected in 17 (52%) patients, the left posterior canal was affected in 14 (42%), and both the right and left posterior canals were affected in 2 (6%). Patient outcome was determined either with a negative Dix Hallpike test or via a telephone call post treatment. All 33 patients who presented with the Tumarkin-like crisis improved. **DISCUSSION AND CONCLUSION:** The 33 patients who experienced a Tumarkin-like phenomenon had a dramatic otolithic crisis without any warning or loss of consciousness, clearly distinguishing this phenomenon from syncope. The, most likely caused by the arrival of otoconia in the utricle that triggered a spinal vestibular reflex and a stereotypical attack. It should be kept in mind that is highly recommended to always hold on to the patient after repositioning to prevent injury. **(RESEARCH)**

37. POST-TRAUMATIC DIZZINESS: NAVIGATING THE MAZE TOWARDS ACCURATE VESTIBULAR DIAGNOSIS AND TREATMENT.

GRZESIAK M.¹ CARENDER W.¹ Basura G,²

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BACKGROUND AND PURPOSE: Diagnosis and treatment of post-traumatic, multiple canal BPPV is complex, especially when differentiating between other possible trauma related vestibular disorders, cervicogenic dizziness, and/ or central vestibular pathology. The purpose of this study is to present a case report which demonstrates the differential diagnosis and clinical reasoning skills utilized to identify and treat multiple origins of dizziness in a patient following a traumatic brain injury (TBI). **CASE DESCRIPTION:** This patient was a 73-year-old active male and executive university director who fell off a six-foot retaining wall with positive loss of consciousness, sustaining a TBI including a right temporal bone fracture with right sided high frequency sensorineural hearing loss, a left sided subdural and subarachnoid hemorrhage, and post-traumatic multiple bilateral canal BPPV. Additional musculoskeletal injuries sustained in his fall included a right shoulder, grade 3 AC joint separation. **OUTCOMES:** VPT evaluation with RealEyes™ xDVR video-oculography goggles revealed BPPV involving 4 semicircular canals in addition to a 3rd degree left beating nystagmus suggestive of a unilateral vestibular hypofunction. Intervention was aimed at treating one canal per visit, beginning with the most symptomatic canal, using the appropriate canalith repositioning maneuver while modifying positioning to minimize right shoulder pain. Following successful treatment of BPPV, treatment was adjusted to facilitate central compensation utilizing gaze stabilization, habituation, and balance exercises, in addition to a daily walking program. Education was provided on how to self-assess and treat re-occurring posterior canal BPPV in addition to avoiding factors that can contribute to central decompensation. He returned 7 weeks later for his sixth visit reporting full resolution of symptoms. Dizziness Handicap Inventory Score was 54/100 initially, decreasing to 6/100 upon discharge. **DISCUSSION AND CONCLUSION:** Scientific and clinical evidence combined with clinician expertise and selection of appropriate tests at each visit, resulted in efficient and accurate diagnosis and treatment. Due to the complexity of differentiating between multiple canal BPPV in addition to other vestibular disorders, it is imperative for the clinician to have a clear understanding of nystagmus patterns. Extensive patient education instilled self-independence and management of re-occurring BPPV and central compensation. (CASE STUDY).

38. POSTURAL ORTHOSTATIC TACHYCARDIA SYNDROME WITH VESTIBULAR DYSFUNCTION AFTER CONCUSSION.

KNOLL J.

Vestibular Rehabilitation NeuroBalance Physical Therapy Clinic.

BACKGROUND AND PURPOSE: Vestibular and Autonomic Dysfunction are well documented disorders following concussion, with orthostatic intolerance (OI) and dizziness as common symptoms. The purpose of this report is to describe the comorbidity of these two disorders in an elite athlete after concussion and present a novel treatment approach to effectively manage both disorders in Post-Concussion Syndrome. **CASE**

DESCRIPTION: Baseline Tests and Measures included heart rate (HR) and blood pressure (BP) measurements during tests of head tilts, oculomotor and VOR function, motion sensitivity to head tilts and turns, balance, and the 3-minute HR stand test for POTS. Outcome measures included inventories of the DHI and PCSS, motion sensitivity, 3-minute HR stand test, along with HR and BP measurements after each of the vestibular ocular and balance tests. Vestibular Rehabilitation was customized to the individual tests and measures, HR and BP were recorded each session before, during and after the vestibular therapy. Vestibular therapy intervention started while seated and was progressed to standing only once the HR and BP measurements were stable with the seated exercises. The Modified Dallas Exercise Recumbent Exercise Program for POTS (Levine Protocol) was prescribed. Daily patient diary of exercises completed, HR and BP responses, and symptoms was recorded.

OUTCOMES: After four months of intervention, resting HR decreased from 90 to 52 (normal for this endurance athlete), BP drop from 130/78 to 90/58 with head tilts fully resolved, and the 3-minute HR stand test for POTS improved from a rise of 43 bpm to normal response of no change in HR. PCSS score decreased from 90 to 15 and the DHI decreased from 86/100 to 24/100. Oculomotor and VOR tests were normal with no variation in HR or BP. Motion sensitivity testing was wnl with no variation in HR or BP with motion of head or eyes. Balance testing was wnl with normal CTSIB, SLS, and FGA. She progressed through the Levine Protocol successfully and returned to full upright training in her sport. No syncopal episodes occurred after the onset of care. After seven months of intervention, PCSS was 0, DHI was 0, and she returned to professional athletic competition.

DISCUSSION AND CONCLUSIONS: The role of the vestibular system in balance and sensory orientation is well understood but is only beginning to be recognized as a regulator of autonomic activity. Activation of the

sympathetic response from the otolith through the vestibulosympathetic reflex pathway has been documented in recent studies. The positive outcome in this case report suggests that combining treatment of vestibular and autonomic systems may be beneficial in improving outcomes of PCS patients with dizziness and OI. (CASE STUDY).

39. THE IMPACT OF VESTIBULAR REHABILITATION ON A PATIENT WITH MILD TRAUMATIC BRAIN INJURY AFTER BLAST EXPOSURE.

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BACKGROUND AND PURPOSE: A blast injury is physical trauma from an explosion that can cause multi-system impairments, including dizziness and vertigo resulting from central and peripheral vestibular dysfunction. Vestibular rehabilitation (VR) may be beneficial to patients (pts) after blast exposure who have impairments with gaze stability, dynamic balance, and ambulation. The purpose of this case study is to describe the impact of VR on a patient (pt) with a mild Traumatic Brain Injury (mTBI) after blast exposure. **CASE DESCRIPTION:** Pt is a 65-year-old male who suffered a blast injury in April 2017 complaining of immediate symptoms (sx) of disorientation, vertigo, imbalance, and aural pain. He presented to VR with a primary complaint of imbalance and dizziness provoked by quick head and body movement. Upon evaluation, he demonstrated signs and sx consistent with peripheral and central vestibular dysfunction. Pt was seen for 26 sessions of VR with a focus on habituation, substitution, and adaptation exercises to address his sx of imbalance, dizziness, and motion sensitivity. These exercises included ambulation with head turns (HT), gaze stabilization, static balance, optokinetics, dual task activities, training on the Balance Master, and dynamic ball toss activities. Variations of these exercises were also prescribed as part of his Home Exercise Program (HEP). **OUTCOMES:** Outcome measures included Dizziness Handicap Inventory (DHI), Functional Gait Assessment (FGA), habitual gait speed (m/s), gait speed with HT (m/s), Dynamic Visual Acuity (DVA), and Visual Vertigo Analogue Scale (VVAS). Upon follow up, pt improved his dynamic balance as evidenced by his increased habitual gait speed (from 0.85 m/s to 1.05 m/s), increased gait speed with HT (from 0.77 m/s to 1.06 m/s), and improved FGA score (from 18/30 to 22/30). He decreased his score on the DHI (from 64/100 m/s to 54/100), indicating reduced disability due to his sx and improved his DVA score (from 6-line difference to 4-line difference), suggesting increased dynamic gaze stability. Upon re-assessment of his VVAS, he reported improvements in dizziness while being a passenger in a car, watching traffic at a busy intersection, walking over a patterned floor, and being under fluorescent lights. **DISCUSSION AND CONCLUSION:** Injuries that result in both peripheral and central vestibular dysfunction may create challenges for VR therapists. Exercises that target specific functional limitations and impairments may be beneficial to pts after blast exposure who experience dizziness, imbalance, and motion sensitivity. This case study demonstrates the effective implementation of a VR program in a pt after blast exposure. Further research is warranted to explore the effectiveness of this intervention for this pt population. (CASE STUDY).

40. VESTIBULAR REHABILITATION: STRATEGIES FOR DISSEMINATION OF CLINICAL PRACTICE GUIDELINES THROUGH KNOWLEDGE TRANSLATION.

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BACKGROUND AND PURPOSE: The American Physical Therapy Association has published 14 clinical practice guidelines (CPG's) in the past 10 years. There has recently been an effort to establish knowledge translation taskforces for each CPG. The purpose of this report is to describe the process established by the pilot taskforce for CPG dissemination and implementation. Specifically, the report includes the process of implementation of key action statements described in the CPG on Peripheral Vestibular Hypofunction (PVH). **METHODS:** Five U.S.-based organizations providing specialty care for the CPG target population (persons with vestibular disorders), are participating in the study. They include a large government facility, small and mid-size private practice, large rehabilitation hospital, and a university teaching hospital. A standardized method of assessing stakeholder-informed adherence to the CPG action statements was conducted at each site. Therapist-stakeholders completed a survey designed to assess: their knowledge and understanding of each of the CPG's 10 action statements; alignment of their current clinical practice with each action statement; and their opinions about the barriers and facilitators to providing quality care in their local context. Survey results were synthesized and used to facilitate face-to-face meetings with each group of therapist-stakeholders. These meetings identified site-specific goals to influence clinical care and therapist behavior in the treatment of persons with PVH. Based on the Consolidated Framework for Implementation Research and the Knowledge to Action Cycle, each of the 5 sites established consensus on the most important action statement(s) to address. Although each of the sites had variable needs to enable clinicians to better implement the CPG, there was overlap in general themes. The

themes proposed included identification of patients with peripheral vestibular hypofunction to offer vestibular rehabilitation and improving exercise prescription, dosing and compliance through various delivery methods including SMS technology for patient reminders. Each clinical site will implement a different strategy for implementation based on the individual site needs. The process used to implement the vestibular hypofunction CPG can be used to inform future APTA-directed CPG taskforces. **DISCUSSION AND CONCLUSION:** Concurrent implementation of the Vestibular Hypofunction CPG in disparate healthcare organizations may identify patterns by which different organizations are likely to implement the action statements in practice. The established processes and resources generated from this study have the potential to be embraced in similar organizational structures to support implementation to proactively change clinical practice and improve the quality and consistency of care received by patients with PVH. **(SPECIAL INTEREST)**

41. VESTIBULAR REHABILITATION IN AN INDIVIDUAL AFTER LEFT SUPERIOR CEREBELLAR CEREBROVASCULAR ACCIDENT AND RIGHT PARIETO-OCCIPITAL INTRAPARENCHYMAL HEMORRHAGE.

MEYER J.

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BACKGROUND AND PURPOSE: Individuals post-stroke can present with central dizziness and impaired balance. Depending on the location of the stroke, vestibular rehabilitation may be indicated to address the patient's impairments and functional limitations. Determining how to modify and progress vestibular rehabilitation is essential to promoting improved function and quality of life in individuals with dizziness after stroke. **CASE DESCRIPTION:** This case describes a sixty-three-year-old male with a posterior circulation stroke (left superior cerebellum, bilateral thalamus, and left medial occipital lobe) and subsequent right intraparenchymal hemorrhage in the parieto-occipital region. He was diagnosed with cortical blindness and bilateral cataracts. He began outpatient rehabilitation eight months after his stroke. At his initial evaluation, he had a right gaze preference, was unable to perform voluntary or spontaneous visual fixation, tracking, or saccades. He was negative for spontaneous nystagmus. He was unable to find midline in unsupported sitting and required moderate assistance to maintain his balance. He reported 10/10 dizziness and nausea in unsupported sitting, was unable to perform active neck movement, and did not tolerate passive neck movement. He had 5/5 strength and moderate dysmetria in left arm and leg. He required total assistance for standing, transfers, and gait. **OUTCOME:** Preliminary outcomes after 3 months: he is able to visually fixate in all directions, read signs and identify letters, voluntarily track horizontally and vertically for 60 seconds through full range of motion, and perform saccades with moderate cues. He can spontaneously track to the right. He continues to demonstrate a right gaze preference but is able to correct to midline with cues. He maintains unsupported sitting without assistance with intermittent cues for midline. He is able to stand up from his wheelchair with contact guard assistance and walk 150 feet with a rolling walker and moderate assistance. He can walk in the parallel bars with bilateral upper extremity support with stand by assistance. Most recent vision testing revealed 20/20 vision. Outcomes after 6 months will be included if the poster is accepted. **DISCUSSION AND CONCLUSION:** Vestibular rehabilitation involving oculomotor exercise, visual perception, habituation, neck range of motion, central integration, and midline perception were essential components to this patient's success with rehabilitation. This case describes additional rehabilitation considerations for individuals with dizziness post-stroke. **(CASE STUDY)**

42. PREVALENCE OF VESTIBULAR IMPAIRMENTS IN ELDERLY SENIORS EXPERIENCING FALLS.

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BACKGROUND AND PURPOSE: Falls are a growing concern in the aging population (65 years and older) and are the leading cause of fractures and hospitalizations, which poses a large burden on the health care system. The vestibular system plays a significant role in gaze, postural stability, and balance. Vestibular impairment can create symptoms of dizziness and is a risk factor for falls. The purpose of this study is to report the prevalence of vestibular impairment in community dwelling seniors with a history of falls. **METHODS:** Inclusion criteria included being 65 years and older and having experienced a fall in the past year. Patients were recruited from one of two fall prevention programs or were recruited from an out-patient Memory Clinic. Vestibular impairment was assessed through the Head Impulse test (video and bedside), Head Shake test and Dix Hallpike test.

Participants with abnormalities on any of these 4 tests were considered to have vestibular impairments (VI). Other clinical tests included the Modified Clinical Test of Sensory in Balance (mCTSIB). Participants who only had abnormalities on mCTSIB were categorized as probable vestibular impairment (pVI). Dynamic visual acuity was assessed, however was not factored into assumptions of vestibular impairment. Questionnaires administered included the Dizziness Handicap Inventory (DHI) and the Activities Specific Balance Confidence (ABC) Scale. **RESULTS:** 41 participants were assessed; 24/41(58.5%) female. Mean age was 80.1 (SD=7.1) years. 34/41 (82.9%) had VI, 3/41(7.3%) had pVI and 4/41 (9.8%) had no detectable vestibular impairment (NVI). Of the 34 with vestibular impairment, 10/34 (29.4%) had Unilateral Vestibular hypofunction (UVH), 24/34 (70.6%) had bilateral vestibular hypofunction (BVH). Of these 2/34 (5.9%) also had unilateral BPPV. For horizontal DVA, participants with UVH had an average of 3.2 (SD=1.6) lines lost, with BVH an average of 4.5 (SD=1.6) lines were lost and for those without vestibular impairment had an average of 3.3 (SD=1.9) lines lost. Average DHI score was 21.4/100 (SD=20.7) for VI, 6/100 (SD=2.8) for pVI and 3.5/100 (SD=4.7) for NVI, respectively. Average ABC was 63.4% (SD=27.3) for VI, 88.4% (SD=1.3) for pVI and 92.3% (SD=5.3) for NVI, respectively. **DISCUSSION AND CONCLUSION:** Vestibular impairment is prevalent in community dwelling seniors experiencing falls. Bilateral Vestibular hypofunction appears to be the most common finding. The extent at which vestibular impairment contributes to falls is unknown. Future work should assess community dwelling seniors who have not experienced falls and assess targeted vestibular rehabilitation for those attending fall prevention programs, as at present vestibular training not incorporated into most programs. **(RESEARCH)**

43. PRELIMINARY EVIDENCE AND ASSOCIATED CHARACTERISTICS FOR VESTIBULAR AND OCULOMOTOR CLINICAL PROFILES FOLLOWING CONCUSSION.

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BACKGROUND AND PURPOSE: Following concussion, unique clinical profiles may present. Vestibular and oculomotor findings are highly prevalent and associated with worse outcomes. Despite the negative relationship to recovery, these deficits may be modified with rehabilitation. The purpose of this study is to examine the prevalence of vestibular and oculomotor profiles; identify associated clinical findings and risk factors; and examine the relationship between vestibular, oculomotor and other profiles after concussion. **METHODS:** A total of 141 patients seen for initial evaluation in a multi-site specialty concussion clinic were included in the study. All patients were seen between October 2016 and November 2016, within 90 days of a diagnosed concussion. Following IRB approval, data were obtained from de-identified medical records and included demographics, medical and injury history, clinical exam findings, Vestibular Ocular Motor Screening (VOMS), and Post-Concussion Symptom Scale (PCSS). Patients were adjudicated by clinicians to be in one or more of the following clinical profiles: 1) vestibular, 2) oculomotor, 3) cognitive, 4) migraine, 5) anxiety/mood. A series of chi-square analyses and odds ratios (OR) followed by logistic regression (LR) were used to determine which factors were associated with the vestibular clinical profile. Chi squares with odds ratios were used to evaluate the relationship of the vestibular profile to other clinical profiles. **RESULTS:** Participants included 55% females (n=78), between 9-60 years (M=23.3, SD=12.7). The vestibular profile was the primary profile in 23% (n=32) and oculomotor was the primary for 15% (n= 21). Results of the first LR (R2= .17, p<.001) indicated that an increase in VOMS VOR over baseline (Adj OR= 6.4, p<.001) was the best predictor of the vestibular profile. Results of the second LR (R2= .40, p<.001) indicated that being male (Adj OR= 5.0, p=.01), reporting vision difficulties (Adj OR= 4.0, p=.02), difficulty reading (Adj OR= 6.6, p=.005), and a near point of convergence distance > 5cm (Adj OR= 5.1, p=.02) were the best predictors of the oculomotor profile. The vestibular profile was associated with an increased likelihood of a co-occurring migraine profile (chi square= 15.8, p<.001, OR= 5.7, 95% CI= 2.4-13.5). The oculomotor profile was associated with an increased likelihood of a co-occurring migraine profile (chi square= 21.2, p<.001, OR=11.2, 95% CI= 3.8-33.5). **DISCUSSION AND CONCLUSION:** Vestibular and oculomotor profiles appear to be the primary presenting profile in a significant portion of patients following concussion. Important evaluative findings and risk factors are linked to identification of these profiles and can be utilized to inform clinical care and identify those who may benefit from vestibular and oculomotor therapies. Both vestibular and oculomotor profiles are significantly comorbid with the post-traumatic migraine profile. **(RESEARCH).**

44. A SURVEY OF ENTRY-LEVEL PHYSICAL THERAPY EDUCATION CONTENT FOR VESTIBULAR REHABILITATION: A PILOT STUDY.

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BACKGROUND AND PURPOSE: Formalized standards for academic preparation and clinical competency of entry-level clinicians in Vestibular Rehabilitation (VR) are not fully established. Understanding the current level of education required of entry-level physical therapists will assist development of curriculum content necessary to meet the needs of health care consumers. **PURPOSE:** To determine the content of VR curricula and expected competency of entry-level physical therapy graduates in the United States. **METHODS:** 18 entry-level Doctor of Physical Therapy programs representing various geographical regions of the United States and institutional classifications were recruited to complete a pilot survey between January-March 2018. The survey examined three themes: 1) Entry-level Program Demographics; 2) Educational Content including foundational sciences, diagnostic groups, examination and intervention knowledge and skills, and clinical decision-making; and 3) Level of Expected Clinical Performance in VR. **RESULTS:** Six programs (5 research-intensive, 1 primary teaching) with an average length of 36 (33-42) months completed the survey. VR content encompassed 8.5 (3-20) and 6.61 (3-12) hours of lecture and lab experiences, respectively. Two programs reported availability of specialty electives in VR. Programs rated many items consistently as essential to entry-level education in foundational sciences, major diagnostic groups, including BPPV, hypofunction, and most tests and measures to identify vestibular-related dysfunction, maneuvers for common forms of BPPV, vestibular exercises and clinical decision-making paradigms. However, ratings of several diagnostic groups and examination techniques showed greater variability in curriculum content and perceived need. **DISCUSSION AND CONCLUSION:** This initial pilot study supports the existence of variability in contact hours, content areas taught, expectations of clinical mastery of vestibular content at graduation, and the need for more standardized recommendations for entry-level VR curricular content. A modified version of this study encompassing a larger sample of US physical therapy programs is planned for summer of 2018, which will provide more robust information on standard educational practices.

(RESEARCH).

45. SENSORY VESTIBULAR BALANCE IMPAIRMENT IN PARKINSON'S DISEASE: IMPLICATIONS FOR EVALUATION, TREATMENT, AND FALL PREVENTION.

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BACKGROUND AND PURPOSE: Falls are a common occurrence in individuals with Parkinson's Disease (PD) and have been shown to increase risk of morbidity, hospitalizations and in some cases mortality. The purpose of this study is to explain the prevalence of sensory vestibular balance impairment in individuals with PD. **CASE DESCRIPTION:** Five participants, each clinically diagnosed with PD, were evaluated by two physical therapists at an Outpatient Physical Therapy Clinic in North Andover, Massachusetts. The number of years since initial PD diagnosis ranged from one month to twenty-two years. All individuals demonstrated abnormal sensory vestibular balance function compared to age norms measured on the Modified Clinical Test of Sensory Interaction (mCTSIB). For each patient, the following outcomes were gathered and recorded: number of falls, ABC, gait speed, and mCTSIB. Number of falls in the past twelve months was measured using subjective patient and caregiver interview. Balance confidence was measured using the Activities-specific Balance Confidence Scale (ABC). Gait speed was measured using the Timed up and Go. Sensory balance function was measured using the Modified Clinical Test of Sensory Interaction (mCTSIB). **OUTCOMES:** Number of falls in the past twelve months was measured using subjective patient and caregiver interview and ranged from 0-20. Balance confidence was measured using the Activities-specific Balance Confidence Scale (ABC) and scores ranged from 12-99% confidence. Gait speed was measured with the Timed Up and Go (TUG) and results ranged from 12-77 seconds. Sensory balance function was measured using the mCTSIB and all participants demonstrated abnormal postural sway with condition 4 (eyes closed on compliant surface) when compared to age matched norms. Four out of the five participants were unable to maintain balance for 10 seconds during each trial of condition 4. **DISCUSSION AND CONCLUSION:** vestibular balance impairment was identified in all 5 participants with pd. The outcomes of this case series suggest that vestibular balance dysfunction may be a prevalent finding in patients with pd, despite other test values being within normal limits, such as berg, tug and abc. For this reason, the mCTSIB is a useful diagnostic tool in patients with pd. These outcomes suggest that evaluating vestibular balance function may improve identification of fall risk and treatment efficacy.

(CASE STUDY).

46. THE RELATIONSHIP OF THE STROOP COLOR AND WORD TEST IN STATIC AND DYNAMIC CONDITIONS IN HEALTHY ADULTS

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BACKGROUND AND PURPOSE: The ability to maintain postural control includes coordinating balance and recovering from imbalance. The Stroop Color and Word (SCW) test is a vision and cognitive test that is performed in static standing. The purpose of this study was to evaluate the relationship of the SCW test in both static and dynamic walking conditions to determine dual task cost. **METHODS:** Twenty-eight participants (13 males, 15 females; mean age =30.75±10.11 years) completed SCW tests in one session (static, 10MW, 10MW with SCW, and self-selected treadmill speed with SCW). Participants were 19 to 54 years old and had no lower extremity injuries in the past 3 months; head injury in the past year; or a diagnosis of a visual, vestibular, or balance disorder. Partial correlation coefficients were calculated controlling for the 10 MW test. **RESULTS:** Results of the current study revealed moderate correlations between the static SCW compared to the 10MW SCW at a self-selected speed ($r=0.55$) but weak correlations compared to the treadmill SCW ($r=0.39$). The mean 10MW test was 4.86 seconds and increased to a mean of 6.75 seconds with the SCW and increased to a mean of 11.05 seconds with the treadmill SCW test. **DISCUSSION AND CONCLUSION:** We found reduced motor performance in terms of speed of the SCW test when adding in gait down a hallway or a self-selected treadmill speed in young healthy middle-aged adult. Since dual task cost increases when combining walking and SWC in healthy middle-aged adults, we intend to evaluate the dual task cost in neurologic impaired individuals in a future study.

(RESEARCH)

47. THE RELATIONSHIP OF THE DYNAMIC VISUAL ACUITY TEST IN HEALTHY INDIVIDUALS DURING STATIC STANDING COMPARED TO AMBULATING ON A TREADMILL.

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BACKGROUND AND PURPOSE: Coordination of the visual, vestibular, and somatosensory systems are required to function normally and maintain balance or postural stability. The DVA test is used to assess different aspects of vestibular function including the vestibulo-ocular reflex. The purpose of the current study was to evaluate the relationship of DVA tests between static standing compared to ambulating on a treadmill at a self-selected walking speed. **METHODS:** Twenty-eight participants (13 males, 15 females; mean age =30.75±10.11 years) completed 3 DVA tests in 1 session. Participants were 19 to 54 years old and had no lower extremity injuries in the past 3 months; head injury in the past year; or a diagnosis of a visual, vestibular, or balance disorder. The static, left and right logmar DVA scores were used to compare the Neurocom BalanceMaster DVA, Neurocom laptop DVA, and self-selected treadmill speed with Neurocom laptop DVA. Intraclass correlation coefficients (ICCs) were calculated using a 2-way, random-effects model. **RESULTS:** Results of the current study revealed statistically significant differences between the DVA for static standing compared to ambulating on a treadmill at a self-selected speed ($P=.007$; $ICC=0.50$; 95% CI, 0. - .167, -.045). The secondary analysis of the Neurocom BalanceMaster DVA was statistically significant from the Neurocom laptop DVA for Right and Left DVA (Right DVA, $P<.001$; $ICC=.76$; 95% CI, -.18, -.08 and Left DVA, $P<.001$; $ICC=.63$; 95% CI, -.21, -.10) but not for the static DVA comparison ($P=.94$; $ICC=-.01$; 95% CI -.30, -.26). **DISCUSSION AND CONCLUSION:** The addition of ambulation on a treadmill may improve the difficulty of performing the computerized DVA test. The DVA has been found to effectively evaluate and monitor changes to the gaze stability system after a concussion and recent evidence supports the use of the DVA after physical exertion as a sideline assessment test. The DVA test with the addition of ambulation may be an appropriate measure to consider and further studies should investigate this test in a concussed population.

(RESEARCH)

48. COMPARISON OF NORMATIVE VALUES FOR THE SENSORY ORGANIZATION TEST AND ENHANCED SENSORY ORGANIZATION TEST IN THE MILITARY POPULATION.

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BACKGROUND AND PURPOSE: The Sensory Organization Test (SOT) identifies impairments in the visual, vestibular and somatosensory systems. The gain can be increased for the sway-referenced surface and support, but no normative data exist for this enhanced SOT (eSOT) and the point at which the composite scores for the SOT differs from the eSOT is unknown. The purpose of the study is to determine normative values for the SOT and eSOT in a military population and the eSOT gain at which scores become different than the SOT.

METHODS: Composite scores for the SOT and eSOT were recorded using theEquiTest (NatusMedical, Inc., Pleasanton, CA) for 237 healthy, active duty military personnel (184 men, 53 women; 30 ±6.9 years old, range 19-45 years old). Subjects were divided into three age groups: 18-26, 27-35, and 36-45 years old. Paired sample

t-tests were used to compare the SOT composite scores to the eSOT composite scores for the entire sample and three age groups. **RESULTS:** Mean (standard deviation) for SOT and eSOT composite scores at gains of 1.2, 1.4, 1.6, 1.8, 2.0, respectively—entire sample: 81(6), 81(5), 79(8), 76(8), 76(8), 76(8), 73(8); 18-26 year old: 81(7), 81(7), 79(7), 79(6), 74(8), 73(9); 27-35 year old: 81(6), 83(4), 79(7), 76(7), 76(8), 74(8); 36-45 year old: 80(6), 78(4), 77(9), 73(8), 73(5), 70(7). There were no significant differences in composite SOT and eSOT scores when the eSOT gain was 1.2. The entire sample had significantly better SOT composite scores than eSOT composite scores when the eSOT gain was 1.4, 1.6, 1.8, and 2.0. The SOT composite score was significantly higher for all age groups except the 18-26 year olds when the eSOT gain was 1.4. The SOT composite score was significantly higher for all age groups when the eSOT gain was 1.8 and 2.0. **DISCUSSION AND CONCLUSION:** To our knowledge, this is the first study to establish norms for the eSOT and the first study to compare composite scores of the SOT to composite scores of the SOT with the gain adjusted. These scores may assist clinicians in determining readiness to return to duty for the military population. When using the SOT for examination or intervention, it may be advantageous to adjust the gain to 1.6-1.8 to challenge service members with balance complaints who score within a normal range on the SOT. **(RESEARCH)**

49. SIDELYING TEST: A BETTER TOOL FOR DIAGNOSING BENIGN PAROXYSMAL POSITIONAL VERTIGO COMPARED WITH DIX HALL PIKE MANEUVER IN PATIENTS WITH VESTIBULAR MIGRAINE.
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BACKGROUND AND PURPOSE: Migraine and vertigo rank among most common complaints in general population. Patients with migraines have 2.03 fold risk of developing benign paroxysmal positional vertigo (BPPV) (Chu, C. H.2015). Sidelying test is a valid alternative to the Dix Hall pike test and is an option in persons with limited mobility (Cohen, 2004). The purpose of this report is to show higher sensitivity with sidelying test when diagnosing BPPV patients with underlying migraine oculomotor abnormalities. **CASE DESCRIPTION:** A 34 y/o/ F with a family history of migraines was referred to vestibular physical therapy with chronic intractable migraines without aura and dizziness two years post diagnosis. Initial evaluation at ENT showed normal audiometry, normal MRI, tinnitus & headache & working diagnosis for Meniere's disease vs Vestibular migraine made. (VNG) demonstrated upbeating L torsional nystagmus and treatment for L PSCC cupulolithiasis was done. Diagnosis changed to VM as patient non responsive to treatment. Initial evaluation at VPT patient tested -ve with R DHP maneuver and +ve with L DHP - showing- left torsional nystagmus that did not fatigue but had onset latency of 5 seconds, treated for L PC cupulolithiasis with Semont's maneuver (SM). However, SM at initial step demonstrated upbeating R torsional nystagmus. Reassessed patient with sidelying test. Left sidelying test showed upbeating R torsional nystagmus. R sidelying test -ve. Treated with modified Epley's for R PSCC canalithiasis. **OUTCOME:** Patient had complete resolution of her symptoms in three visits. Patient followed up a year later and reported of being asymptomatic since last treatment for R PC canalithiasis was done. Her migraine improved and she gets occasional symptoms controlled by PRN medications. Patient had successful intervention with vestibular physical therapy for right posterior semicircular canal with modified Epley's maneuver. Patient continued to demonstrate L torsional nystagmus in Left dix hall pike without being symptomatic even a year later. **DISCUSSION AND CONCLUSION:** An underlying central positional nystagmus along with symptoms of migraine resulted in difficulty in differentially diagnosing patient with BPPV nystagmus, here DHP maneuver resulted in a picture similar to posterior canal cupulolithiasis. The addition of Sidelying Test helped to differentiate between the two conditions. Presence of upbeating R torsional nystagmus in L sidelying test might be explained by location of otolith in the long arm of the posterior Canal close to the common crus. **(CASE STUDY)**

50. TRANSLATION AND VALIDATION OF THE ARGENTINE VERSION OF THE VISUAL VERTIGO ANALOGUE SCALE (VVAS).

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BACKGROUND AND PURPOSE: The VVAS was developed to evaluate visual vertigo and its intensity in nine challenging situations that typically provoke dizziness. The aims of this study were to translate the VVAS into Spanish, adapt it for use in Argentina, and validate it for patients over the age of 18 with vestibular disorders. **METHODS:** The original version was translated and adapted for use in Argentina using standardized methodology proposed by Beaton et al. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the institutional review boards of Hospital Carlos G. Durand in the city of Buenos Aires. A final version was used with 39 vestibular patients in order to evaluate aspects such as understanding, ambiguity and response time, (cultural adaptation. One hundred nine additional patients answered the questionnaire between January 2016 and January 2018. Internal consistency, ceiling and

floor effect and concurrent validity were evaluated. Some of these 109 patients (n=88) provided test-retest data for calculating the Intraclass Correlation Coefficient (ICC 2.1) as an indicator of reliability. **RESULTS:** A ceiling effect was observed in 21 (19.3%) patients. An acceptable internal consistency was observed (Cronbach's alpha: 0.91). The results showed acceptable reliability (ICC 2.1: 0.79 [95% CI: 0.7 - 0.86]). Strong correlations were observed between the VVAS questionnaire and the total DHI (rho: 0.59), as well as between DHI physical and functional components (rho: 0.56 and 0.55, respectively). The VVAS and the emotional component of the DHI showed a moderate correlation (rho: 0.46). 75% of the hypotheses stated were confirmed, thus indicating a strong concurrent validity. **DISCUSSION AND CONCLUSION:** We found no versions of this questionnaire adapted or validated in other countries. The VVAS is a useful tool for assessing visual vertigo, and in the future should be evaluated as a tool for planning treatments, objectively evaluating rehabilitation results and the patient's evolution and response to treatment. This Argentine version of the VVAS is a valid and reliable tool, suitable for assessing visual vertigo in patients with vestibular disorders.

(RESEARCH)

51. UNDETECTED CRANIAL CEREBROSPINAL FLUID LEAK IN A YOUNG WOMAN REFERRED TO PHYSICAL THERAPY FOR CHRONIC DIZZINESS.

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BACKGROUND AND PURPOSE: Cranial cerebrospinal fluid (CSF) leaks are challenging to diagnose as patients with leaks often present with non-specific symptoms including vertigo, imbalance, visual changes, and headache. CSF leaks are usually caused by head trauma or sinus surgery but can occur spontaneously. The purpose of this case report is to educate providers about the signs and symptoms of cranial CSF leaks by describing the physical therapy evaluation and differential diagnosis of chronic dizziness in a young woman.

CASE DESCRIPTION: A 27-year-old overweight female presented to an outpatient physical therapy clinic for evaluation of dizziness described as spinning, disorientation, and unsteadiness. Her dizziness began 7 years ago and increased with standing upright, closing her eyes, getting out of bed, bending forward, walking in stores, moving her eyes, and raising her head after looking down. She also reported spontaneous vertigo independent of position change, imbalance, frequent falls, daily headaches, aural fullness, tinnitus, worsening vision, neck and back pain, and tingling in her face, neck, and back. Further questioning revealed she had clear drainage from her nose with bending forward and her headaches were worse standing up. Medical history was notable for 7 motor vehicle accidents, migraines, seasonal allergies, suspected pseudotumor cerebri, and papilledema. Evaluation of her vestibular system, oculomotor system, and cervical spine revealed findings suggestive of central nervous system pathology. **OUTCOME:** The physical therapist referred the patient to an otolaryngologist specializing in endoscopic and skull based surgery for CSF leaks. Magnetic resonance imaging of her brain showed signs of low intracranial pressure including dry ventricles and brain slumping resulting in Chiari malformation. A maxillofacial and sinus computed tomography (CT) scan showed an old fracture near the cribriform plate. CSF rhinorrhea was confirmed with radionuclide cisternography with nasal pledgets. The patient underwent endoscopic sinus surgery with repair of a CSF leak in roof of her ethmoid sinus. The patient reported improvement in her symptoms; however, she continued to have intermittent headaches and dizziness. She was referred to a cardiologist and was diagnosed with postural orthostatic tachycardia syndrome (POTS). Her remaining symptoms improved with exercise and increased salt and fluid intake. **DISCUSSION AND**

CONCLUSION: With careful consideration of the patient's symptoms and medical history, combined with a thorough evaluation of the patient's balance systems, the physical therapist suspected a CSF leak and appropriately referred the patient. Because patients with undiagnosed CSF leaks are likely to be referred for vestibular rehabilitation to improve their dizziness and imbalance, it is critical that providers working in vestibular settings are aware of the clinical presentation of this condition.

(CASE STUDY)

52. VIDEONYSTAGMOGRAPHY EVALUATION OF DYNAMIC ASYMMETRY OF VESTIBULO-OCULAR REFLEX (VOR) RESPONSES, AFTER UNILATERAL PERIPHERAL LOSS. COMPARISON OF PASSIVE ROTATIONAL TESTING VERSUS ACTIVE HEAD MOVEMENTS TESTING.

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BACKGROUND AND PURPOSE: Rotational Chair Testing (RCT) is commonly used to evaluate VOR gain and symmetry (VORS). Based on our experience, recovery of VORS, in patients after acute unilateral loss, measured by RCT is not always correlated with quality of live improvement measured by DHI scale. However, when VORS is evaluated with active head movements testing (AHMT) it seems that there is a better correlation between symmetry recovery and DHI improvement. The goal of this study is verifying this hypothesis. **METHODS:** This is a retrospective longitudinal study, 51 patients 28 to 68 years of age, 27 males and 24 females were recruited in 2 PT private practice, the control group were 30 healthy subjects. Inclusion/exclusion criteria were: acute unilateral

loss diagnosis (vestibular neuritis) lateral canal paresis showed by caloric and vHIT evaluation, DHI score > 50, persistence of spontaneous nystagmus beating toward the unaffected ear and VOR directional preponderance > 6°/s. Patients received VR treatment or one month twice a week in a PT practice as well as home exercises program. At the beginning of each VR session patients completed DHI followed by evaluation of VORS, RCT and AHMT, that was done in randomized order. RCT evaluation was sinusoidal test, 0,25 Hz, 60° range, duration 32 seconds. For AHMT subjects were asked to do the same movements as sinusoidal test, an audio-cue system was used to guide head movements frequency, VOR and head speed values were corrected by an algorithm. **RESULTS:** The main parameters studied for each paradigm, active head movements testing (AHMT) and Rotational Chair Testing (RCT), were: horizontal VOR directional preponderance (degrees/second), calculated as cumulative slow-phase eye position at the end of acquisition (degrees) divided by duration of test acquisition (seconds), and his correlation with DHI results. We noticed that, from the second treatment session: VOR directional preponderance diminution with AHMT paradigm was statistically significant greater than VOR directional preponderance diminution with RCT paradigm, $p < 0,05$ (Student's t-test). Correlation between VOR directional preponderance diminution with AHMT paradigm and DHI results diminution ($r = 0,9$) was statistically significant greater ($p < 0,05$) than correlation between VOR directional preponderance diminution with RCT paradigm and DHI results diminution ($r = 0,6$). **DISCUSSION AND CONCLUSION:** According to this study VOR symmetry evaluation with active head movements testing paradigm (AHMT) shows a stronger correlation with changes of the quality of life of the patient measured by DHI scale, compared with Rotational Chair Testing paradigm (RCT). Thus AHMT paradigm seems more relevant for vestibular rehabilitation assessment of patients with vestibular neuritis as well as probably for other patients with acute vestibular unilateral hypofunction evaluation.

(RESEARCH)

53. SEMICIRCULAR SUPERIOR CANAL DEHISCENCE (SSCD) AND RECURRENCE OF BENIGN PAROXYSMAL POSITIONAL VERTIGO (BPPV) FOLLOWING HEAD TRAUMA.

WALLACE B. Melancon B.

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(CASE STUDY)

54. ESTABLISHING CONCURRENT VALIDITY FOR THE 20 FOOT WALK TEST IN INDIVIDUALS WITH DIZZINESS AND IMBALANCE IN AN OUTPATIENT SETTING.

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BACKGROUND AND PURPOSE: Standard tests, including the timed 50-foot walk test to measure walking speed, are valid for patients experiencing vestibular and balance dysfunction, but are often cumbersome to perform in a busy clinical environment. The purpose of this study is to validate the 20 ft walk test as compared to the 50 ft walk test in hopes to objectively calculate walking speed in a more efficient manner, while using this gait speed as a measure of progress. **METHODS:** The study was a prospective clinical trial conducted at multiple locations of Burke Rehabilitation outpatient facilities. Thirty-five subjects were enrolled with mixed diagnoses, including, but not limited to dizziness and imbalance, vertigo, BPPV, Meniere's, and concussion. Inclusion criteria: vestibular diagnosis, patients ages 18-90. Exclusion criteria: inability to ambulate, limited cognitive function, English as a second language, significant comorbidity, inability to provide verbal consent. Routine testing prior to this study included: completion of the Dizziness Handicap Inventory, Activities-specific Balance Confidence Scale, timed 50-foot walk test and Functional Gait Index at initial evaluation and discharge. The timed 20-foot Walk Test was added to this testing battery to measure gait speed by the therapist using a stop watch and guarding. A 5-foot distance pre and post accounted for acceleration/deceleration. Verbal consent provided by patient. **RESULTS:** There was a strong and statistically significant correlation between the gait speed calculated from the timed 20-foot walk test and 50-foot walk test for the initial examination and at discharge. Paired t-tests of gait speed calculated from the 20-foot walk test and 50-foot walk test showed no significant differences at initial examination ($n = 35$, $t = -.509$, $df = 34$, $p = .614$) and at discharge ($n = 26$, $t = -0.912$, $df = 25$, $p = .370$). There were correlations of the gait speeds from the 20-foot walk tests at initial examination and at discharge with respective ABC, DHI and FGA measures. Gait speed calculated from the 20-foot walk test had strong and significant correlations with the FGA at initial examination and at discharge. These correlations were moderate for the ABC. Gait speed calculated from the 20-foot and 50-foot walk tests did not correlate with the DHI at either initial examination or discharge.

DISCUSSION AND CONCLUSION: This study showed that the timed 20-foot walk test demonstrates concurrent validity with the 50-foot walk test as well as convergent validity with the FGA. This allows for clinicians to use the timed 20-foot walk test when physical constraints of the clinic area do not allow accurate assessment via the timed 50-foot walk test. Validation of the 20-foot walk test provides the clinician with an efficient method of both assessing and treating patients with various vestibular and balance impairments.

(RESEARCH)

55. TEST-RETEST RELIABILITY OF SYSTEMS ASSESSING SENSORY CONTRIBUTIONS TO BALANCE

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BACKGROUND AND PURPOSE: Balance is controlled through the integration of information from the visual, vestibular, and somatosensory systems. The Sensory Organization Test (SOT), and recently, the Central Sensorimotor Integration Test (CSMI), have been developed to help characterize balance dysfunction. The primary difference between these tests is the CSMI evokes sway through pseudorandom stimuli, while the SOT does not. Our aim was to examine test-retest reliability and explore learning effects of the SOT and CSMI.

METHODS: Fourteen healthy volunteers (8 females, 6 males, mean age = 25.8 ± 3.13yrs) participated in 2 testing sessions, 6 weeks apart (mean = 43.3 ± 2.49 days). Participants performed 2 SOT test conditions (eyes open and eyes closed on sway referenced support surface) and 2 CSMI test conditions (eyes open and eyes closed on pseudorandom stimuli surface). Intraclass Correlation Coefficients (ICC) and paired t-tests were calculated for SOT scores and CSMI Sensory Weight. **RESULTS:** The test-retest reliability of the SOT scores were moderate (EO, ICC3,1=0.749, EC, ICC3,1=0.577), while the test-retest reliability for the CSMI sensory weight were moderate (EO, ICC3,1=0.557) and good (EC, ICC3,1=0.854). Participants significantly improved performance in the SOT EC condition (p=0.043), but not in the EO condition. No significant differences were found for either CSMI condition over six weeks (p>0.05). **DISCUSSION AND CONCLUSION:** Although the SOT showed moderate reliability, the increased performance may indicate learning effects not present in the CSMI test. Given comparable reliability, CSMI testing may provide a beneficial alternative to the SOT for observing functional gains and assessing the efficacy of interventions as it does not appear to be confounded by learning effects.

(RESEARCH)

56. EXPLORING OUTCOMES MEASURES AFTER VESTIBULAR REHABILITATION IN CHRONIC CONCUSSION PATIENTS

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BACKGROUND AND PURPOSE: Current recommendations to measure change after vestibular rehabilitation in chronic concussion patients include measures ranging from single question symptom scores to complex objective balance tests. Such measures utilize both patient-oriented and objective outcomes. This study examined 4 common tests, both patient oriented and objective, that are used in concussion rehabilitation. We also explored the relationship between the change in these tests after vestibular rehabilitation. **METHODS:** Eighteen participants (14 females and 4 males, mean age 39.6 years old (±12.5 SD)) participated in this study. On average, participants were 2.4 ±2.4 years post injury and had prolonged complaints of imbalance. Participants engaged in vestibular rehabilitation 2x/week for 6 weeks under the supervision of a physical therapist. Outcome measures included both patient-oriented and objective outcomes. Specifically, Dynamic Handicap Inventory (DHI) and Sports Concussion Assessment Tool (SCAT) symptom checklist, as well as the modified Balance Error Scoring System (mBESS) and Sensory Organization Test (SOT). **RESULTS:** There were significant changes in both patient-oriented and objective measures. The SCAT symptom checklist (p=0.001) and the SOT (p<0.001) showed significant change after rehabilitation. The change in SOT (18.3±12.5 SD) exceeded the MDC of 8 points. The change in SCAT symptoms was 16.8 ±18. There were no changes in the DHI (p=0.191) or the mBESS (p =0.125) after rehabilitation. Of the 2 patient-oriented scales (SCAT and DHI), there was a moderately significant correlation (r=0.49, p=0.046). Of the 2 objective tests (mBESS and SOT), there was a moderately significant correlation (r=0.47, p=0.050). Interestingly, there was no significant correlation between either of the patient-oriented measures with either of the objective measures. **DISCUSSION AND CONCLUSION:** Vestibular rehabilitation can improve both patient-oriented and objective measures in subjects with a concussion > 1 yr. Clinicians should include both patient-oriented and objective testing to fully capture change in the chronically concussed patient. The SCAT symptom checklist and SOT were most sensitive to change after vestibular rehabilitation compared to the DHI and mBESS in this chronic population.

(RESEARCH)

57. USE OF GAZE STABILITY TESTING WITH EXERTION AS PART OF A RETURN TO COMPETITION PROCESS IN COMBAT SPORTS

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BACKGROUND AND PURPOSE: Dizziness post mild traumatic brain injury (mTBI) is common and shown to be predictive of prolonged recovery. Vestibular ocular reflex (VOR) impairment can contribute to mTBI dizziness. Sustained gaze stability (GS) is an integral part of combat sports. Winning in combat sports is often

achieved through head blows. MTBI management presents a unique challenge in these athletes. Our case study examines the effect of exertion on GS and the utility of this testing in an active rehabilitation process. **CASE DESCRIPTION:** Four professional mixed martial arts (MMA) fighters reporting concussion symptoms after competition were referred to vestibular physical therapy after medical evaluation. Two athletes were symptomatic for > 3 months and 2 were assessed within 3 weeks of injury. **OUTCOMES:** Balance, GS testing (>= 150 d/sec range) and reported symptoms improved with therapy, as expected. Activity-provoked dizziness and reduced skill level occurred when the athletes resumed shadow boxing, bag work, and grappling. GS at rest, and pre/post exertion test-retest stability was found lacking. Home program (HEP) and training was modified as follows: sport-specific activity and conditioning at sub symptom threshold, GS HEP at varied angles and positions approximating sport/combat. Exertion for GS tests in high performance range (150 d/sec to 300 d/sec) was via treadmill at athlete selected max speed sustainable for 5 minutes to approximate an MMA fight with rounds increasing to a max of 5 (title fight) as GS was sustained. Sustained GS coincided with symptom free pre injury training intensity and skill level. **DISCUSSION AND CONCLUSION:** The need for assessing gaze stability pre/post exertion highlights the relationship between active rehabilitation and return to sport. Approximating the intensity of an athlete's sport is also important, particularly for combat sports because of the inherent risks.
(CASE STUDY)

58. RELIABILITY AND VALIDITY OF A NOVEL TEST TO ASSESS GAZE STABILIZATION IN VESTIBULAR REHABILITATION

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BACKGROUND AND PURPOSE: Clinical utility of the gaze stabilization test (GST) as a diagnostic test has been established [1,2,3,4,5]. The Rusk observational vestibulo-ocular reflex (RoVOR) test was developed as a novel, inexpensive assessment of functional gaze stability in patients with vestibular disorders. The primary purpose of this study was to establish the reliability, validity, and response stability of the RoVOR test. A secondary aim was to report values representing clinically relevant changes for the RoVOR. **METHODS:** Participants included 45 healthy adults (10 male) with mean age 35.5+/-7.6 years and range from 22–56 years. Testing sessions lasted 15 minutes each day and took place on two occasions, separated by 7-10 days. On day one, participants performed two trials of the cDVA to screen for vestibular pathology [2], then participants performed two trials of the GST [5,6], followed by two trials of the RoVOR test. The RoVOR was performed with the participant seated 3 meters from a 1" optotype displayed at eye level on a blank wall. The rater was seated 8 feet in front and at most 6 inches laterally to the participant. The participant was asked to rotate his/her head in the yaw plane as fast as possible for one minute, modifying the speed of the head turns as necessary in order to maintain a stable visual target. To establish test-retest reliability, participants returned a second day to complete two trials of the RoVOR and GST. The order of administration of trials were randomized. **RESULTS:** Interrater, intra-rater, and test-retest reliability for within and between sessions for the RoVOR test were excellent. Minimal detectable change with 95% confidence intervals (MDC95) of the RoVOR test for within and between sessions were 2.03 (1.41 – 2.64) and 5.55 (4.92 – 6.13), respectively. Within and between session test-retest reliability for the GST was found to be excellent and fair-to-good, respectively. Strong correlations between the RoVOR and the GST were found across all trials for day one (r: 0.83–0.85) and moderate-to-strong correlations were found across trials for day two (r: 0.64–0.70). Due to strong correlation values found between the RoVOR and GST tests, a regression equation was calculated that can be used to predict GST values given the number of head turns completed during the RoVOR test: $GST' = 35.378 + 1.902*(RoVOR\#)$, where GST' is an estimate of the head velocity achieved during the GST and RoVOR# is the number of head turns measured during the RoVOR test. **DISCUSSION AND CONCLUSION:** Findings support the potential utility of the RoVOR as a diagnostic and outcome measure for individuals with vestibular disorders. Due to a strong correlation between the RoVOR and GST, an equation was developed to allow clinicians to convert number of head turns measured during the RoVOR to a maximum head velocity that would be obtained with the GST. In this way, clinicians could compare RoVOR values to established cut-points to identify fallers and individuals with vestibular disorders [3,7].

(RESEARCH)

59. INFLUENCE OF GAZE STABILITY ON INJURY INCIDENCE IN NCAA DIVISION II ATHLETES

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BACKGROUND AND PURPOSE: Maintenance of visual acuity or gaze stabilization during head movement is controlled by the vestibular system and is essential for optimal performance in sport. Vestibular impairment following concussion is reported in 55-80% of athletes. While it seems reasonable to suspect that reduced gaze stabilization might impair physical performance on the playing field and contribute to increased incidence

of injury, the relationship between gaze stabilization function and athletic injury has not been studied.

METHODS: 146 division II collegiate athletes, 124 male football players and 22 female soccer players, mean age 20.58 years old (+- 1.48 SD), were assessed using the Neurocom Invision Gaze Stabilization Test (GST). GST testing was performed during the pre-season in the horizontal (yaw) plane recording right and left scores as well as average overall score and existing asymmetries. Injury reports for each athlete were recorded during play and practice during the fall season and maintained in an electronic. **RESULTS:** 64% of the athletes studied were injured during the fall season. There was no difference in average GST scores between athletes who sustained injury during season and those who did not. There was also no difference in average GST scores for athletes with a history of concussion versus no concussion. No correlation between average GST score and injury was found in either football ($r=.631$) or women's soccer ($r=.353$). **DISCUSSION AND CONCLUSION:** Lower horizontal gaze stabilization function, which is only one component of the vestibular ocular reflex (VOR), does not appear to be associated with an increase in injury incidence in NCAA Division II football or female soccer players. Further investigation of the VOR, specifically the Dynamic Visual Acuity Test may be warranted to investigate the role of the VOR and its relationship to injury incidence in future studies. **(RESEARCH)**

60. THE EFFECTS OF ROTATIONAL PLATFORM TRAINING ON BALANCE AND ADLS – PRELIMINARY RESULTS

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BACKGROUND AND PURPOSE: Patients with vestibular dysfunction complain of postural instability. Patients with unilateral vestibular loss who orient more to vertical have better functional status. We proposed that performing balance training at velocities that target the vestibular system would lead to increased reliance on vestibular information, and therefore improve function. The purpose of this study was to determine whether patients who train at these vestibular dependent velocities demonstrate improved function. **METHODS:** Twelve patients with chronic vestibular and balance dysfunction (age 58 ± 15 years; 3 males, 8 females) and 4 healthy control subjects (age 62 ± 23 years; 4 females) participated. Patients were randomized into 3 groups: clinical balance training (CBT $n=3$) and training with ramp platform perturbations (4 deg amplitude) either at vestibular (1, 2, 4 deg/sec; VESTIB $n=6$) or at non-vestibular velocities (0.5, 8, 16 deg/sec; Non-VESTIB $n=3$). The healthy control subjects completed training at vestibular velocities. Subjects' kinematic and kinetic responses to ramp rotational platform perturbations (0.5, 1, 2, 4, 8, 16 deg/sec at 6 deg amplitude), and scores on the Activities-specific Balance Confidence Scale (ABC), Dizziness Handicap Inventory (DHI), Vestibular Activities of Daily Living Scale (VADL) and Functional Gait Assessment (FGA) were compared before and after the 2 week, 3x/week training sessions. **RESULTS:** Control subjects demonstrated minimal change in orientation to vertical during platform rotations following training. The VESTIB group demonstrated greater improvements in orientation to vertical during ramp perturbations following training than the Non-VESTIB or CBT groups. Both the CBT and VESTIB groups demonstrated improvements on a composite clinical score incorporating the ABC, DHI, VADL, and FGA following training whereas the Non-VESTIB group did not demonstrate improvement. **DISCUSSION AND CONCLUSION:** These preliminary results indicate that training using platform rotations may be an effective intervention for improving postural control following vestibular loss. Further research is needed to explore the efficacy of incorporating rotational platform training with clinical balance training. **(RESEARCH)**